Array Configuration Utility XE

User Guide

Part Number 239449-002

September 2001 (Second Edition)

Product Version: 1.1

COMPAQ

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Compaq Array Configuration Utility XE User Guide

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Contents

About This Guide

This guide provides step-by-step instructions for installation and use of the Compaq Array Configuration Utility XE.

Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.

CAUTION: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or loss of information.

IMPORTANT: Text set off in this manner presents clarifying information or specific instructions.

NOTE: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Text Conventions

This document uses the following conventions:

- *Italic type* is used for complete titles of published guides or variables. Variables include information that varies in system output, in command lines, and in command parameters in text.

- **Bold type** is used for emphasis, for onscreen interface components (window titles, menu names and selections, button and icon names, and so on), and for keyboard keys.
- `Monospace typeface` is used for command lines, code examples, screen displays, error messages, and user input.
- Sans serif typeface is used for uniform resource locators (URLs).

Getting Help

If you have a problem and have exhausted the information in this guide, you can get further information and other help in the following locations.

Compaq Technical Support

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Be sure to have the following information available before you call Compaq:

- Technical support registration number (if applicable)
- Product serial number
- Product model name and number
- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level

Compaq Website

The Compaq website has information on this product. You can access the Compaq website at www.compaq.com.

Compaq Authorized Reseller

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- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.

Reader's Comments

Compaq welcomes your comments on this guide. Please send your comments and suggestions by email to `ServerDocumentation@compaq.com`.

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Getting Started

Features and System Requirements

The Compaq Array Configuration Utility XE is a browser-based utility with the following features:

- Can be used any time that the server is on
- Has different operating modes, allowing faster configuration or greater control over the configuration options
- Suggests the optimum configuration for an unconfigured system
- Provides on-screen tips for individual steps of a configuration procedure
- Allows online array capacity expansion, logical drive capacity extension, assignment of online spares, and RAID or stripe size migration

The minimum display settings for optimum performance are 800 × 600 resolution and 256 colors. The server must have Microsoft Internet Explorer 5.0 installed and be running Microsoft Windows 2000, Windows NT 4.0, or Linux. Refer to the *README.TXT* file for further information about browser and Linux support.

Running the Array Configuration Utility XE

You can run the Array Configuration Utility XE directly from the software component, or you can run it from Compaq Insight Manager XE.

Using the Component

1. Download the Array Configuration Utility XE component from the website or from the CD supplied with the controller.
2. Install the component onto your system.

   When installation is complete, the Array Configuration Utility XE icon appears in the system tray.
3. Click **Start** and navigate to **Programs, Compaq System Tools, Compaq Array Configuration Utility.**
4. Choose whether you would like to enable remote access.

   If remote access is disabled, the Array Configuration Utility XE can only be run on the server that has the component installed.
5. Open your browser.

   — If remote access is enabled, enter the following text into the URL field (where *SERVERNAME* is the name or IP address of the host):

   `http:\\SERVERNAME:2301`

   — If remote access is disabled, enter the following text into the URL field:

   `127.0.0.1`

   The **Device Home Page** for Compaq Web-Based Management opens.
6. Click the **anonymous** link near the top of the screen.

   A login screen opens.
7. Enter your user name and password. When the Array Configuration Utility XE is first installed, use `administrator` for both the user name and password.

   NOTE: To change the user name or password, click the appropriate link on this screen. The choice of user name is limited to user, guest, or administrator.

   The **Device Home Page** is displayed again.
8. Click the **Compaq Array Configuration Utility XE** button near the bottom of the screen.

The Array Configuration Utility XE searches for controllers that are connected to your system and identifies them. This process may take a minute or two.

When controller detection is complete, the introductory screen is displayed.

Figure 1-1: Introductory screen

Using Compaq Insight Manager XE

1. On the server where the Array Configuration Utility XE is located, ensure that the Array Configuration Utility XE is configured to allow remote access.
2. On the remote system, connect to the Compaq Insight Manager XE server (port :280) and log in.
3. Select **Device Queries.** Under **Device by Type,** select **All Servers.**
4. Connect to the server that is running the Array Configuration Utility XE.
5. Under **Device Links,** select the **Device Home Page.**
6. Click the **Compaq Array Configuration Utility XE** button near the bottom of the screen.

The Array Configuration Utility XE searches for controllers that are connected to your system and identifies them. This process may take a minute or two.

When controller detection is complete, the introductory screen (Figure 1-1) is displayed.

Configuration Mode Selection Screen

When you select a controller, the configuration mode selection screen (Figure 1-2) opens. Your screen may be different from the screen shown in the figure for these reasons:

- If the controller that you selected is unconfigured, the gray section of the screen shows only unassigned drives. Arrays, logical drives, and unused space are absent.
- **Express Configuration** is listed only if there is unused space or an unassigned drive on the selected controller.
- **Advanced Configuration** is only available with some operating systems.

Figure 1-2: Configuration mode selection screen

Details of the subsequent steps in the controller configuration procedure are given in the next two chapters of this guide.

- If the controller is not configured (it has no arrays or logical drives, only unassigned physical drives), see Chapter 2.
- If the controller is already configured but you want to reconfigure it, see Chapter 3.

Description of Screen Regions

The appearance of a typical screen depends on which of the three configuration modes (**Express, Assisted,** or **Advanced)** you use. Assisted and express modes use wizards to guide you through the configuration process; advanced mode lets you configure your system without help from wizards.

Typical Wizard-Based Screen

Figure 1-3: Screen regions in wizard

The **Controller Selection List** shows all the identifiable controllers that are connected to your system.

The **Main Menu** shows the allowable options at this stage.

The **Configuration View** window shows all arrays, logical drives, unused space, and unassigned physical drives that are connected to the selected controller. The logical view is shown by default.

- Click an icon to get a popup window (see Figure 1-4 for an example) listing further information about the corresponding item.
- Change to the physical view at any time by clicking **Show Physical View** in the upper right-hand corner of the window.

The **FAQ Column** lists information and tips relevant to the current screen. Check this region before clicking **Help** in the upper right-hand corner of the browser screen.

Figure 1-4: Typical More Information popup window

Typical Advanced Mode Screen

This mode shows all the configuration options for a particular device at the same time, in a frame on the right-hand side of the screen. The FAQ column is absent.

Figure 1-5: Typical advanced mode screen

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Configuring a New Controller

Log in as described in Chapter 1 and select a controller.

When you select an unconfigured controller, the configuration mode selection screen (Figure 2-1) opens.

Figure 2-1: Starting to configure a new controller

If you select a controller that is already configured, arrays and logical drives are also present in the gray box rather than just unassigned physical drives. The procedure for reconfiguring a previously configured controller is described in Chapter 3.

These methods are available for configuring the controller:

- **Express Configuration** automatically sets up the optimum configuration for the controller after you have answered a few simple questions.
- **Assisted Configuration** uses a set of wizards to guide you through the manual configuration process.
- **Advanced Configuration** lets you configure the controller manually without using wizards. (This configuration option is only available with certain operating systems.)

Using Express Configuration Mode

1. Click **Express Configuration.** The express mode start screen is displayed.

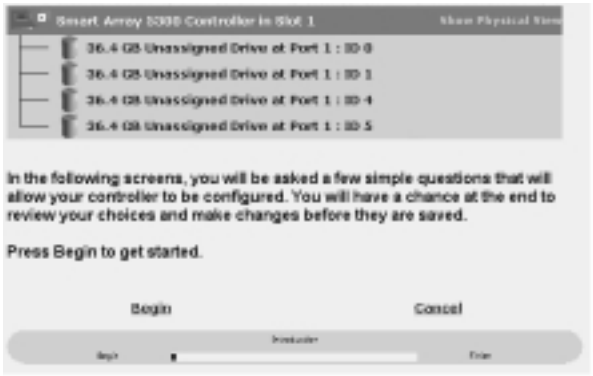

Figure 2-2: Express mode start screen

2. Click **Begin.**

   The Array Configuration Utility XE uses all of the physical drives attached to the controller to create the optimum number of arrays and logical drives. This process takes a few moments; when it is finished, the screen is updated. The gray **Configuration View** window shows the new configuration (see Figure 2-3), and underneath this window is a list of possible fault-tolerance levels for the first logical drive.

Figure 2-3: Choosing a RAID level

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

   If you have chosen a fault-tolerant RAID method, and an unassigned physical drive of the appropriate capacity is available, the Array Configuration Utility XE asks if you want to assign a spare drive. Make your choice, and then click **Next.**

4. The screen now displays the chosen configuration and asks you to confirm that it is acceptable.

   — Discarding the suggested configuration returns you to the configuration mode selection screen (Figure 2-1) so that you can configure the new array manually.

   — Accepting the suggested configuration produces a screen confirming that the Array Configuration Utility XE has saved the new configuration. At this point, you can configure another controller or you can exit the Array Configuration Utility XE.

   Choose the appropriate radio button.

5. Click **Finish.**

Using Assisted Configuration Mode

Creating an Array

1. Click **Assisted Configuration.**
2. Click **Create an array,** and then click **Begin.** The physical drive selection screen is displayed. (In larger configurations, use the scrollbars in the **Configuration View** region to see all the physical drives and arrays connected to the controller.)

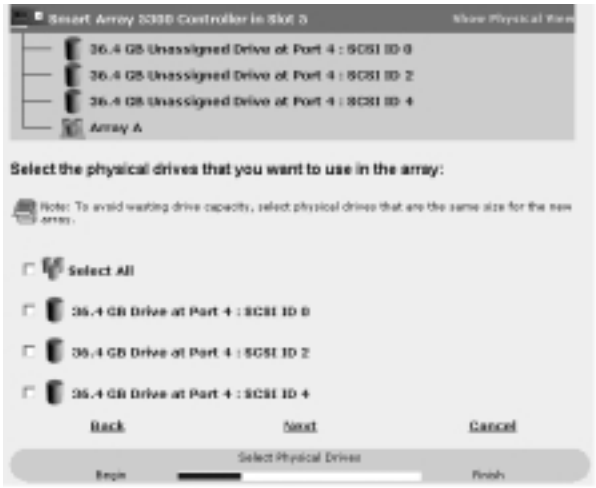

Figure 2-4: Physical drive selection screen

3. Choose the physical drives that you want to use in the array.
   - — Use physical drives of comparable capacity.

     The Array Configuration Utility XE 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, any excess capacity of the other drives 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 is on the array.

4. Click **Next** when you have finished choosing physical drives.

   If an unassigned physical drive of the appropriate capacity is available, you are asked whether you want to assign a spare drive to the array.

   — If you do not want a spare, click **No,** and then click **Next.**

   — To assign a spare, click **Yes,** and then click **Next.** On the next screen, select the drive that you want to be the spare, and then click **Next.**

   NOTE: An array can have only one spare, but a spare can be shared by several arrays.

5. Click **Finish** to confirm the configuration. The configured array screen is displayed.

Figure 2-5: Configured array screen (no logical drives)

Creating a Logical Drive

1. Click **Create a logical drive** (see Figure 2-5), and then click **Begin.**
2. Choose the unused space that you want to use to build the logical drive on, and then click **Next.**
3. Choose the fault tolerance 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.
4. Choose the 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, use the following table to determine what stripe size to set.

Table 2-1: Optimum Stripe Size

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

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

   MaxBoot increases the number of sectors used per track from 32 to 63. This increase allows a larger boot partition for operating systems that use cylinders, heads, and sectors of a physical drive to determine the drive size. (One such operating system is Microsoft Windows NT 4.0.)

   Logical drive performance is likely to decrease with MaxBoot enabled.
6. Set the size that you want the logical drive to be, and then click **Next.**

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

If the controller has an array accelerator, a screen is now displayed that lets you disable it for the currently selected logical drive. Choose whether to disable the array accelerator, and then click **Next.**

NOTE: Disabling the array accelerator for a logical drive reserves use of the accelerator cache for other logical drives on the array that need to have the maximum possible performance (such as those that contain database information).

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

7. Check that the configuration is acceptable, and then click **Finish.**

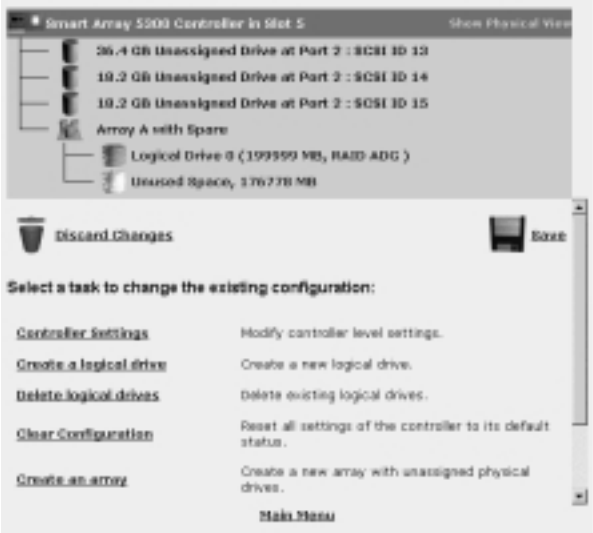

Figure 2-6: New logical drive before saving

8. Click the **Save** icon to commit the changes to the controller, and then click **OK** on the confirmation alert. (If you discard the changes, all changes since the previous save are lost.)

To make further modifications to the array configuration, see Chapter 3.

Using Advanced Configuration Mode

1. On the configuration mode selection screen, click the **Advanced Configuration** link. The advanced mode start screen is displayed.

Figure 2-7: Advanced mode start screen

2. Click an item in the **Configuration View** window. The screen displays a list of the tasks that are available for that item.

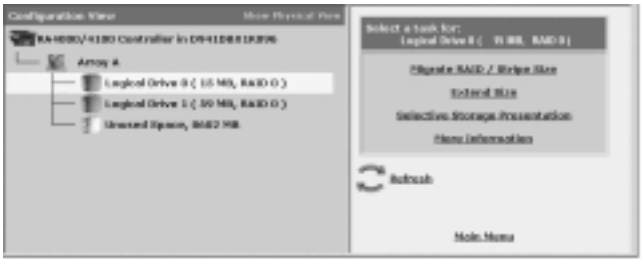

Figure 2-8: Typical task list for a logical drive

The listed (available) tasks 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 current controller configuration and model. (For example, **Create Array** is not an available task for a controller item if there are no unassigned physical drives connected to the controller.) Table 2-2 lists all the possible tasks for every type of item.

The **More Information** task is present for all items except unused space. Clicking the link for this task causes a popup window to be displayed with additional information about the selected item. See the "Description of Screen Regions" section in Chapter 1 for an example of this type of screen.

Table 2-2: Possible Tasks in Advanced Configuration Mode

Item	Available Tasks
Controller	Clear Configuration
	Controller Settings
	Create Array
	Logical Drive Array Accelerator Settings
	More Information
Array	Assign Spare
	Create Logical Drive
	Delete
	Expand
	Remove Spare
	More Information
Logical drive	Delete
	Extend Size
	Migrate RAID / Stripe Size
	Selective Storage Presentation
	More Information
Unused space	(No available tasks associated with this item)

3. Click a task link. A list of all possible configuration options for that task is displayed on the right-hand side of the screen (replacing the task list). See the "Description of Screen Regions" section in Chapter 1 for an example of this type of screen.
4. Set the configuration options as you want them to be.
5. Click the **OK** button.

3

Modifying an Existing Configuration

Log in as described in Chapter 1 and select the controller that you want to reconfigure. You may have the choice of using Express, Assisted, or Advanced Configuration modes, depending on the operating system being used and the current configuration of the controller.

Using Express Configuration Mode

This mode is available only if the selected controller has unassigned physical drives or unused space.

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. Make your choice, and then click **Next.**

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

   The screen displays the optimum configuration for the controller and asks you to confirm that it is acceptable.

2. Choose the appropriate radio button, and then click **Finish.**

Using Assisted Configuration Mode

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

These are the possible menu options:

- Assign a spare
- Clear Configuration
- Controller Settings
- Create an array
- Create a logical drive
- Delete arrays
- Delete logical drives
- Expand array
- Extend logical drive
- Migrate a logical drive
- Remove a spare
- Selective Storage Presentation

The following sections describe these options in more detail.

Assign a Spare

NOTE: An array can have only one spare, but a spare can be shared by several arrays.

1. Click **Assign a spare,** and then click **Begin.**
2. Choose the array that needs a spare drive.
3. Choose the drive that you want to assign as a spare, and then click **Next.**

4. Click **Finish** to accept the changes.
5. Click the **Save** icon to apply the changes to the system, and then click **OK** on the confirmation alert.

Clear Configuration

This option 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.**

   A warning screen is displayed to remind you that you will lose all data on the logical drive. Click **Delete** to continue.
2. Click **Finish** to accept the changes.
3. Click the **Save** icon 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

This option lets you alter the priority settings for array expansion and rebuild. You can also disable the array accelerator (if one is present) or change the ratio of read cache to write cache (if the controller has battery-backed cache).

The default controller settings provided by the Array Configuration Utility XE are adequate for many purposes. To change the controller settings:

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

   The next two screens let you change the expand priority and the rebuild priority settings. 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 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 lets you disable it for particular logical drives. Choose whether to disable the array accelerator for any logical drives, and then click **Next.**

   NOTE: Disabling the controller for a particular logical drive reserves use of the accelerator cache for other logical drives on the array that need to have maximum possible performance (such as those that contain database information).

   If the controller has a battery-backed cache, a screen now appears that lets you change the read/write cache ratio. Choose the ratio that you want the controller to use, and then click **Next.**

   NOTE: This ratio determines the amount of memory allocated to the read and write caches on the array accelerator. Different types of applications have different optimum ratios. You can only change the ratio if the controller has a battery-backed cache and if there are logical drives configured on the controller.

4. Click **Finish** to accept the changes.
5. Click the **Save** icon 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. Choose the physical drives that you want to use in the array.
   - — Use physical drives of comparable capacity.

     The Array Configuration Utility XE 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, any excess capacity of the other drives 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 is available on the array.
3. Click **Next** when you have finished adding physical drives to the array.

   If a spare or unassigned physical drive of the appropriate capacity is available, you can now assign a spare drive to the array.
   - — If you do not want a spare, click **No,** and then click **Next.**
   - — To assign a spare, click **Yes,** and then click **Next.** On the next screen, select the drive that you want to be the spare, and then click **Next.**

   NOTE: An array can have only one spare, but a spare can be shared by several arrays.
4. Click through the remaining screens to confirm the configuration.

Create a Logical Drive

1. Click **Create a logical drive,** and then click **Begin.**
2. Choose the unused space that you want to use to build the logical drive on, and then click **Next.**
3. Choose the fault-tolerance 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.

4. Choose the 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, see Table 3-1 to determine what stripe size to set.

Table 3-1: Optimum Stripe Size

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

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

   MaxBoot increases the number of sectors used per track from 32 to 63. This increase allows a larger boot partition for operating systems that use cylinders, heads, and sectors of a physical drive to determine the drive size. (One such operating system is Microsoft Windows NT 4.0.)

   Logical drive performance is likely to decrease with MaxBoot enabled.

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

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

   If the controller has an array accelerator, a screen is now displayed that lets you disable it for the currently selected logical drive. Choose whether to disable the array accelerator for this logical drive, and then click **Next.**

NOTE: Disabling the array accelerator for a particular logical drive reserves use of the accelerator cache for other logical drives on the array that need the maximum possible performance (such as those that contain database information).

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

7. Check that the configuration is acceptable, and then click **Finish.**
8. Click the **Save** icon to apply the changes to the system, and then click **OK** on the confirmation alert.

Delete Arrays

This option 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, or you can use the liberated physical drive space for expansion of another array 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.** A warning screen is displayed 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 the **Save** icon to apply the changes to the system, and then click **OK** on the confirmation alert.

Delete Logical Drives

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

- Create new logical drives.
- Migrate the RAID level or stripe size of an existing logical drive.
- Extend an existing logical drive on the same array, if your 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.** A warning screen is displayed 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 the **Save** icon to apply the changes to the system, and then click **OK** on the confirmation alert.

Expand Array

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

- Create new logical drives.
- Migrate the RAID level or stripe size of existing logical drives.
- Extend existing logical drives on the array, if your operating system allows logical drive extension.

1. **Expand array** is available only if the controller has unassigned physical drives of sufficient capacity to be added to an existing array. If this is not the case, install at least one physical drive (of the same capacity as existing drives in the array) on the controller, and then click **Refresh.**
2. Click **Controller Settings** and check that the expand priority setting is acceptable.
3. Back up all data on the array. Although array expansion is unlikely to cause data loss, observing this precaution provides additional data protection.
4. Click **Expand array,** and then click **Begin.**
5. Choose the array that you want to expand, and then click **Next.**
6. Select the physical drives that you want to add to the array, and then click **Next.**
7. 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 only expand one array at a time; remaining array expansions are queued.

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

8. 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** window. A **More Information** popup window is displayed that lists the drive 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 array expansion (see the Expand Array section), or by deleting another logical drive on the same array.

Not all operating systems support online logical drive extension through the Array Configuration Utility XE. Also, **offline** logical drive extension is possible for some operating systems by backing up data, reconfiguring the array, and restoring data from backup. Check the operating system documentation for current information.

IMPORTANT: The extension process takes about 15 minutes per gigabyte, or considerably longer if the controller does not have a battery-backed cache. While logical drive extension is taking place, no other expansion, extension, or migration can occur 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. Type 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 only extend 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** window. A **More Information** popup window is displayed that lists the drive status.

Migrate a Logical Drive

This option lets you alter the stripe size (data block size) or RAID level, or both, for a selected logical drive. The array might need to have unused space available for the migration to be possible, depending on the initial and final settings for the stripe size and RAID level.

IMPORTANT: The migration process takes about 15 minutes per gigabyte, or considerably longer if the controller does not have a battery-backed cache. While migration is taking place, no other expansion, extension, or migration can occur 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, and then 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 only migrate one logical drive at a time; remaining migrations are queued.

6. Click **Save.** Migration begins.

To check the progress of a migration, click the icon for that logical drive in the **Configuration View** window. A **More Information** popup window is displayed that lists the drive status.

Remove a Spare

1. Click **Remove a spare,** and then click **Begin.**
2. Choose the spare that you want to remove, and then click **Next.**
3. Click **Finish,** and then click **Save** to apply the changes to your system.

Selective Storage Presentation (for Fibre Channel Controllers Only)

This menu option lets you forbid selected host controllers from accessing a logical drive. This prevents data corruption that may occur when different servers using different operating systems access the same data.

1. Click **Selective Storage Presentation,** and then click **Begin.**
2. Choose the logical drive for which you want to change the access settings, and then click **Next.**

   A screen is displayed that lets you enable or disable the access settings.

   — Disabling the access settings lets all host controllers gain access to the selected logical drive.

   — Enabling the settings lets you deny access to selected hosts.
3. Select the appropriate radio button, and then click **Next.**

If you enable the access settings, the screen lists all identified host controllers. Select the host controllers that are to have access to the logical drive, rename the connections if necessary, and then click **Next.**

4. Click **Finish.**

Using Advanced Configuration Mode

1. Click the **Advanced Configuration** link. The advanced mode start screen is displayed.

Figure 3-1: Advanced mode start screen

2. Click an item in the **Configuration View** window. The screen displays a list of the tasks that are available for that item.

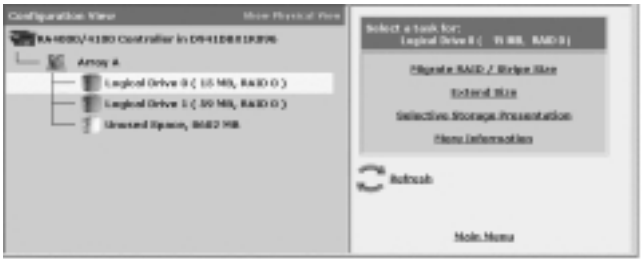

Figure 3-2: Typical task list for a logical drive

The listed (available) tasks 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 current controller configuration and model. (For example, **Create Array** is not an available task for a controller item if there are no unassigned physical drives connected to the controller.) Table 3-2 lists all the possible tasks for every type of item.

The **More Information** task is present for all items except unused space. Clicking the link for this task causes a popup window to be displayed with additional information about the selected item. See the "Description of Screen Regions" section in Chapter 1 for an example of this type of screen.

Table 3-2: Possible Tasks in Advanced Configuration Mode

Item	Available Tasks
Controller	Clear Configuration
	Controller Settings
	Create Array
	Logical Drive Array Accelerator Settings
	More Information
Array	Assign Spare
	Create Logical Drive
	Delete
	Expand
	Remove Spare
	More Information
Logical drive	Delete
	Extend Size
	Migrate RAID / Stripe Size
	Selective Storage Presentation
	More Information
Unused space	(No available tasks associated with this item)

3. Click a task link. A list of all possible configuration options for that task is displayed on the right-hand side of the screen (replacing the task list). See the "Description of Screen Regions" section in Chapter 1 for an example of this type of screen.
4. Set the configuration options as you want them to be.
5. Click the **OK** button.

A

Drive Arrays and Fault Tolerance

What Is a Drive Array?

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.

Merely adding extra physical drives to the system increases the total storage capacity (see Figure A-1). However, this addition does not affect the efficiency of read/write (R/W) operations, since data can still only be transferred to one physical drive at a time.

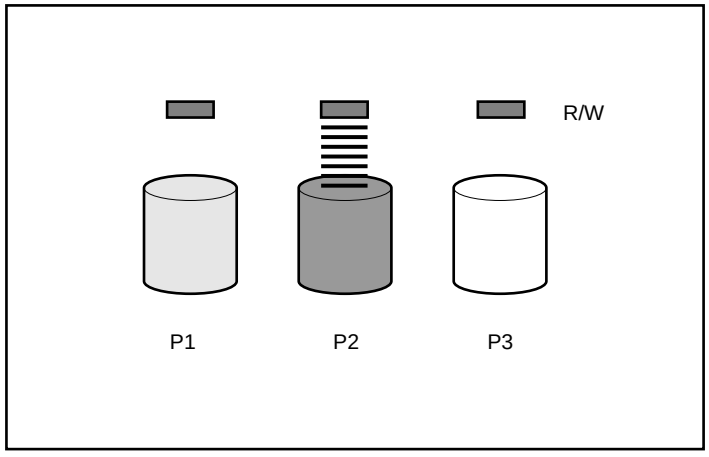

Figure A-1: Physical drives added to system

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

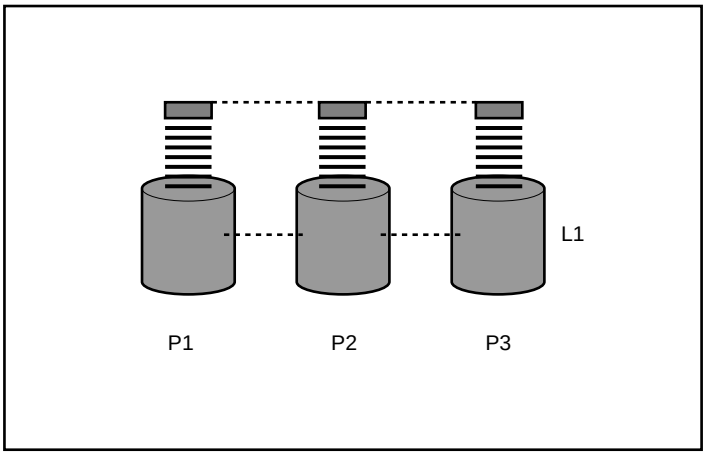

Figure A-2: Physical drives configured into a logical drive (L1)

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 termed a **block,** and over all the physical drives in a logical drive the blocks form a set of data **stripes** (see Figure A-3).

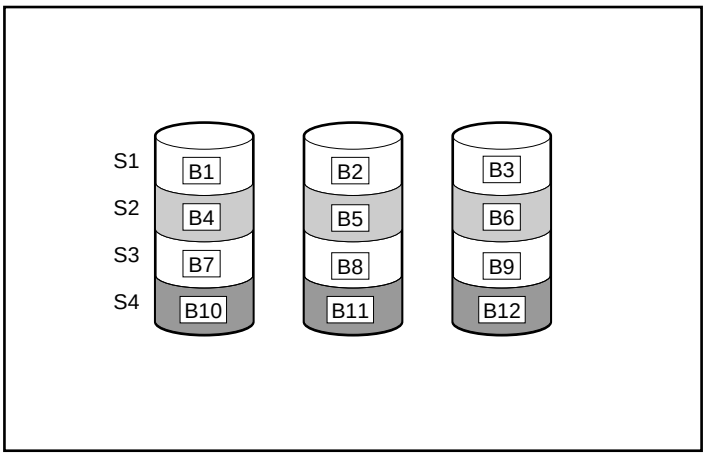

Figure A-3: Data striping (S1-S4) of data blocks B1-B12

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 termed a **drive array,** often abbreviated to just **array.** Since all the physical drives in an array are commonly configured into just one logical drive, the term array is also often used as a synonym for logical drive. However, an array can contain several logical drives (see Figure A-4), each of a different size.

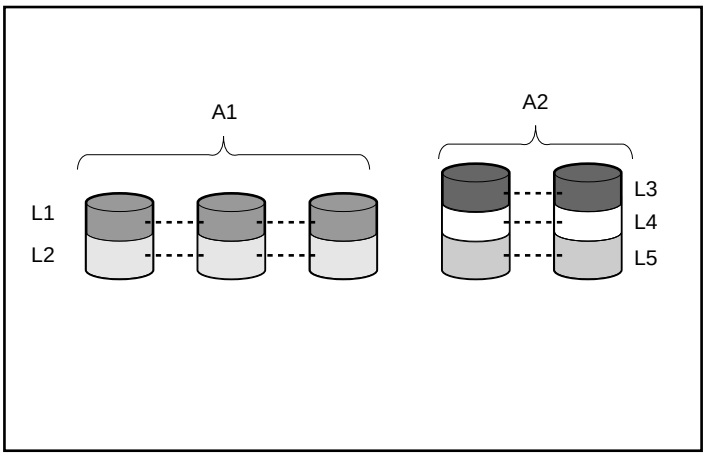

Figure A-4: Two arrays (A1, A2) containing five logical drives spread over five physical drives

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

Drive failure, although rare, is potentially catastrophic. In Figure A-4, for example, failure of **any** physical drive causes **all** logical drives in the same array to fail, and all data on the drives is lost.

To protect against data loss due to physical drive failure, logical drives are configured with **fault tolerance.** There are several fault-tolerance methods; those supported by current Compaq controllers (and described in the following section) are:

- RAID 0—Data Striping only (no fault tolerance)
- RAID 1 (sometimes called RAID 0+1)—Drive Mirroring
- RAID 5—Distributed Data Guarding
- RAID ADG—Advanced Data Guarding

For any configuration except RAID 0, further protection against data loss can be achieved by assigning an **online spare** (or **hot spare**). This is a physical drive that contains no data and is connected to the same controller as the array. When a physical drive in the array fails, the controller automatically rebuilds information that was originally on the failed drive onto the online spare. This quickly restores the system to full RAID-level data protection. (However, in the unlikely event that another drive in the array should fail 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; you can configure one hard drive to be the online spare for several arrays, as long as the arrays are all on the same controller.

Fault-Tolerance Methods

RAID 0—No Fault Tolerance

This configuration (see Figure A-3) provides no protection against data loss when a drive fails. However, it is useful for rapid storage of large amounts of non-critical data (for printing or image editing, for example), or when cost is the most important consideration.

Advantages

- Highest performance method for writes
- Lowest cost per unit of data stored
- All drive capacity is used to store data (none needed for fault tolerance)

Disadvantages

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

RAID 1—Drive Mirroring

In this configuration, data is duplicated onto a second drive.

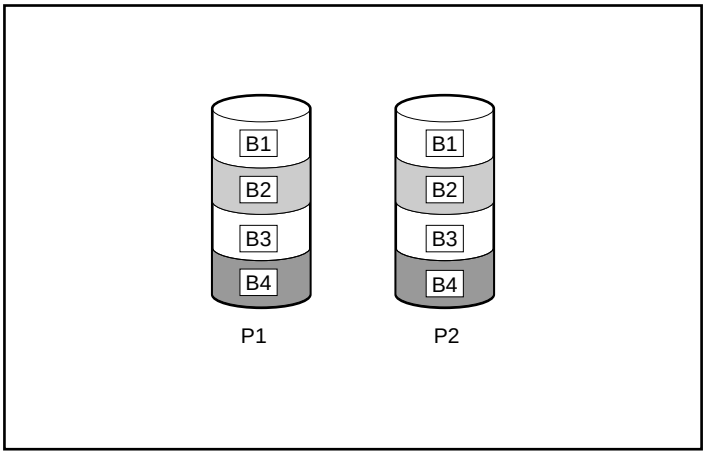

Figure A-5: Drive mirroring of P1 onto P2

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

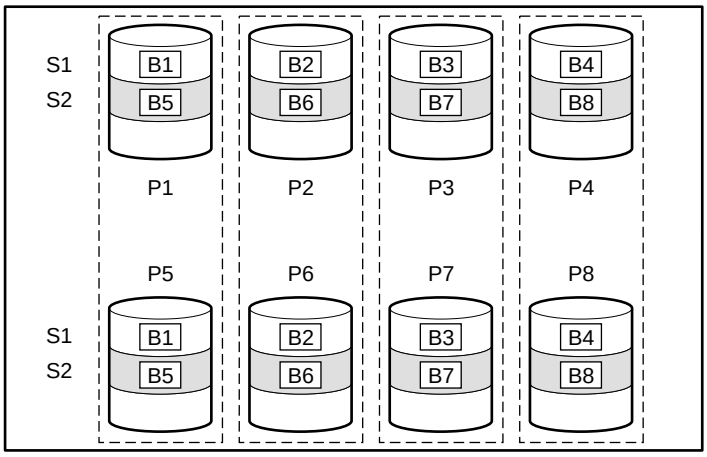

Figure A-6: Mirroring with more than two physical drives in the array

In each mirrored pair, the physical drive that is not busy answering other requests answers any read request sent to the array. (This is termed **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 more than two physical drives in the array, this fault-tolerance method is sometimes referred to as RAID 0+1 or RAID 1+0. However, these terms are ambiguous, because different equipment manufacturers define and implement these methods in slightly different ways.

Advantages

- Highest read and write performance of any fault-tolerant configuration
- No loss of data as long as none of failed drives are mirrored to another failed drive (up to half of the physical drives in the array can fail)

Disadvantages

- Expensive (many drives needed for fault tolerance)
- Only 50% of total drive capacity useable for data storage

RAID 5—Distributed Data Guarding

By this method, a block of **parity data** is calculated for each stripe from the data that is in all other blocks within that stripe. The blocks of parity data are distributed over every physical drive within the logical drive (see Figure A-7). When a physical drive fails, data that was on the failed drive can be calculated from the user data on the remaining drives and the parity data. 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.

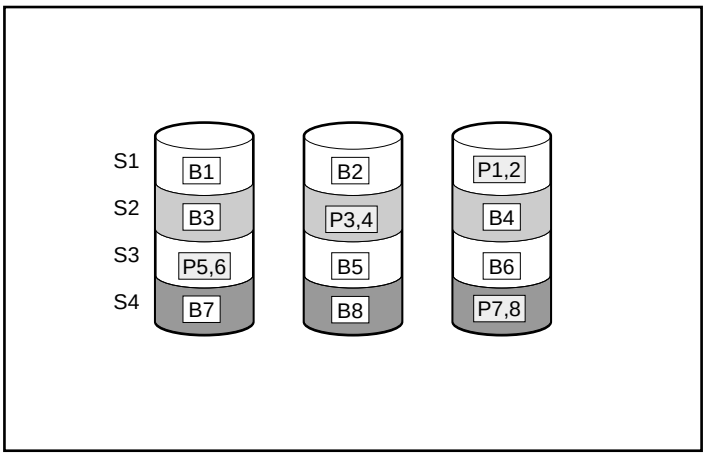

Figure A-7: Distributed data guarding, showing parity information (Px,y)

Advantages

- High read performance
- No loss of data if one physical drive fails
- More drive capacity usable than with RAID 1—parity information requires only the storage space equivalent to one physical drive

Disadvantages

- Relatively low write performance
- Loss of data if a second drive fails before data from the first failed drive is rebuilt

RAID ADG—Advanced Data Guarding

RAID ADG is similar to RAID 5 in that parity information is generated (and stored) to protect against data loss caused by drive failure. With RAID ADG, however, two different sets of parity data are used. This allows data to still be preserved if two drives fail. As can be seen from Figure A-8, each set of parity data uses up a capacity equivalent to that of one of the constituent drives.

This method is most useful when data loss is unacceptable, but cost must also be minimized. The probability that data loss will occur when arrays are configured with RAID ADG is less than when they are configured with RAID 5 (see Appendix B for details).

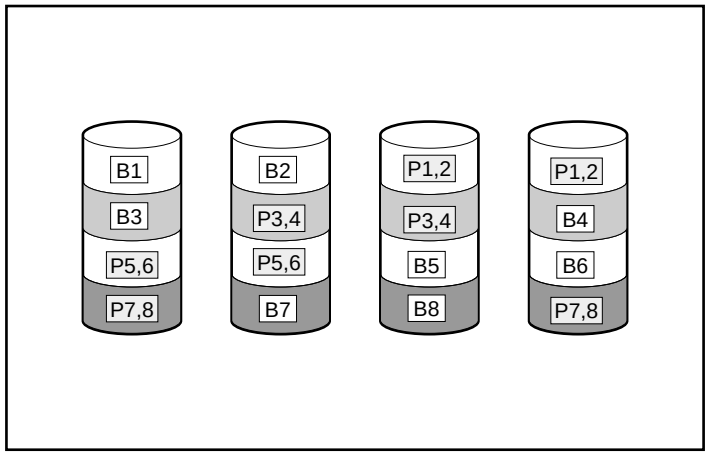

Figure A-8: Advanced data guarding (RAID ADG)

Advantages

- High read performance
- High data availability—any two drives can fail without loss of critical data
- More drive capacity usable than with RAID 1—parity information requires only the storage space equivalent to two physical drives

Disadvantage

The only significant disadvantage of RAID ADG is a relatively low write performance (lower than RAID 5), due to the need for two sets of parity data.

Table A-1 summarizes the important features of the different kinds of RAID described here. The decision chart in Figure A-9 may help you to determine which option is best for your situation.

Table A-1: Summary of RAID Methods

	RAID 0	RAID 1	RAID 5	RAID ADG
Alternative name	Striping (no fault tolerance)	Mirroring	Distributed Data Guarding	Advanced Data Guarding
Usable drive space*	100%	50%	67% to 93%	50% to 96%
Usable drive space formula	n	n/2	(n-1)/n	(n-2)/n
Minimum number of physical drives	1	2	3	4
Tolerates failure of 1 physical drive?	No	Yes	Yes	Yes
Tolerates simultaneous failure of >1 physical drive?	No	Only if no two failed drives are in a mirrored pair	No	Yes
Read performance	High	High	High	High
Write performance	High	Medium	Low	Low
Relative cost	Low	High	Medium	Medium

*Values for usable drive space are calculated with these assumptions:

- All physical drives in the array have the same capacity.
- Online spares are not used.
- No more than 14 physical drives are used for RAID 5. (This number is recommended so that the risk of logical drive failure is kept low; see Appendix B for further information.)
- No more than 56 physical drives are used for RAID ADG. (In this case, the limitation is the number of physical drives that can be connected to the controller.)

MOST IMPORTANT	ALSO IMPORTANT	SUGGESTED RAID LEVEL
Fault tolerance	**Cost effectiveness**	*RAID ADG*
	I/O performance	*RAID 1*
Cost effectiveness	**Fault tolerance**	*RAID 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*

Figure A-9: Choosing a RAID method

Other Fault-Tolerance Options

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.

However, the hardware-based RAID methods described in this Appendix provide a much more robust and controlled fault-tolerant environment. Additionally, controller duplexing and software-based RAID do not support online spares, auto-reliability monitoring, interim data recovery, or automatic data recovery.

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

B

Probability of Logical Drive Failure

The probability that a logical drive will fail depends on the RAID level setting.

- A RAID 0 logical drive fails if only one physical drive fails.
- For a RAID 1 logical drive, the failure situation is complex.
  - 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. This maximum is reached only if no failed drive is mirrored to any other failed drive. In practice, a logical drive usually fails before this maximum is reached. As the number of failed drives increases, it becomes increasingly unlikely that a newly failed drive is not mirrored to a previously failed drive.
  - The failure of **only two** physical drives is enough to cause a logical drive to fail **if** the two drives happen to be mirrored to each other. The risk of this occurring decreases as the number of mirrored pairs in the array increases.
- A RAID 5 logical drive (with no online spare) fails if two physical drives fail.
- A RAID ADG logical drive (with no online spare) 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.

The graph in Figure B-1 provides more quantitative information. The data for this graph is calculated from the mean time between failure (MTBF) value for a typical physical drive, assuming that no online spares are present. Adding an online spare to any of the fault-tolerant RAID configurations further decreases the probability of logical drive failure by a factor of about a thousand.

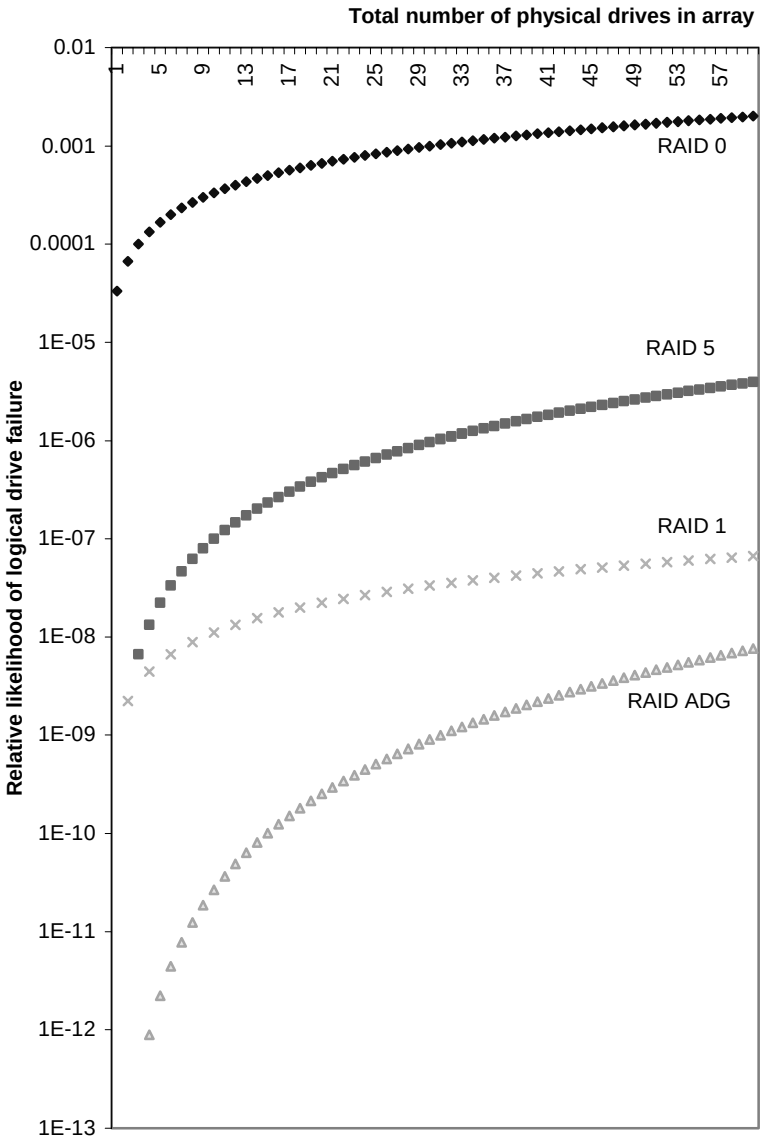

Figure B-1: Probability of logical drive failure

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