COMPAQ

**Advanced Data Guarding for the
Smart Array 5300 Controller**
Reference Guide

Notice

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About This Guide

This guide describes the features of RAID ADG and the installation of the RAID ADG Enabler Module onto the Smart Array 5300 controller board.

Text Conventions

This document uses the following conventions to distinguish elements of text:

Keys	Keys appear in boldface. A plus sign (+) between two keys indicates that they should be pressed simultaneously.
USER INPUT	User input appears in a different typeface and in uppercase.
FILENAMES	File names appear in uppercase italics.
Menu Options, Command Names, Dialog Box Names	These elements appear in initial capital letters.
COMMANDS, DIRECTORY NAMES, and DRIVE NAMES	These elements appear in uppercase.
Type	When you are instructed to *type* information, type the information **without** pressing the **Enter** key.
Enter	When you are instructed to *enter* information, type the information and then press the **Enter** key.

Symbols in Text

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

WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or loss of life.

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.

Symbols on Equipment

These icons may be located on equipment in areas where hazardous conditions may exist.

Any surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.
WARNING: To reduce the risk of injury from electrical shock hazards, do not open this enclosure.

Any RJ-45 receptacle marked with these symbols indicates a Network Interface Connection.
WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.

| | Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists. **WARNING:** To reduce the risk of injury from a hot component, allow the surface to cool before touching. |

| | Power Supplies or Systems marked with these symbols indicate the equipment is supplied by multiple sources of power. **WARNING:** To reduce the risk of injury from electrical shock, remove all power cords to completely disconnect power from the system. |

⚠ Important Safety Information

Before installing this product, read the *Important Safety Information* document provided.

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

You are entitled to free hardware technical telephone support for your product for as long you own the product. A technical support specialist will help you diagnose the problem or guide you to the next step in the warranty process.

In North America, call the Compaq Technical Phone Support Center at 1-800-OK-COMPAQ[1]. This service is available 24 hours a day, 7 days a week.

Outside North America, call the nearest Compaq Technical Support Phone Center. Telephone numbers for world wide Technical Support Centers are listed on the Compaq website. Access the Compaq website by logging on to the Internet at www.compaq.com.

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[1] For continuous quality improvement, calls may be recorded or monitored.

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

■ Technical support registration number (if applicable)

■ Product serial number (s)

■ Product model name(s) and numbers(s)

■ Applicable error messages

■ Add-on boards or hardware

■ Third-party hardware or software

■ Operating system type and revision level

■ Detailed, specific questions

Compaq Website

The Compaq website has information on this product as well as the latest drivers and Flash ROM images. You can access the Compaq website by logging on to the Internet at www.compaq.com.

Compaq Authorized Reseller

For the name of your nearest Compaq Authorized Reseller:

■ 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.

Chapter **1**

Introduction: RAID ADG

RAID ADG is similar to RAID 5 in that data protection is achieved by writing parity information to the physical drives in the array. With RAID ADG, however, *two* sets of parity data are used (Figure 1-1). These two sets are different, and each set occupies a capacity equivalent to that of one of the constituent drives. (For further information about other RAID levels, refer to the *Compaq Smart Array 5300 Controller User Guide*.)
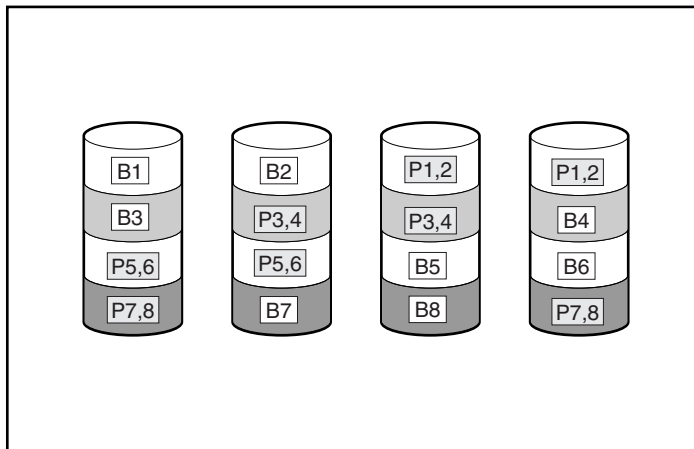

Figure 1-1. RAID ADG, showing data blocks (B) and two sets of parity data (P)

RAID ADG is most useful when data loss cannot be accepted, but low cost of implementation is also desirable. The probability that a system will suffer data loss when configured with RAID ADG is less than when configured with either RAID 1 or RAID 5 (see Appendix C for reliability data).

The main advantages of RAID ADG are:

■ High read performance

■ High data availability – any two drives can fail without loss of critical data

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

The following table summarizes the most important features of the different varieties of RAID available. The decision chart in Figure 1-2 may help you determine which RAID option is best for your situation.

Table 1-1
Summary of RAID Features

	RAID 0	RAID 1 / RAID 0+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 hard drives	1	2	3	4
Tolerant of single hard drive failure?	No	Yes	Yes	Yes
Tolerant of multiple simultaneous hard drive failure?	No	In RAID 0+1, only when the failed drives are not mirrored to each other	No	Yes
Read performance	High	High	High	High
Write performance	High	Medium	Low	Low
Relative cost	Low	High	Medium	Medium

*Note: The value for usable drive space is calculated assuming a maximum of 14 hard drives of the same capacity (or a maximum of 56 for RAID ADG) with no online spares. Compaq recommends that these maximum figures (excluding any allowable online spares) are not exceeded when configuring a drive array, due to the increased likelihood of logical drive failure with more hard drives.

MOST IMPORTANT	ALSO IMPORTANT	SUGGESTED RAID LEVEL
Fault tolerance	**Cost effectiveness**	*RAID ADG*
	I/O performance	*RAID 0+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 0+1*

Figure 1-2. Choosing a RAID method

Chapter 2

Installation

For Advanced Data Guarding to be available as a fault-tolerance option on your system, the RAID ADG Enabler Module must be installed on the Smart Array 5300 controller in the server. Also, you will need to have at least 64 MB of read/write cache on the controller.

Preliminary Steps

⚠ **WARNING:** To reduce the risk of personal injury or damage to the equipment, consult the safety information and user documentation provided with your computer before attempting the installation.

Many computers are capable of producing energy levels that are considered hazardous. These computers are intended to be serviced by qualified personnel trained to deal with those hazards. Do not remove enclosures or attempt to bypass any interlocks that may be provided for the purpose of removing these hazardous conditions.

⚠ **CAUTION:** Electrostatic discharge (ESD) can damage electronic components. Be sure you are properly grounded before beginning this procedure. See Appendix B for ESD information.

Before installing or removing the RAID ADG Enabler Module:

1. Perform a normal system shutdown.

⚠ **CAUTION:** In systems using external data storage, be sure the server is the first unit powered down and the last to be powered back up. This will ensure that the system will not erroneously mark the drives as failed.

2. Turn off the server.

3. Turn off any peripheral devices attached to the server.

4. Unplug the AC power cord from the outlet, then from the server.

5. Disconnect any peripheral devices from the server.

> ⚠ **WARNING:** To reduce the risk of personal injury from hot surfaces, allow the internal system components and hot-plug hard drives to cool before touching.

6. Remove or open the access panel.

7. Remove the Smart Array 5300 controller from the PCI slot.

Locating the Connector

The connector for the RAID ADG Enabler Module is located at the corner of the controller board near the Array Accelerator connector socket (Figure 2-1).
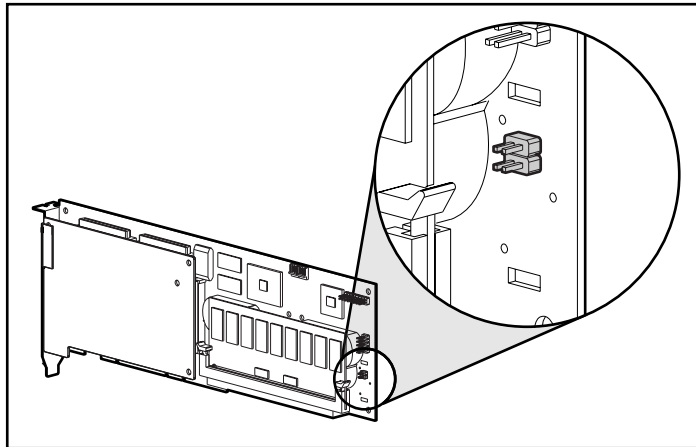
Figure 2-1. Location of the RAID ADG Enabler Module connector on the Smart Array 5300 controller board

The module attaches to the controller board with the narrow tab (circled in Figure 2-2) nearest to the corner of the controller board. This tab can be pressed outwards during installation to allow the module to be more readily inserted into the board. The clips at each end of the module fit into the slots on the board.
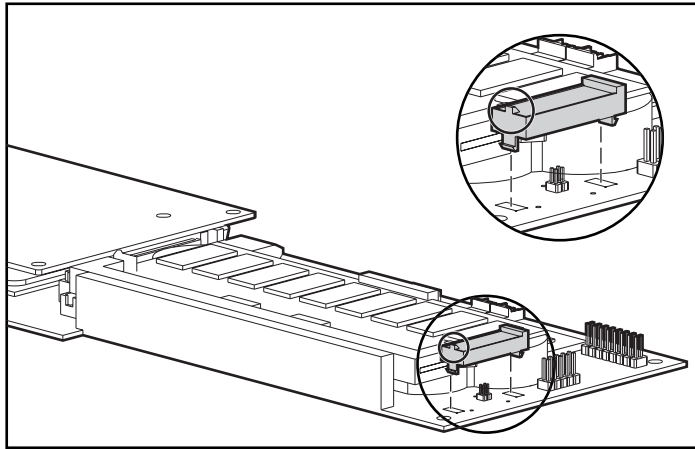
Figure 2-2. Aligning the module on the controller board

Installing the RAID ADG Enabler Module

To install the RAID ADG Enabler Module:

1. Perform the preliminary steps described earlier in this chapter.

2. Ensure that the Array Accelerator on your Smart Array 5300 controller has at least 64 MB of read/write cache.

3. Hold the module at an angle and insert the rear end of the module into the appropriate slot ❶.
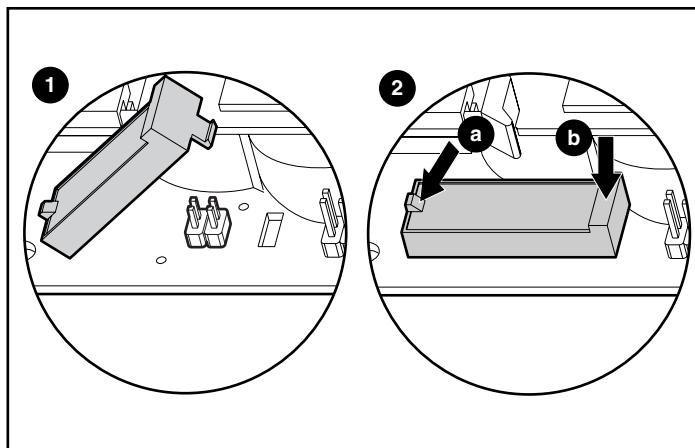
Figure 2-3. Installing the module

4. Use one thumb to press the tab at the top of the rear end outward ❷(a) while using the other thumb to *gently* press the other end of the module ❷(b) into the connector and slot on the controller board.

5. Replace the Smart Array 5300 controller in the server.

6. Replace or close the access panel.

7. Reconnect peripherals and power.

8. Power on the system.

Removing the Enabler Module

When replacing a Smart Array 5300 controller, you may want to remove the RAID ADG Enabler Module from the old controller and install it onto the new controller.

To remove the RAID ADG Enabler Module:

1. Perform the preliminary steps listed earlier in this chapter.

2. Press the innermost plastic clip under the controller board towards the other clip ❶, and push the module out of the board ❷.

Figure 2-4. Removing the RAID ADG Enabler Module

Chapter 3

System Setup

When you have installed the RAID ADG Enabler Module, your array controller can be configured to use Advanced Data Guarding.

The greater reliability of RAID ADG (see Appendix C) allows an array to be built with up to 56 drives, spanning all four channels of a Smart Arr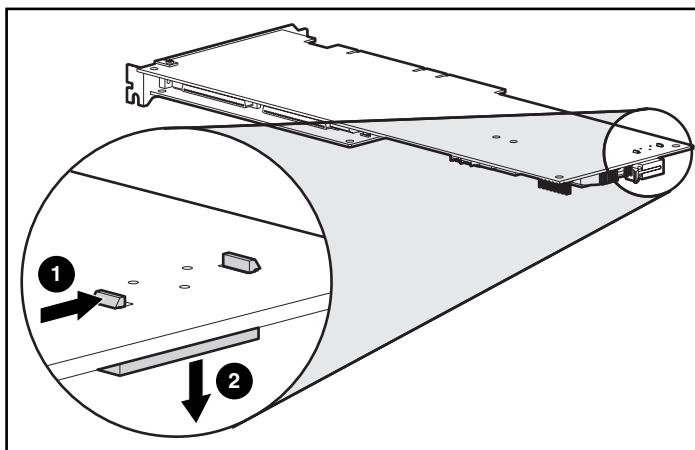ay 5300 controller and its attached 2- to 4-channel adapter board. Furthermore, although the maximum capacity of a logical drive is 502 GB, some operating systems (such as Windows NT and Windows 2000) will allow multiple logical drives to be combined into a single user volume. Consult your operating system documentation for details.

Brief instructions for setting up your system with RAID ADG are given below for Windows 2000, Windows NT, and NetWare. More detailed information can be found in the *Compaq Smart Array 5300 Controller User Guide*.

> **IMPORTANT:** Although data loss is not anticipated, Compaq recommends that you back up all data before changing the fault tolerance setting. This backup data may also be used to return the system to the original configuration, if necessary.

> **NOTE:** A logical volume that is configured for RAID ADG can only be migrated to other controllers that are also configured to support RAID ADG.

Configuring a New System for RAID ADG

Windows NT and Windows 2000

There are three main steps to configure a new system for RAID ADG:

1. Set up an array.

2. Assign hard drives to the array.

3. Create logical drives within the array.

Setting Up an Array

1. Check that you have the latest version of the configuration utility by visiting the Compaq website (www.compaq.com). Download and install the newer version if necessary. An ACU program icon will automatically be generated on the desktop.

2. Double-click the ACU icon.

3. Select the controller (Smart Array 5300) from the drop-down list in the top left corner of the main ACU screen.

4. Click the Settings button in the Controller section in the top right corner of the main ACU screen.

5. Set the rebuild priority, expansion priority, and accelerator ratio.

6. Click the Done button to activate the settings and return to the main ACU screen.

Assigning Hard Drives to the Array

1. Click the Create Array button in the Controller section of the screen.

2. Select the hard drives that are to make up the array, remembering to leave one for the online spare if desired. With RAID ADG, you may select up to 56 drives per array.

3. Click the Assign Drive(s) to Array button.

4. Select the hard drive that is to be the online spare.

5. Click the Assign Spare to Array button.

6. Click the Done button to activate the settings and return to the main ACU screen.

Creating a Logical Drive within the Array

1. Select the array from the left-hand side of the main ACU screen.

2. Click the Create Logical Drive button

3. Select the RAID ADG check box on the screen that is displayed.

4. Enable the Array Accelerator.

5. Change the stripe size, if required. The default setting is 16 kB for RAID ADG, suitable for most common uses. The Stripe Size section later in this chapter discusses stripe sizes most useful for various applications.

6. Change the logical drive size, if desired.

7. Click the Done button to activate the settings and return to the main ACU screen.

8. Choose Save Configuration from the Controller menu.

9. Choose Exit from the Controller menu.

NetWare

1. Check that you have the latest support pack or operating system patch from the Novell website installed on your system.

2. Check that you have the latest drivers for the Smart Array 5300 from the Compaq website installed on your system.

3. Open the CPQONLIN utility.

   In a new system, with no logical drives configured, the auto-configuration wizard is automatically displayed.

4. Select RAID ADG as the fault tolerance level. The wizard creates and configures a logical drive on an array in your system using this RAID setting. Alternatively, you can choose to custom configure your system.

5. Save the changes and close out of CPQONLIN.

Migrating an Existing Logical Drive to RAID ADG

Windows NT and Windows 2000

If you are migrating from a logical drive that is configured for RAID 0 or RAID 5, you will need to expand the array before migrating to RAID ADG.

Check that you have the latest version of the configuration utility by visiting the Compaq website (www.compaq.com). Download and install the newer version if necessary. An ACU program icon will automatically be generated on the desktop.

Expanding the Array

1. Add at least one extra hard drive to your system if migrating from RAID 5, or two extra hard drives if migrating from RAID 0. The capacity of each added drive should be no less than that of the smallest hard drive currently used in the logical volume.

2. Double-click the ACU icon on the desktop.

3. Select the array to be expanded from the left-hand side of the main ACU screen.

4. Click the Expand button.

5. Select the extra hard drives added, except any added spare.

6. Click the Assign Drive(s) to Array button.

7. Select the online spare, if added.

8. Click the Assign Spare to Array button.

9. Continue the migration when expansion has finished.

Migrating the Logical Drive

1. In the ACU, click the Migrate button in the Logical Drive section on the right-hand side of the main ACU screen.

2. Select the RAID ADG check box on the Migrate RAID/Stripe Size screen that is displayed.

3. Change the stripe size, if required. The default setting is 16 kB for RAID ADG, suitable for most common uses. The Stripe Size section later in this chapter discusses stripe sizes most useful for various applications.

4. Click the Done button.

5. Choose Save Configuration from the Controller menu.

6. Choose Exit from the Controller menu.

NetWare

If you are migrating from a logical drive that is configured for RAID 0 or RAID 5, you will need to expand the array before migrating to RAID ADG.

Check that you have the latest support pack or operating system patch from the Novell website installed on your system, and check that you also have the latest drivers for the Smart Array 5300 from the Compaq website.

1. Add at least one extra hard drive to your system if migrating from RAID 5, or two extra hard drives if migrating from RAID 0. The capacity of each added drive should be no less than that of the smallest hard drive currently used in the logical volume.

2. Open the CPQONLIN utility.

3. Expand the array if necessary, and continue migrating to RAID ADG when expansion is complete.

4. On the Main Configuration View screen, highlight the logical drive that is to be reconfigured for RAID ADG.

5. Click the Drive Settings option on the Logical Drive menu.

6. Choose RAID ADG from the list.

7. Choose a stripe size. The Stripe Size section later in this chapter discusses stripe sizes most useful for various applications.

8. Save the changes and close out of CPQONLIN.

Assigning an Online Spare Drive

In fault-tolerant systems, addition of an online spare (hot spare) to a logical drive provides further protection against data loss caused by hard drive failure. As soon as drive failure occurs, missing data can be automatically rebuilt from parity data onto the online spare. Without an online spare there is a chance that

more hard drives will fail before the failed drive is replaced, leading to failure of the complete logical drive and consequent loss of data. This is less likely with RAID ADG than RAID 5, since RAID ADG can sustain failure of two drives.

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

There can only be one spare drive per array. However, an online spare may be assigned to more than one array, if efficient use of drive capacity is important. The capacity of the online spare should be at least as large as that of the other drives in the array.

These are the fault-tolerance options available if you have a limited number of drives (listed from best to worst):

■ RAID ADG with 1 spare (3 drives used for fault tolerance)

■ RAID ADG without a spare (2 drives used for fault tolerance)

■ RAID 5 with 1 spare (2 drives used for fault tolerance)

■ RAID 5 without a spare (1 drive used for fault tolerance)

■ RAID 0 (no fault tolerance)

To assign an online spare to an array during configuration, see the previous sections in this chapter.

To assign an online spare to an array after configuration:

1. Ensure that at least one hard drive containing no data is attached to the same controller as the array.

2. Open the Array Configuration Utility.

3. Select the array in the Main ACU screen.

4. Click the Modify button in the Array section of the Main screen.

5. Select the drive to be used as an online spare.

6. Click the Assign Spare to Array button.

7. Click the Done button.

8. Click the Settings button in the Controller section on the right side of the Main ACU screen.

9. In the Rebuild Priority section of the Controller Settings screen, select High if rebuilding data is more important than handling operating system requests; select Low if the controller should rebuild data only when it is idle.

> **IMPORTANT:** Selecting a high rebuild priority will result in reduced server performance while the rebuild is in progress. Setting the rebuild priority to Low allows normal server performance, since rebuilding only occurs when the server is idle.

10. Click the Done button.

11. Choose Save Configuration from the Controller menu.

12. Choose Exit from the Controller menu.

Performance Tuning

There are several ways in which you can optimize the performance of your system. You can:

■ Change the accelerator cache percentage allocated to reads and writes.

■ Choose a stripe size more suitable for the type of data transfer common to your system.

■ Change the fault tolerance mode to one that requires less overhead.

■ Enlarge the logical drive to span all four controller channels.

Changing the Cache Read/Write Allocation

By default, the Array Accelerator cache capacity is equally divided between reads and writes. If your server application has significantly more reads than writes (or vice versa), you may need to change this setting to improve performance.

> **NOTE:** 16 MB of cache is used for a transfer buffer (8 MB with 32-MB Array Accelerator boards).

1. Check that you have the latest version of the configuration utility by visiting the Compaq website (www.compaq.com). Download and install the newer version if necessary. An ACU program icon will automatically be generated on the desktop.

2. Double-click the ACU icon.

3. Select the array in the Main ACU screen.

4. Click the Settings button in the Controller section on the right side of the Main ACU screen.

5. In the Accelerator Ratio section of the Controller Settings screen that is displayed, either click a check box by one of the choices offered or enter a percentage in one of the fields.

6. Click the Done button.

7. Choose Save Configuration from the Controller menu.

8. Choose Exit from the Controller menu.

You may also need to change the stripe size. This is described in the following section.

Optimizing the Stripe Size

Stripe size is the size of the data block written to a hard drive in each stripe of the logical drive. Table 3-1 summarizes the stripe sizes available for each of the fault tolerance methods. The default stripe size gives acceptable performance in most circumstances. When high performance is important, you can modify the stripe size according to the information in Table 3-2.

Table 3-1
Available Stripe Sizes

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

Table 3-2
Optimum Stripe Size

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

To change the stripe size, carry out the procedure described for your operating system in one of the following sections.

Windows NT and Windows 2000

1. Check that you have the latest version of the configuration utility by visiting the Compaq website (www.compaq.com). Download and install the newer version if necessary. An ACU program icon will automatically be generated on the desktop.

2. Double-click the ACU icon.

3. Select the logical drive to be reconfigured from the left-hand side of the main ACU screen.

4. Click the Migrate button in the Logical Drive section on the right-hand side of the main ACU screen.

5. Change the stripe size.

6. Click the Done button.

7. Click Save Configuration on the Controller menu.

8. Click Exit on the Controller menu.

NetWare

1. Check that you have the latest support pack or operating system patch from the Novell website installed on your system.

2. Check that you have the latest drivers for the Smart Array 5300 from the Compaq website installed on your system.

3. Open the CPQONLIN utility.

4. On the Main Configuration View screen, highlight the logical drive that is to be reconfigured.

5. Click the Drive Settings option on the Logical Drive menu.

6. Choose a stripe size.

7. Save the changes and close out of CPQONLIN.

Changing the Fault Tolerance Mode

Performance decreases in this order:

- RAID 0 (highest performance, but no protection against drive failure)

- RAID 1

- RAID 5

- RAID ADG

If performance is too low with your current fault tolerance method, it can be improved by migrating to a different RAID level. Follow the steps outlined in the section "Migrating an Existing Logical Drive to RAID ADG" earlier in this chapter, and select a different RAID level at the appropriate step in the sequence.

Regulatory Compliance Notices

Federal Communications Commission Notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that may reasonably be expected to be installed in a business or commercial environment. Class B devices are those that may reasonably be expected to be installed in a residential environment (that is, personal computers). The FCC requires devices in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

The rating label on the device shows which class (A or B) the equipment falls into. Class B devices have an FCC logo or FCC ID on the label. Class A devices do not have an FCC logo or FCC ID on the label. Once the class of the device is determined, refer to the following corresponding statement.

Class A Equipment

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at personal expense.

Class B Equipment

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

■ Reorient or relocate the receiving antenna.

■ Increase the separation between the equipment and receiver.

■ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

■ Consult the dealer or an experienced radio or television technician for help.

Declaration of Conformity for Products Marked with the FCC logo – United States Only

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For questions regarding your product, contact:

Compaq Computer Corporation
P. O. Box 692000, Mail Stop 530113
Houston, Texas 77269-2000

or call 1-800- 652-6672 (1-800-OK COMPAQ). (For continuous quality improvement, calls may be recorded or monitored.)

For questions regarding this FCC declaration, contact:

Compaq Computer Corporation
P. O. Box 692000, Mail Stop 510101
Houston, Texas 77269-2000

or call (281) 514-3333.

To identify this product, refer to the Part, Series, or Model number found on the product.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Compaq Computer Corporation may void the user's authority to operate the equipment.

Cables

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

Canadian Notice (Avis Canadien)

Class A Equipment

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Class B Equipment

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

European Union Notice

Products with the CE Marking comply with both the EMC Directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Norms (in brackets are the equivalent international standards):

■ EN55022 (CISPR 22) - Electromagnetic Interference

■ EN50082-1 (IEC801-2, IEC801-3, IEC801-4) - Electromagnetic Immunity

■ EN60950 (IEC950) - Product Safety

Japanese Notice

ご使用になっている装置にVCCIマークが付いていましたら、次の説明文を
お読み下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準
に基づくクラスB情報技術装置です。この装置は、家庭環境で使用すること
を目的としていますが、この装置がラジオやテレビジョン受信機に近接して
使用されると、受信障害を引き起こすことがあります。
取扱説明書に従って正しい取り扱いをして下さい。

VCCIマークが付いていない場合には、次の点にご注意下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に
基づくクラスA情報技術装置です　この装置を家庭環境で使用すると電波
妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ず
るよう要求されることがあります。

Taiwanese Notice

警告使用者：

這是甲類的資訊產品，在居住的環境中使用時，可能
會造成射頻干擾，在這種情況下，使用者會被要求採
取某些適當的對策。

Appendix B

Electrostatic Discharge

A discharge of static electricity from a finger or other conductor can damage printed circuit boards or other static-sensitive devices. This type of damage may reduce the life expectancy of the device.

Preventing Electrostatic Damage

To prevent electrostatic damage, observe the following precautions:

- Avoid hand contact by transporting and storing parts in static-safe containers.

- Keep electrostatic-sensitive parts in their containers until they arrive at static-free work stations.

- Place parts on a grounded surface before removing them from their container.

- Avoid touching pins, leads, or circuitry.

- Always make sure you are properly grounded when touching a static-sensitive component or assembly.

Grounding Methods

There are several methods for grounding. Use one or more of the following measures when handling or installing electrostatic-sensitive parts:

■ Use a wrist strap connected by a ground cord to a grounded workstation or the computer chassis. Wrist straps are flexible straps with a minimum of 1 megohm +/- 10 percent resistance in the ground cords.

■ Use heel straps, toe straps, or bootstraps at standing workstations. Wear the straps on both feet when standing on conductive floors or dissipating floor mats.

■ Use conductive field service tools.

■ Use a portable field service kit with a folding static-dissipating work mat.

If you do not have any of the suggested equipment for proper grounding, have an Authorized Compaq Service Provider install the part.

> **NOTE:** For additional information on static electricity or assistance with the installation of this product, contact your Authorized Compaq Service Provider or refer to the Server Maintenance and Service Guide.

Appendix **C**

Reliability Data

Figure C-1 shows the relative probability of logical drive failure for different RAID settings and different logical drive sizes, assuming no online spares are present. With RAID 0, the logical drive will fail if only one physical drive fails; with RAID 5, two physical drives must fail; and with RAID ADG, three hard drives must fail.

The situation is more complex for RAID 0+1. The *maximum* number of hard drives that can fail without failure of the logical drive is $n/2$. This will happen only if none of the failed drives are mirrored to each other. In practice, logical drive failure will usually occur before this maximum number is reached, since the probability of a newly failed drive not being mirrored to a previously failed drive becomes increasingly small as the number of failed drives increases. Also note that a RAID 0+1 logical drive may fail if only two hard drives fail, if they are mirrored to each other; the probability of this happening decreases as the number of mirrored pairs in the array increases.

An online spare can be added to any of the fault-tolerant RAID levels to further decrease the probability of logical drive failure to about a thousandth of the previous level.

For RAID 0+1 and RAID 5, Compaq recommends that no more than 14 physical drives be used per logical drive. However, logical drive failure is much less likely with RAID ADG, and Compaq supports the use of up to 56 physical drives per logical drive when running this fault-tolerance method.
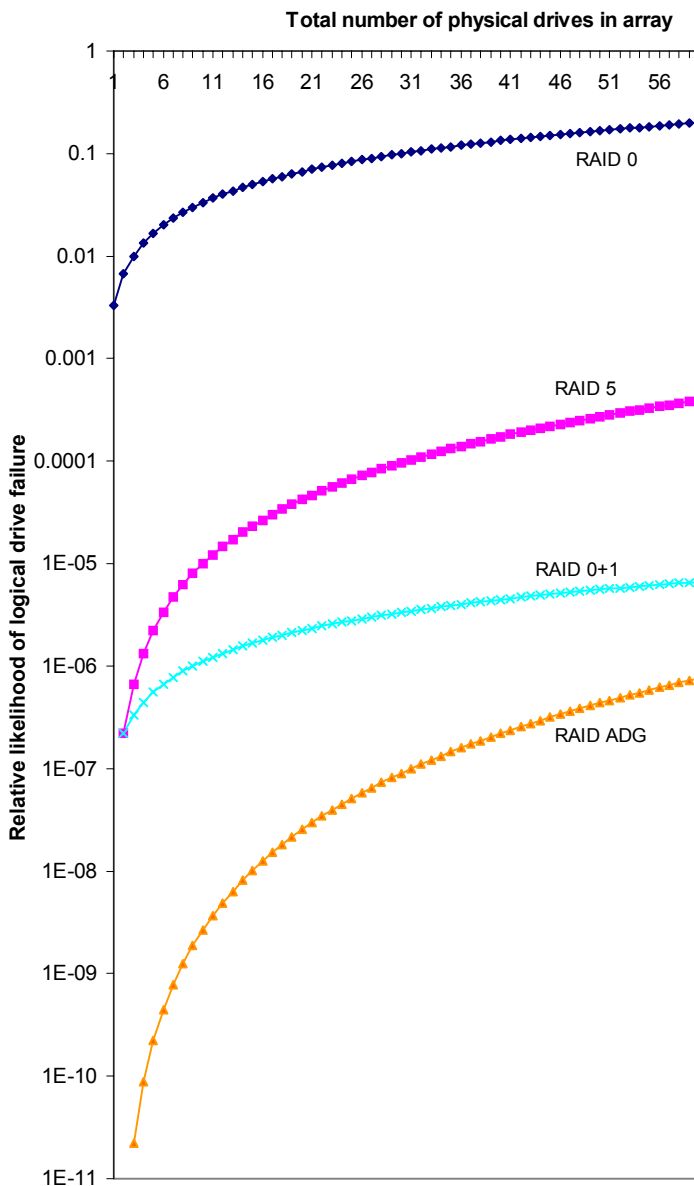
Figure C-1. Probability of logical drive failure for different RAID levels

Appendix **D**

Additional POST Error Messages

If a system fault is present when the computer is started up, Power-On Self-Test messages will display. Many of these messages are self-explanatory and suggest corrective actions. Messages unique to the use of RAID ADG are listed in the following table.

Table D-1
POST Error Messages

Number	Message	Meaning and recommended action
1754	Slot z drive array – RAID ADG drive(s) configured but ADG Enabler Module is detached or defective. Please check for detached ADG Enabler Module. Array Accelerator is temporarily disabled.	An operational ADG Enabler Module must be attached whenever RAID ADG volumes are configured or the Array Accelerator will be disabled. Replace the ADG Enabler Module.
1755	Slot z drive array – ADG Enabler Module appears to be defective. Please replace the ADG Enabler Module.	Replace the defective ADG Enabler Module, or remove it if unneeded (i.e., if no RAID ADG logical drives are configured).

Questions and Answers

Q: What is RAID ADG?

A: RAID ADG is an extension of RAID 5 that allows additional fault tolerance by using two different and independent parity schemes. Data is striped across a set of hard drives, just as with RAID 5, and the two sets of parity data are calculated and written across all the drives in the array.

RAID ADG provides an extremely high fault tolerance, and can sustain two simultaneous drive failures without downtime or data loss. This is a perfect solution when data is mission-critical.

Q: What does the abbreviation RAID ADG mean?

A: ADG is an abbreviation for Advanced Data Guarding, the term Compaq uses for this type of fault tolerance.

Q: When should RAID ADG be used?

A: There are three primary reasons for using RAID ADG.

- ❑ When a higher level of fault tolerance than RAID 5 is needed and high drive capacity utilization is also required

- ❑ When a higher level of drive capacity utilization than RAID 0+1 is required while maintaining a high level of fault tolerance

- ❑ When a large logical volume is needed, incorporating from 10 to 56 hard drives

Q: What is the difference between RAID ADG and RAID 0+1?

A: RAID ADG uses the capacity of only two hard drives for fault tolerance, regardless of the size of the RAID volume. This means a lower cost of implementation for six or more drives.

RAID ADG also provides a higher level of fault tolerance, since the mathematical probability of suffering a second drive failure in the same mirror set as an already-failed drive (in RAID 0+1) is higher than the probability of a third drive failure in RAID ADG. However, RAID 0+1 is the highest-performance RAID level.

Q: What is the difference between RAID ADG and RAID 5?

A: RAID ADG allows two drives to fail simultaneously without downtime or data loss. (Data is also preserved if one drive fails and another simply has a few bad sectors.) However, RAID 5 only allows one drive to fail. RAID ADG thus provides a much higher level of fault tolerance than RAID 5.

Due to this higher level of protection, users can set up larger RAID volumes, spanning up to 56 physical drives. With RAID 5, the maximum recommended number of drives per volume is only 14.

RAID 5 and RAID ADG have equal performance when reading data, but RAID ADG is slower when writing data due to the extra parity set that it uses. The exact difference in performance will vary from one situation to another.

Q: What products support RAID ADG?

A: RAID ADG is available with controller model SA-5304/128. It is also supplied with the 128-MB cache module available as an option for the SA-5302/32 and SA-5302/64 controllers.

Q: Does RAID ADG support online spares?

A: Yes. Customers can incorporate online spares for added data protection.

Q: How is RAID ADG activated?

A: Both a hardware key and a firmware upgrade are required. If the hardware key (RAID ADG Enabler Module) is missing or faulty, the write cache is disabled and the user cannot configure any further RAID ADG volumes.

Customers who buy SA-5304/128 controllers will be able to download the firmware upgrade to activate RAID ADG from the Compaq website at www.compaq.com/smartarray.

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