Installation and User's Guide
Serial Attached SCSI RAID Controllers

Microsemi

a **Microchip** company

Revision History

Revision	Revision Date	Details of Change
7	December 2020	Updated for 2020.2 release.
6	August 2019	Updated for 2019.2 release.
5	January 2019	Updated for 2019.1 release.
4	June 2017	Updated supported OSes; add DKMS installation instructions.
3	October 2016	Add support for 8405E and 8805E SAS RAID controllers.
2	September 2016	Update supported OSes, Installing driver on Solaris, and Technical Specification.
1	April 2016	Update supported OSes; add backup unit status, SGPIO/IPBI LED blink pattern, DKMS drivers, misc corrections.

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Limited 3-Year Hardware Warranty

1. Microsemi Corporation ("Microsemi") warrants to the purchaser of this product that it will be free from defects in material and workmanship for a period of three (3) years from the date of purchase. If the product should become defective within the warranty period, Microsemi, at its option, will repair or replace the product, or refund the purchaser's purchase price for the product, provided it is delivered at the purchaser's expense to an authorized Microsemi service facility or to Microsemi.

2. Repair or replacement parts or products will be furnished on an exchange basis and will either be new or reconditioned and will be subject to original warranty term. All replaced parts or products shall become the property of Microsemi. This warranty shall not apply if the product has been damaged by accident, misuse, abuse or as a result of unauthorized service or parts.

3. Warranty service is available to the purchaser by delivering the product during the warranty period to an authorized Microsemi service facility or to Microsemi and providing proof of purchase price and date. The purchaser shall bear all shipping, packing, and insurance costs and all other costs, excluding labor and parts, necessary to effectuate repair, replacement or refund under this warranty.

4. For more information on how to obtain warranty service, click on the Services & Support link at *microsemi.com*.

5. THIS LIMITED WARRANTY DOES NOT EXTEND TO ANY PRODUCT WHICH HAS BEEN DAMAGED AS A RESULT OF ACCIDENT, MISUSE, ABUSE, OR AS A RESULT OF UNAUTHORIZED SERVICE OR PARTS.

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7. WITHIN THE US, SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, AND SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION OR EXCLUSIONS MAY NOT APPLY TO YOU.

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9. FOR AUSTRALIA RESIDENTS, IF THE PRODUCT SHOULD BECOME DEFECTIVE WITHIN THE WARRANTY PERIOD, MICROSEMI, AT ITS OPTION, WILL REPAIR OR REPLACE THE PRODUCT, OR REFUND THE PURCHASER'S PURCHASE FOR THE PRODUCT, PROVIDED IT IS DELIVERED AT THE PURCHASER'S EXPENSE BACK TO THE PLACE OF PURCHASE AFTER MICROSEMI TECHNICAL SUPPORT HAS ISSUED AN INCIDENT NUMBER. IN ADDITION TO THE WARRANTIES SET FORTH HEREIN, OUR GOODS COME WITH GUARANTEES THAT CANNOT BE EXCLUDED UNDER THE AUSTRALIAN CONSUMER LAW. YOU ARE ENTITLED TO A REPLACEMENT OR REFUND FOR A MAJOR FAILURE AND FOR COMPENSATION FOR ANY OTHER REASONABLY FORESEEABLE LOSS OR DAMAGE. YOU ARE ALSO ENTITLED TO HAVE THE GOODS REPAIRED OR REPLACED IF THE GOODS FAIL TO BE OF ACCEPTABLE QUALITY AND THE FAILURE DOES NOT AMOUNT TO A MAJOR FAILURE.

Regulatory Compliance Statements

Federal Communications Commission Radio Frequency Interference Statement

Attention: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the 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 instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. However, if this equipment does cause interference to radio or television equipment 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 equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.
- Use a shielded and properly grounded I/O cable and power cable to ensure compliance of this unit to the specified limits of the rules.

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.

UL Compliance Statement

Microsemi Adaptec products are tested and listed by Underwriters Laboratories, Inc. to UL 60950-1 Second Edition and IEC-60950-1 Second Edition standards, file numbers E175975. Microsemi Adaptec products are for use only with UL listed ITE.

Microsemi Corporation	Use only with the listed ITE:
	ASR-8405/ASR-8405E/ASR-8805/ASR-8805E/ASR-8885/ ASR-8885Q/ASR-81605Z/ASR-81605ZQ/ AFM-700
FC Tested to Comply With FCC Standards FOR HOME OR OFFICE USE	

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European Union Compliance Statement

This Information Technology Equipment has been tested and found to comply with EMC Directive 2014/30/EU, in accordance with:

- EN55032 (2014) Emissions:
    - Class B ITE radiated and conducted emissions
- EN55024 (2010) Immunity:
    - EN61000-4-2 (2009) Electrostatic discharge: ±4 kV contact, ±8 kV air
    - EN61000-4-3 (2010) Radiated immunity: 3V/m
    - EN61000-4-4 (2012) Electrical fast transients/burst: ±1 kV AC, ±0.5 kV I/O
    - EN61000-4-5 (2014) Surges: ±1 kV differential mode, ±2 kV common mode
    - EN61000-4-6 (2014) Conducted immunity: 3 V
    - EN61000-4-11 (2004) Supply dips and variations: 30% and 100%
- EN50581 (2012) Technical Documentation:
    - For the assessment of electrical and electronic products with respect to the restriction of hazardous substances

In addition, all equipment requiring U.L. listing has been found to comply with EMC Directive 2014/35/EU, in accordance with EN60950 with amendments A1, A2, A3, A4, A11, A12.

Australian/New Zealand Compliance Statement

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to the Australian/New Zealand standard AS/NZS 3548 set out by the Spectrum Management Agency.

Canadian Compliance Statement

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.

Japanese Compliance (Voluntary Control Council Initiative)

This equipment complies to class B Information Technology equipment based on VCCI (Voluntary Control Council for Interface). This equipment is designed for home use but it may causes radio frequency interference problem if used too near to a television or radio. Please handle it correctly per this documentation.

Korean Compliance (KCC) Statement

Microsemi Adaptec products are tested and certified by KCC:

KCC-REM-KHK-ASR-6xx5
KCC-REM-KHK-ASR-7xxx5

KCC-REM-KHK-ASR-6xx5
KCC-REM-KHK-ASR-7xxx5
MSIP-REM-KHK-ASR-8xxx5

The above certification covers the following series:

ASR-8405, ASR-8405E, ASR-8805, ASR-8805E, ASR-8885
ASR-8885Q, ASR-81605Z, ASR-81605ZQ
AFM-700

B급 기기
(가정용 방송통신기자재)
Class B Equipment
(For Home Use Broadcasting & Communication Equipment)
이 기기는 가정용(B급) 전자파적합기기로서 주
로 가정에서 사용하는 것을 목적으로 하며, 모
든 지역에서 사용할 수 있습니다.

This equipment is home use (Class B) electromagnetic wave suitability equipment and to be used mainly at home and it can be used in all areas.

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1   About This Guide

This Installation and User's Guide explains how to install your Microsemi® Adaptec® RAID controller. It also describes the utilities included in your controller kit, and provides a basic overview of Serial Attached SCSI (SAS) and Redundant Array of Independent Disk (RAID) technology.

These Serial Attached SCSI RAID (ASR) controller models are described in this guide:

- ASR-8405, ASR-8405E
- ASR-8805, ASR-8805E
- ASR-8885, ASR-8885Q
- ASR-81605Z, ASR-81605ZQ

1.1   What You Need to Know Before You Begin

You should be familiar with computer hardware, data storage, RAID technology, and SAS and Serial ATA (SATA) technology. (For more information about SAS technology, see *Introduction to SAS*.)

You should also be familiar with direct-attached storage (DAS) concepts and technology.

> **Note:** Because this guide covers multiple RAID products, some of the features and functions described may not be available for your controller. For more information, see *About Your RAID Controller*.

1.2   Terminology Used in this Guide

Because you can use your   to manage data storage in a variety of configurations, the generic term "storage space" is used to refer to controller(s) and disk drives being managed with maxView Storage Manager™ (called simply maxView Storage Manager in the remainder of this guide) or the other utilities described in this guide.

Many of the terms and concepts referred to in this guide are known to computer users by multiple names. This guide uses these terms:

- Controller (also known as adapter, board, or card)
- Disk drive (also known as hard disk, hard drive, or hard disk drive)
- Solid State Drive (also known as SSD or non-rotating storage media)
- Enclosure (also known as a RAID enclosure, storage enclosure, or disk drive enclosure)
- Array (also known as a container, logical device, or logical drive)

> **Note:** maxView Storage Manager refers to arrays as logical drives. Your RAID controller creates *arrays*, which your operating system (and maxView Storage Manager) recognizes as *logical drives*. For more information, refer to the *maxView Storage Manager User's Guide*.

1.3   How to Find More Information

You can find more information about your   and utilities software by referring to these documents, available for download at *start.microsemi.com*.

- *Readme.txt*—Includes updated product information and known issues.
- *maxView Storage Manager User's Guide for Microsemi ARC-Family Controllers*—Describes how to install and use the maxView Storage Manager software (see *About maxView Storage Manager*) to manage direct attached storage on Microsemi Adaptec Series 8 controllers.

> **Note:** In the remainder of this guide, this manual is referred to simply as the *maxView Storage Manager User's Guide*.

- *maxView Storage Manager Online Help*—Describes how to use the maxView Storage Manager software; accessible from the main window of maxView Storage Manager.
- *RAID Controller Command Line Utility User's Guide*—Describes how to use the included RAID Controller Configuration (ARCCONF) command line utility (see *About the RAID Controller Configuration Utility*) to perform basic array and configuration management functions.
- *Event Monitor User's Guide*—Describes how to use the Event Monitor utility to monitor the storage controllers installed on your system

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2 Kit Contents and System Requirements

This chapter describes the contents of your   kit and the system requirements that must be met for you to successfully install and use your controller.

2.1 Kit Contents

-
- Cables (Not included in 'Single' product. If your kit includes cables, the type and quantity vary—for more information, see *Cables* on page 12.)
- (*Select models only*) Low-profile bracket

    Note: The latest firmware, controller drivers, utilities (maxView Storage Manager, ARCCONF CLI) and documentation can be downloaded at *start.microsemi.com*. See *Creating a Driver Disk* on page 27 for information about downloading drivers.

2.2 System Requirements

- PC-compatible computer with Intel Pentium, or equivalent, processor
- Motherboard with these features:
    - Support for multi-function devices where one of the devices is a PCI bridge
    - Large memory-mapped address ranges

    Refer to the Readme for additional motherboard compatibility information.

- One of these operating systems:
    - Microsoft® Windows® Server, Windows 10, Windows 8.1, Windows 7
    - Red Hat® Enterprise Linux
    - CentOS
    - SuSE Linux Enterprise Server
    - Ubuntu Linux
    - Oracle Linux
    - Citrix Xenserver
    - VMware ESXi

        Note: Refer to the Readme for up-to-date operating system version support, or check the Knowledgebase at *www.adaptec.com*. From the main menu, select **Support>Knowledgebase> Answers>Advanced Search**. Select your controller, limit the category by OS Support, then click **Search**.

- 4 GB of RAM minimum
- Available compatible PCIe slot (depending on your controller model—see the descriptions in *About Your RAID Controller*)
- 350 MB of free disk drive space
- USB flash drive or CD burner, for creating driver disks and bootable media

3 About Your RAID Controller

This chapter provides an overview of the features of your .

3.1 Standard RAID Controller Features

- Support for SAS and SATA Hard Disk Drives (HDD) and Solid State Drives (SSD)
- Flash ROM for updates to controller firmware, BIOS, and the RAID Configuration utility
- Disk drive hot-swapping
- Event logging and broadcasting, including email notification messages
- Multiple options for creating and managing RAID arrays—A browser-based software application (maxView Storage Manager), a BIOS-based utility (ARC), a command line utility (ARCCONF) (see *Managing Your Storage Space*)
- Native command queuing (NCQ), which lets disk drives arrange commands into the most efficient order for optimum performance
- Support for disk drive enclosures with SES2 enclosure management hardware
- Support for a flash backup module (see *Adding a Flash Backup Module*)
- Support for maxCache™ SSD read and write caching (see *Modifying Cache Settings* on page 58)

  Note: maxCache is supported on Series Q controllers only.

- Power-management of disk drives in your storage space to reduce cooling and electricity costs (see *Modifying Power Management Settings*)
- Audible alarm
- I/O statistics logging

3.1.1 Array-level Features

  Note: Not all features are supported by all controllers. For more information, see the *maxView Storage Manager User's Guide*.

- Support for RAID 0, RAID 1, RAID 5, RAID 10, RAID 50, and simple volumes
- Support for hybrid RAID 1 and RAID 10 arrays comprised of hard drives and Solid State Drives (SSDs)
- Support for hot spares (global and dedicated)
- Support for automatic failover, so arrays are automatically rebuilt when a failed drive is replaced (applies to redundant arrays in SES2- or SAF-TE-enabled disk drive enclosures *only*)
- Optimized disk utilization, which ensures that the full capacity of all disk drives can be used, even if the disk drives vary in size
- Online capacity expansion, so you can increase the capacity of an array without recreating it
- Support for array migration from one RAID level to another

3.1.2 Advanced Data Protection Suite

- Copyback Hot Spare—You can use this feature to move data from a hot spare back to its original location after a failed disk drive is replaced.
- Striped Mirror (RAID 1E)—A RAID 1 Enhanced array is similar to a RAID 1 array except that data is both mirrored *and* striped, and more disk drives can be included.
- Dual Drive Failure Protection (RAID 6)—A RAID 6 array is similar to a RAID 5 array except that it includes *two* independent sets of parity data instead of one.
- Dual Drive Failure Protection (RAID 60)—A RAID 60 array is similar to a RAID 50 array except that it includes *four* independent sets of parity data instead of two.

3.2 Adding a Flash Backup Module

This table shows the flash backup module (or "zero maintenance cache protection") supported by your RAID controller. To purchase a flash backup module, visit *www.adaptec.com*.

RAID Controller	Flash Module
RAID 8405/8805/8885	Flash Backup Module AFM-700 with Superca-pacitor module (optional)
RAID 8885Q	Flash Backup Module AFM-700 with Superca-pacitor module (pre-installed)
RAID 81605Z/81605ZQ	Flash Backup Module AFM-700 with Superca-pacitor module (integrated)

3.3 Upgrading the Controller Firmware

You can upgrade the firmware on your   using the Adaptec Flash Utility or from the computer's uEFI BIOS. Follow the instructions in *Using the Adaptec Flash Utility* or *Updating the Controller Firmware* on page 66. You can also upgrade the controller firmware with maxView Storage Manager and the ARCCONF command-line utility. Refer to the *maxView Storage Manager User's Guide* and the *Command Line Interface User's Guide* for more information. If the firmware upgrade is unsuccessful, follow the instructions in *Resetting the Controller*.

3.4 About the RAID 8405

The RAID 8405 is a SAS RAID controller with these features:

Form Factor	Low-profile MD2
Bus compatibility	PCIe 3.0
PCIe bus width	x8
Data transfer rate	12 Gb/s per port
Phys (Unified Serial Ports)	4
Standard cache	1024 MB DDR3
Connectors, internal	1 mini-SAS HD x4 (SFF-8643)
Maximum number of disk drives	4 direct-attached (or up to 256 with expanders)
Enclosure Support	IBPI and SGPIO (Serial General Purpose Input/Output)
Onboard speaker	Yes
Zero Maintenance Cache Protection Module	Flash Backup Module AFM-700 (optional, sold separately)

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3.5   About the RAID 8405E

The RAID 8405E is a SAS RAID controller with these features:

Form Factor	Low-profile MD2
Bus compatibility	PCIe 3.0
PCIe bus width	x8
Data transfer rate	12 Gb/s per port
Phys (Unified Serial Ports)	4
Standard cache	1024 MB DDR3
Connectors, internal	1 mini-SAS HD x4 (SFF-8643)
Maximum number of disk drives	4 direct-attached
Enclosure Support	IBPI and SGPIO (Serial General Purpose Input/Output)
Onboard speaker	Yes
Zero Maintenance Cache Protection Module	No

3.6 About the RAID 8805

The RAID 8805 is a SAS RAID controller with these features:

Form Factor	Low-profile MD2
Bus compatibility	PCIe 3.0
PCIe bus width	x8
Data transfer rate	12 Gb/s per port
Phys (Unified Serial Ports)	8
Standard cache	1024 MB DDR3
Connectors, internal	2 mini-SAS HD x4 (SFF-8643)
Maximum number of disk drives	8 direct-attached (or up to 256 with expanders)
Enclosure Support	IBPI and SGPIO (Serial General Purpose Input/Output)
Onboard speaker	Yes
Zero Maintenance Cache Protection Module	Flash Backup Module AFM-700 (optional, sold separately)

3.7 About the RAID 8805E

The RAID 8805E is a SAS RAID controller with these features:

Form Factor	Low-profile MD2
Bus compatibility	PCIe 3.0
PCIe bus width	x8
Data transfer rate	12 Gb/s per port
Phys (Unified Serial Ports)	8
Standard cache	1024 MB DDR3
Connectors, internal	2 mini-SAS HD x4 (SFF-8643)
Maximum number of disk drives	8 direct-attached
Enclosure Support	IBPI and SGPIO (Serial General Purpose Input/Output)
Onboard speaker	Yes
Zero Maintenance Cache Protection Module	No

3.8   About the RAID 8885/8885Q

The RAID 8885/8885Q is a SAS RAID controller with these features:

Form Factor	Low-profile MD2
Bus compatibility	PCIe 3.0
PCIe bus width	x8
Data transfer rate	12 Gb/s per port
Phys (Unified Serial Ports)	16
Standard cache	1024 MB DDR3
Connectors, internal	2 mini-SAS HD x4 (SFF-8643)
Connectors, external	2 mini-SAS HD x4 (SFF-8644)
Maximum number of disk drives	16 direct-attached (or up to 256 with expanders)
maxCache SSD support	**8885Q**: Up to 8 solid state drives, 2TB capacity, max. See the maxCache compatibility list at *www.adaptec.com/compatibility*.
Enclosure Support	IBPI and SGPIO (Serial General Purpose Input/Output)
Onboard speaker	Yes
Zero Maintenance Cache Protection Module	Flash Backup Module AFM-700 (8885: optional, sold separately; 8885Q: standard, pre-installed)

3.9   About the RAID 81605Z/81605ZQ

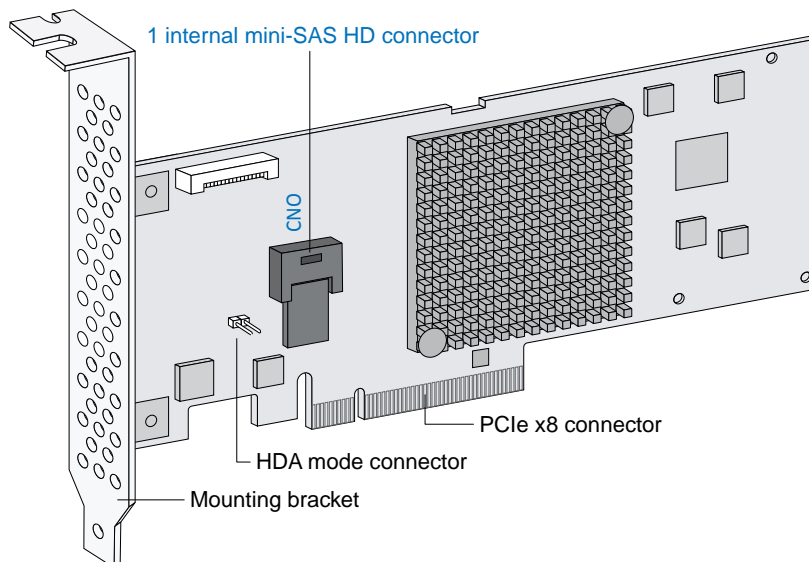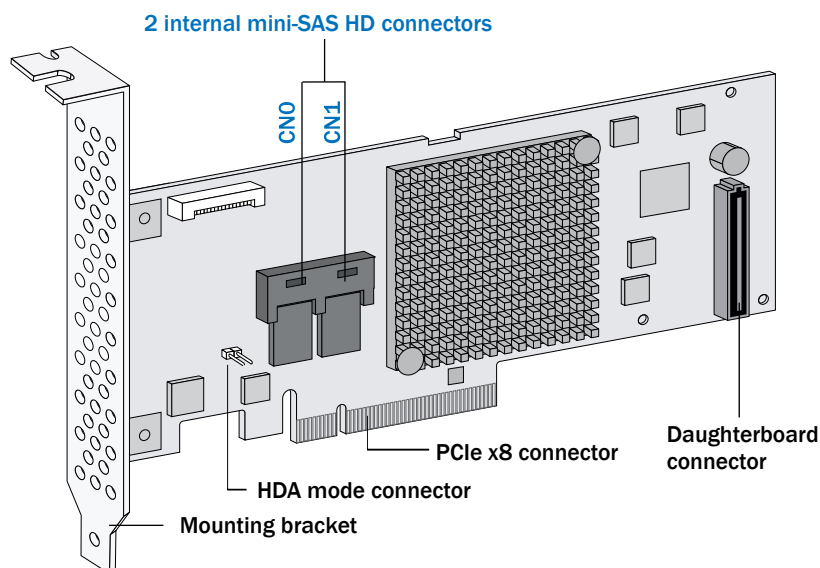The RAID 81605Z/81605ZQ is a SAS RAID controller with these features:

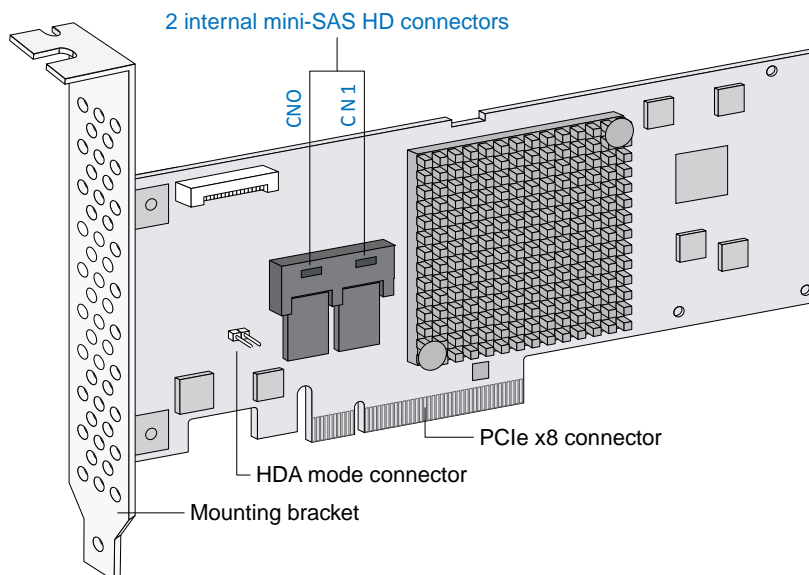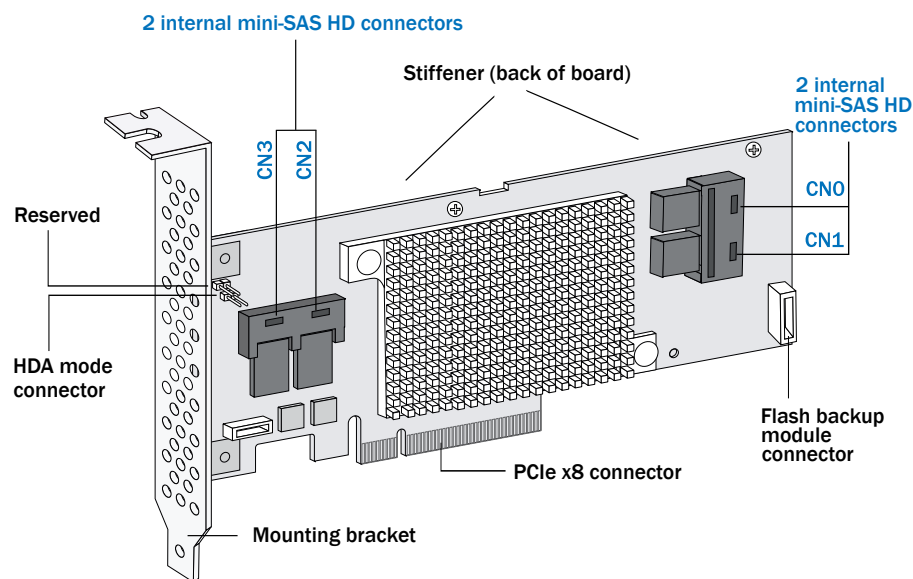| Form Factor	Low-profile MD2
Bus compatibility	PCIe 3.0
PCIe bus width	x8
Data transfer rate	12 Gb/s per port
Phys (Unified Serial Ports)	16
Standard cache	1024 MB DDR3
Connectors, internal	4 mini-SAS HD x4 (SFF-8643)
Maximum number of disk drives	16 direct-attached (or up to 256 with expanders)
maxCache SSD support	**81605ZQ:** Up to 8 solid state drives, 2TB capacity, max. See the maxCache compatibility list at *www.adaptec.com/compatibility*.
Enclosure Support	IBPI and SGPIO (Serial General Purpose Input/Output)
Onboard speaker	Yes
Zero Maintenance Cache Protection Module	Integrated Flash Backup Module AFM-700

4 Getting Started

This chapter provides the basic information you need to set up your disk drives and arrays the way you want them. It describes the options you have for installing your RAID controller and disk drives and creating arrays for storage. It also describes how to prepare your controller for installation into a low-profile computer cabinet.

4.1 Choosing a RAID Level

This section provides a brief overview of the RAID levels supported by your RAID controller, including the minimum and maximum number of disk drives required by each.

> **Note:** Before you begin, familiarize yourself with your controller's physical features and the RAID levels that it supports (see *Standard RAID Controller Features* on page 4).

- RAID 0 (Non-redundant Array)—Stripes data across multiple disk drives. Improved performance but no redundancy (see *Non-redundant Arrays (RAID 0)*).
- RAID 1 Array—Created from two disk drives where one disk drive is a *mirror* of the other (the same data is stored on each disk drive). Redundancy, but reduced capacity (see *RAID 1 Arrays*).
- RAID 1E Array—Similar to a RAID 1 array except that data is mirrored *and* striped, and more disk drives can be included (see *RAID 1 Enhanced Arrays*).
- RAID 5 Array—Stripes data for improved performance and uses *parity* data to provide redundancy (see *RAID 5 Arrays*).
- RAID 10 Array—Built from two or more equal-sized RAID 1 arrays, stripes and mirrors data across multiple disk drives. Redundancy and improved performance (see *RAID 10 Arrays*).
- RAID 50 Array—Built from multiple disk drives configured as two or more RAID 5 arrays, stripes stored data and parity data across all disk drives (see *RAID 50 Arrays*).
- RAID 6 Array—Similar to a RAID 5 array except that it includes *two* independent sets of parity data instead of one (see *RAID 6 Arrays*).
- RAID 60 Array—Similar to a RAID 50 array except that it includes *four* independent sets of parity data instead of two (see *RAID 60 Arrays*).

See *Comparing RAID Levels* to see how many disk drives you must connect to your RAID controller to support the RAID level you want.

4.2 Selecting Disk Drives and Cables

4.2.1 Disk Drives
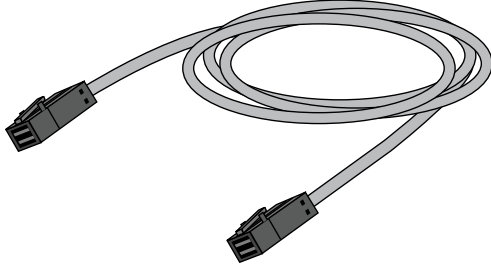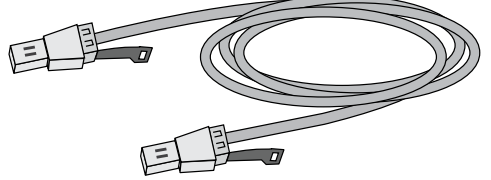
Your RAID controller supports SAS disk drives, SATA disk drives, and SATA and SAS Solid State Drives (SSDs). When selecting disk drives for your RAID array, ensure that all the disk drives have the same performance level. You can use different-sized disk drives in the array, but the array will be limited to the capacity of the smallest and slowest disk drive. For more information about arrays, refer to the *maxView Storage Manager User's Guide* or online Help. For more information about compatible disk drives, refer to *www.adaptec.com/compatibility*.

4.2.2 Cables

Depending on your requirements, you can use any of the cables listed below. Cable connectors are keyed so that you can't insert them incorrectly. For more information about cabling options for your , visit *www.adaptec.com*.

> **Note:** We recommend using only SAS cables.

SAS HD Cables (Series 8 controllers)

	Internal SAS HD to SAS HD (SFF-8643 to SFF- 8643)—Connects to a backplane or enclosure.
	External SAS HD to SAS HD (SFF-8644 to SFF- 8644)—Connects to a backplane or enclosure.

4.3 Replacing the Full-Height Bracket with a Low-Profile Bracket

If you are installing your   into a low-profile computer cabinet, replace the original full-height bracket with the low-profile bracket included in your distribution kit. The full-height bracket is mounted on the front of the controller, the low-profile bracket is mounted on the back of the controller, as shown in the figure below.
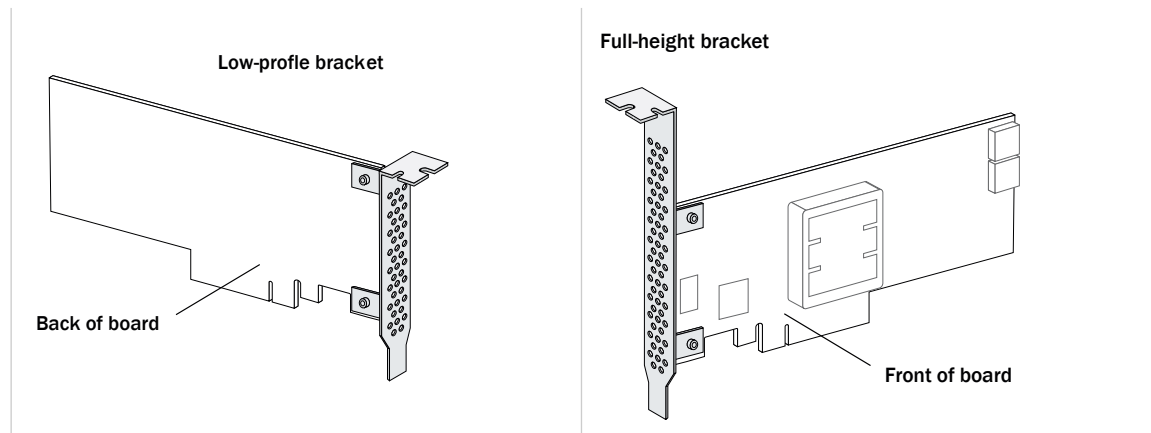
To replace the full-height bracket with the low-profile bracket:

1. Remove the full-height bracket from the controller board. The full-height bracket is installed on the front side of the controller, with the mounting screws inserted from the back of the controller, as shown in the Figure 1.
   Using a Phillips head screw driver, remove the mounting screws, as shown in Figure 2, then set the screws aside for use in the next step.
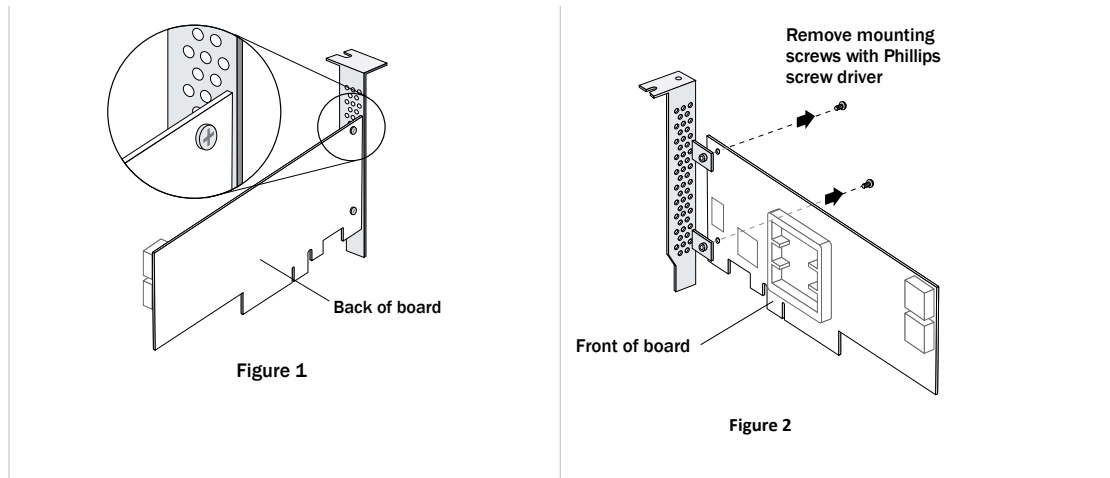
Figure 1

Figure 2

2. Attach the low-profile bracket to the controller board. The low-profile bracket is installed on the *back* side of the controller, with the mounting screws inserted from the front of the controller, as shown the Figure 3.

Insert the screws through the holes on the front of the controller, then fasten the screws to the bracket with a Phillips screw driver.

> **Caution:** The mount points on the low-profile bracket have a smooth or flat side and a raised side that looks like a spacer (see Figure 3). Be sure to install the bracket with the flat side against the controller PCB and the raised side facing away from the PCB.

Figure 3
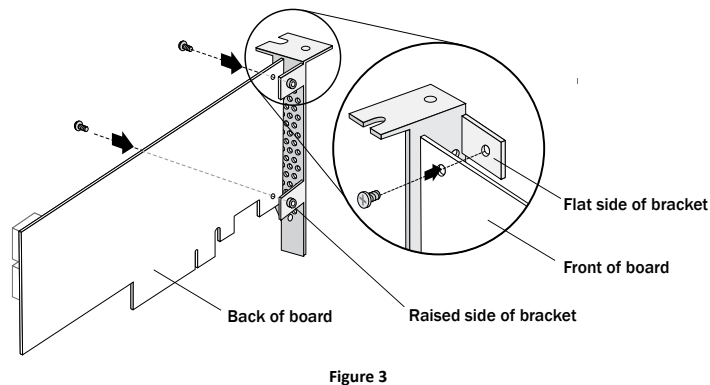
> **Caution:** The torque on the mounting screws should be a maximum of 3.0-4.0 lbf-in to avoid deformation. Be sure that the controller is not bent after attaching the low-profile bracket to the controller board.

4.4   Installation Options

When you install your RAID controller, you can choose to create a bootable array and then install your operating system and the controller driver on that array.

Alternatively, you can complete a standard installation, where the controller driver is installed on an existing operating system.

4.5   Basic Installation Steps

This section describes the installation process. Follow the steps for the installation option you've chosen.

4.5.1 Installing with an Operating System

1. Install and connect your controller and internal disk drives (see *Installing the Controller and Disk Drives*). If your controller has an external connector, you can connect external disk drives as well (or instead).

2. Set the boot controller (see *Setting the Boot Controller*).

3. Create a bootable array (see *Creating an Array*).

4. Install your operating system and the controller driver (see *Installing the Driver and an Operating System*.)

5. Install maxView Storage Manager and begin to manage your data storage (see *Managing Your Storage Space*).

4.5.2 Installing on an Existing Operating System

1. Install and connect your controller and internal disk drives (see *Installing the Controller and Disk Drives*).

   If your controller has an external connector, you can connect external disk drives as well (or instead).

2. Install the controller driver (see *Installing the Driver on an Existing Operating System*).

3. Install maxView Storage Manager and begin to manage your data storage (see *Managing Your Storage Space*).

5   Installing the Controller and Disk Drives

This chapter explains how to install your , and how to install and connect internal and external disk drives.

5.1   Before You Begin

- Read *Safety Information*.
- Familiarize yourself with your 's physical features and the RAID levels that it supports (see *Standard RAID Controller Features*).
- Ensure you have the right number of disk drives for the RAID level you want to use for your arrays (see *Selecting Disk Drives and Cables*).
- If you are installing the into a low-profile computer cabinet, replace the original full-height bracket with the low-profile bracket included in the kit (see *Replacing the Full-Height Bracket with a Low-Profile Bracket*).

5.2   Installing the Controller

This section describes how to install the RAID controller into your computer cabinet. RAID controllers come in two basic configurations: standard and zero maintenance cache protection with batteryless backup (ZMCP). ZMCP uses flash memory and a supercapacitor module to protect the cache without a battery.

Follow one of these sets of instructions:

- To install a RAID controller *without* zero maintenance cache protection, see the next section.
- To install a RAID controller *with* zero maintenance cache protection, see *Installing a RAID Controller with Zero Maintenance Cache Protection*.

    Caution: Be sure to handle the controller by its bracket or edges only.

5.2.1   Installing a RAID Controller without Zero Maintenance Cache Protection

To install a RAID controller without zero maintenance cache protection:

1. Turn off your computer and disconnect the power cord. Open the cabinet, following the manufacturer's instructions.

2. Select an available PCIe expansion slot that's compatible with your and remove the slot cover, as shown below. (PCIe bus compatibility is marked to the controller figures in *About Your RAID Controller*.)
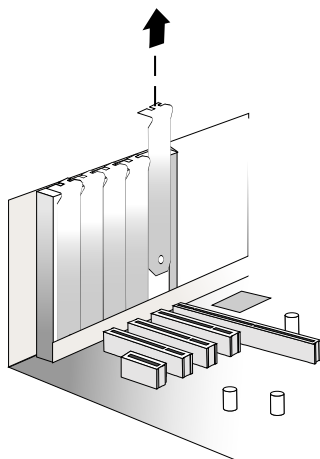
3. Insert the into the expansion slot and press down gently but firmly until it clicks into place. When installed properly, the should appear level with the expansion slot.

    Caution: Touch a grounded metal object before handling the .

4. Secure the bracket in the expansion slot, using the retention device (for instance, a screw or lever) supplied with your computer.

5. Prepare and install your internal disk drives, following the instructions in *Connecting Disk Drives to Your Controllers*.

    If you are not installing internal disk drives, close your computer cabinet, reattach the power cord, then continue with *Connecting External Devices*.

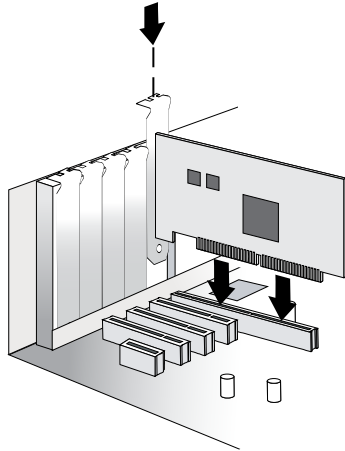## 5.2.2   Installing a RAID Controller with Zero Maintenance Cache Protection

RAID controllers with zero maintenance cache protection include a flash module daughterboard and a supercapacitor module. On Series Q controllers, the daughterboard is pre-installed. On RAID controllers with *optional* zero maintenance cache protection (see *Adding a Flash Backup Module*), the daughterboard is user installed. The supercapacitor module is always user installed.

The following instructions describe how to install the RAID controller and supercapacitor module on a Series 8/8ZQ controller using the *mounting plate* method. It assumes that the daughterboard is already installed.

> **Warning:** Do NOT remove or insert a fully charged supercapacitor module. Always discharge the unit first to avoid damage to the controller or flash backup module. The factory ships with discharged units, so they are safe to install when you receive them. To ensure that an installed unit is discharged, switch your system OFF, then wait 5 minutes. After a dirty shutdown, wait 3 minutes after backup is complete, then remove the unit.

To install a RAID controller with zero maintenance cache protection:

1. Assemble the mounting plate and attach the supercapacitor module:

    a. Attach the full-height bracket and mounting clip to the mounting plate. The full-height bracket is installed on the front side of the mounting plate (the side with the bents), with the mounting screws inserted from the back, as shown in the figure below. (Be sure to attach the mounting plate to the bracket with recessed side at the bottom!) Attach the mounting clip to the front of the mounting plate with four (4) Phillips screws. The large friction clip should face the front of the mounting plate.

Large friction clip

Recessed side
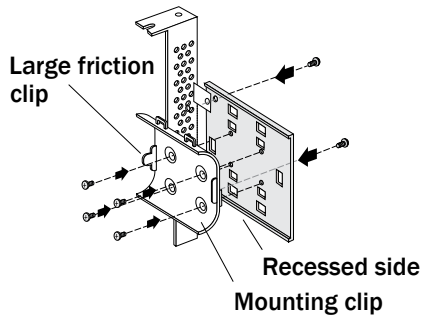
Mounting clip

b. Insert the supercapacitor module into the mounting clip. The supercapacitor module snaps securely into place between the large and small friction clips, as shown in the figure below. Be sure to orient the supercapacitor module such that the connecting cable faces the rear of the mounting plate.
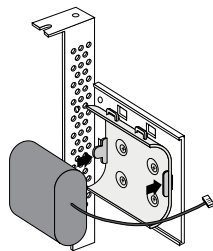
c. Set the mounting plate aside; continue with the steps below.

2. Turn off your computer and disconnect the power cord. Open the cabinet, following the manufacturer's instructions.

3. Select an available PCIe expansion slot that's compatible with your RAID controller and remove the slot cover, as shown in the figure below. (PCIe bus compatibility is marked on the controller figures in *About Your RAID Controller*.) Be sure to choose a slot in the backplane with an *empty* slot next to it; you will use the empty slot to install the supercapacitor mounting plate, after you install the controller. Remove the slot cover for the mounting plate, then continue with the next step.
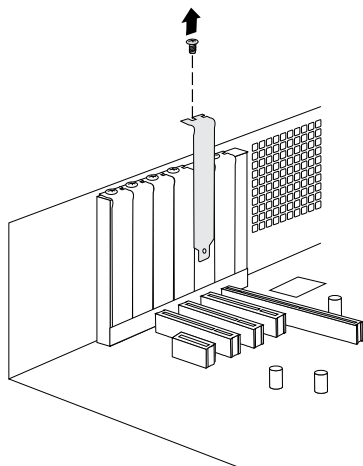
4. Insert the RAID controller into the expansion slot and press down gently but firmly until it clicks into place. When installed properly, the RAID controller should appear level with the expansion slot. Secure

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the bracket in the expansion slot, using the retention device (for instance, a screw or lever) supplied with your computer.

> **Caution:** Touch a grounded metal object before handling the RAID controller.

5. Attach the supercapacitor module to the RAID controller by inserting the connector into the socket on the flash module daughterboard, as shown in the figure below. (The connector attaches to the socket in only one direction.) Use the included extender cable if you need extra length to reach the connector on the daughterboard.

Extender cable
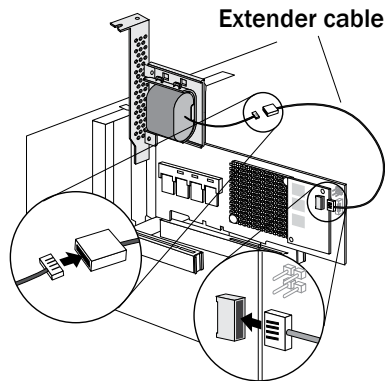
6. Install the mounting plate in the empty slot next to the controller, as shown in the next figure. After securing the mounting plate to the card cage, verify that the supercapacitor module and mounting plate sit above (and do not touch) the PCIe slot.

Gap
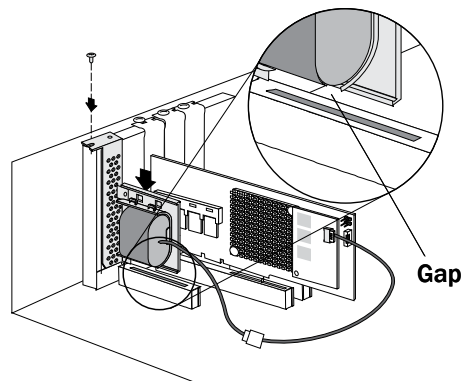
7. Prepare and install your internal disk drives, following the instructions in *Connecting Disk Drives to Your Controllers*.

   If you are not installing internal disk drives, close your computer cabinet, reattach the power cord, then continue with *Connecting External Devices*.

8. Restart your computer.
   The supercapacitor starts charging automatically. It should reach full charge in 5-6 minutes.

5.3   Connecting Disk Drives to Your Controllers

You can connect SAS disk drives, SATA disk drives, and SATA and SAS Solid State Drives (SSDs) to your . (See *www.adaptec.com/compatibility* for a list of compatible drives.) There are no jumpers or switches to set before installation.

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If you plan to build a bootable array, ensure that you install at least the minimum number disk drives required to support the RAID level you want. See *Choosing a RAID Level* for more information.

> **Note:** Although you can connect both SAS and SATA disk drives to your SAS controller, we recommend that you do *not* combine SAS and SATA disk drives within the same array. See *What is SAS?* for more information.

You have two connection options:

- To connect directly to the controller, see the following section.
- To connect to a backplane, see *Connecting Drives to a System Backplane*.

To connect Solid State Drives to your controller, see *Connecting Solid State Drives (SSDs)*.

5.3.1   Connecting Drives Directly to the Controller

In a direct-attach connection, SAS or SATA disk drives are connected directly to a SAS card with SAS cables. The number of direct-attached disk drives is limited to four per internal SAS connector. (For more information about direct-attach connections, see *How are Disk Drives Identified in SAS?*.)

1. Install your internal SAS or SATA disk drives, following the instructions in your system's documentation.

2. Use internal SAS, mini-SAS, or mini-SAS HD cables to attach the disk drives to the controller, as required.

3. When all internal disk drives have been installed and attached to the controller, close your computer cabinet, reattach the power cord, then continue with *Connecting External Devices*.

5.3.2   Connecting Drives to a System Backplane

In a backplane connection, disk drives and SAS cards are attached to and communicate with each other through a system backplane.

The number of disk drives is limited to the number of slots available on the backplane. Some backplanes have embedded SAS expanders and can support up to 128 end devices. (For more information about backplane and expander connections, see *How are Disk Drives Identified in SAS?*.)

1. Connect one or more internal SAS or SATA disk drives to the backplane. (Refer to your system's documentation for more information.)

2. Use an internal mini-SAS or mini-SAS HD cable to connect the controller to the backplane, as required.

3. When all internal disk drives have been installed and connected, close your computer cabinet, reattach the power cord, then continue with *Connecting External Devices*.

5.3.3   Connecting Solid State Drives (SSDs)

To connect a Solid State Drive to your controller, you can use a direct-attached connection or a backplane connection, as required. If your server does not have a standard 2.5-inch drive tray, you must use a bracket/SLED which enables the SSD to fit properly.

> **Note:** For maxCache applications or hybrid RAID arrays (comprised of hard drives and SSDs) you can use any Solid State Drive on the compatibility list. See *www.adaptec.com/compatibility* for a list of compatible SSDs. maxCache is supported on Series Q controllers only.

In a direct-attach connection (described in the steps below), you connect SSDs directly to the controller with SAS cables (mini-SAS to SATA). In a backplane connection, use the appropriate cable for your backplane type (see *Connecting Drives to a System Backplane* for more about backplane connections). For maxCache caching applications, you can connect a maximum of 8 maxCache-compatible SSDs to a controller. For RAID arrays, controllers support a maximum of 256 drives, including SSDs (for details, see *About Your RAID Controller*).

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1. Install the SSDs in your server. For servers with a standard 2.5-inch drive tray, install the SSD directly into the tray. If your server does not have a standard 2.5-inch drive tray, use a bracket or adapter which enables it to fit properly.

Use a 2.5" to 3.5" adapter to install your SSD if server does not have 2.5" tray.

Typical SSD installation

2. Use an internal mini-SAS or mini-SAS HD to SATA cable, as required, to attach the SSD(s) to the controller, as shown in the example below.

To other SSDs

Internal x4 mini-SAS HD connector

Single-port connector

SSD connected to controller with internal mini-SAS HD to SATA Fanout cable
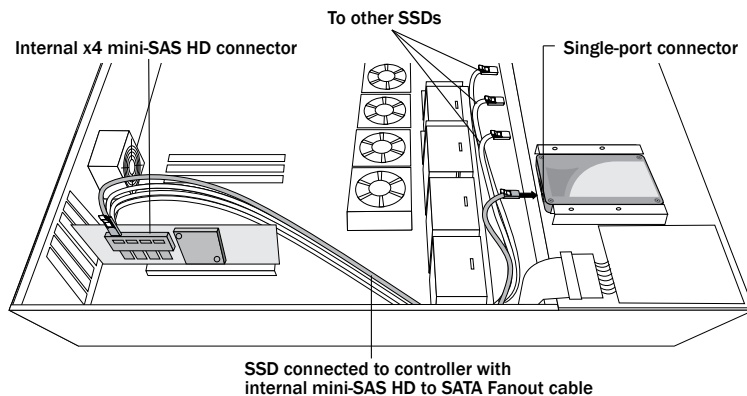
3. When all SSDs have been installed and connected, close your computer cabinet, reattach the power cord, then continue with *Connecting External Devices*.
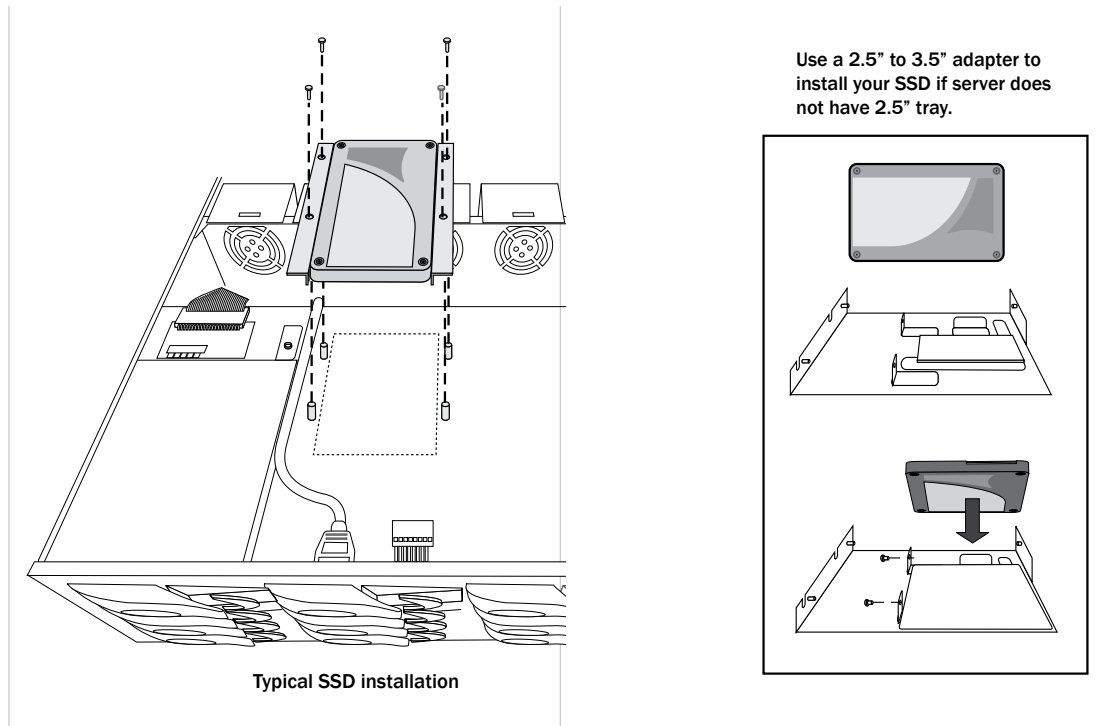
5.4   Connecting External Devices

Note: If you are not connecting any external devices, see the following section, *Next Steps*.

Use high-quality cables to connect your controller to your external device(s), such as disk drives or disk drive enclosures.

We recommend using only cables. For more information about cabling options for your controller, see *Cables* on page 12.

5.5 Next Steps

If you are installing the controller driver and an operating system onto a bootable array, continue with Creating a Bootable Array.

If you are completing a standard installation onto an existing operating system, continue with *Installing the Driver on an Existing Operating System*.

6   Creating a Bootable Array

This chapter explains how to set your controller to be the boot controller, and how to create a bootable array.

> **Note:** If you are completing a standard installation onto an existing operating system, you don't have to complete this task. Skip to *Installing the Driver on an Existing Operating System*.

6.1   Setting the Boot Controller

> **Note:** If your system won't contain more than one bootable controller, skip to the next section, *Creating an Array*.

Your RAID controller supports bootable disk drives and bootable arrays. To enable your system to boot from either a disk drive or an array connected to your controller:

1. Enter the system setup.

2. Navigate to the drive boot sequence.

3. Move the boot controller to the top of the list.

For more information, refer to your computer documentation.

6.2   Creating an Array

This section explains how to create an array.

A RAID 5 array is created in the examples shown in this section because RAID 5 provides the most security and best performance with a minimum of three disk drives. However, you can choose to create an array with a different RAID level; you can also change array level later, after the operating system is installed.

You can create an array using any of these tools:

- RAID Configuration Utility (ARC)—BIOS-based menus and keyboard navigation (see the following section).
- maxView Storage Manager—Graphical software application (running from a bootable USB image) that you can navigate with your mouse (see *About maxView Storage Manager*).
- ARCCONF—Command line utility. For instructions, refer to the *RAID Controller Command Line Utility User's Guide.*

You can use any of these tools, but the ARC utility is the quickest and easiest tool for this task.

> **Note:** We recommend that you do *not* combine SAS and SATA disk drives within the same array. maxView Storage Manager displays a warning if you try to create a logical drive using a combination of SAS and SATA disk drives. See *What is SAS?* for more information.

6.2.1   Creating an Array with the ARC Utility

The ARC utility is menu-based. Instructions for completing tasks appear on-screen. Menus can be navigated using the arrows, Enter, Esc, and other keys on your keyboard.

To create a RAID 5 array:

1. Power on your computer. When prompted, press `Ctrl+A` to enter the ARC utility.

> **Note:** On computers that support the Unified Extensible Firmware Interface, or uEFI, ARC utility options are presented with a uEFI/HII interface rather than the Ctrl-A

interface described below. To begin using the ARC utility with the uEFI/HII interface, see *Ctrl-A or uEFI/HII?* on page 56.

2. If you have more than one controller of the same model or family in your computer, select your controller, then press `Enter`.

3. Select **Logical Device Configuration**, then press `Enter`.

4. Select **Initialize Drives**, then press `Enter`.

5. Select at least three disk drives for the array, press `Insert` for each selected disk drive, then press `Enter`.

    > **Caution:** During initialization, all data is deleted from the disk. Before continuing, back up any data you want to keep.

6. Press `Y`, then press `Enter`.
    The selected disk drives are initialized, then the Logical Device Configuration screen appears.

7. Select **Create Array**, then press `Enter`.

8. Select the disk drives that were just initialized, press `Insert` for each selected disk drive, then press `Enter`.

9. When the Array Properties screen opens, follow the instructions in the following table.

Property Line	Entry or Selection
Array Type	Select **RAID 5**, then press `Enter`.
Array Label	Type a name, then press `Enter`.
Array Size	Press `Enter`, then press `Enter` again to use the default granularity of GB.
Stripe Size	Press `Enter` to use the default (256 KB). > **Note:** This property applies only to striped arrays (RAID 0, 1E, 10, 5, 50, 5EE, 6, and 60).
Read Caching	Press `Enter` to use the default (Enable).
Write Caching	Press `Enter` to use the default (Enable always), then press `Y` to confirm.
Create RAID via	Press `Enter` to use the default (Build/Verify).
MaxCache Read	Press `Enter` to use the default (Enable)
MaxCache Write	Press `Enter` to use the default (Disable)
[Done]	Press `Enter`.

10. When a cache warning message displays, type `Y`.

11. Once the array is created, a message displays telling you that the array can now be used. Press any key to return to the Logical Device Configuration menu.
    You can start using the array immediately. However, performance is reduced until the build process is complete.

12. Press `Esc` until the Exit utility window appears.

13. Select `Yes`, then press `Enter`.

    The computer restarts.

14. Continue with *Making Your Array Bootable*.

6.2.2 Creating an Array with maxView Storage Manager

This section describes how to use the maxView Storage Manager configuration wizard to build an array.

> **Note:** Before you begin, download the maxView Storage Manager bootable USB image at *start.microsemi.com*, then copy the bootable image to a USB flash drive. For details, refer to the *maxView Storage Manager User's Guide*.

To create a RAID 5 array:

1. Insert the bootable USB drive on the machine you want to configure.
The Boot menu opens in a shell window.

2. Select **Launch maxView** from the menu.
After a minute or so, the maxView Storage Manager login screen opens in a browser window.

3. Enter `root/root` for the login credentials.

4. On the ribbon, in the Logical Disk group, click **Create Logical Drive**.

5. When the wizard opens, ensure that **Express Configuration** is selected, then click **Next**.
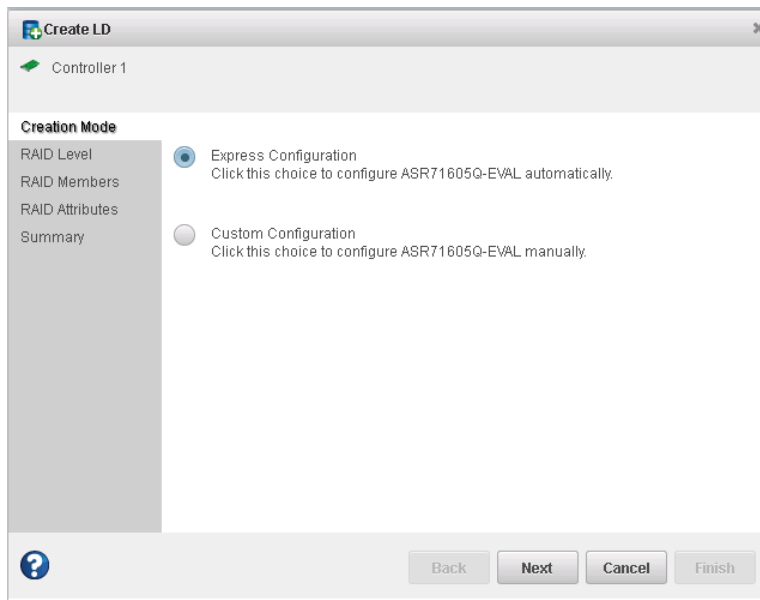
6. Review the logical drive configuration summary.

> **Note:** maxView Storage Manager uses the term *logical drive* when referring to an *array* (see *Terminology Used in this Guide*).

The following example shows a RAID 5 array, ready to be created.

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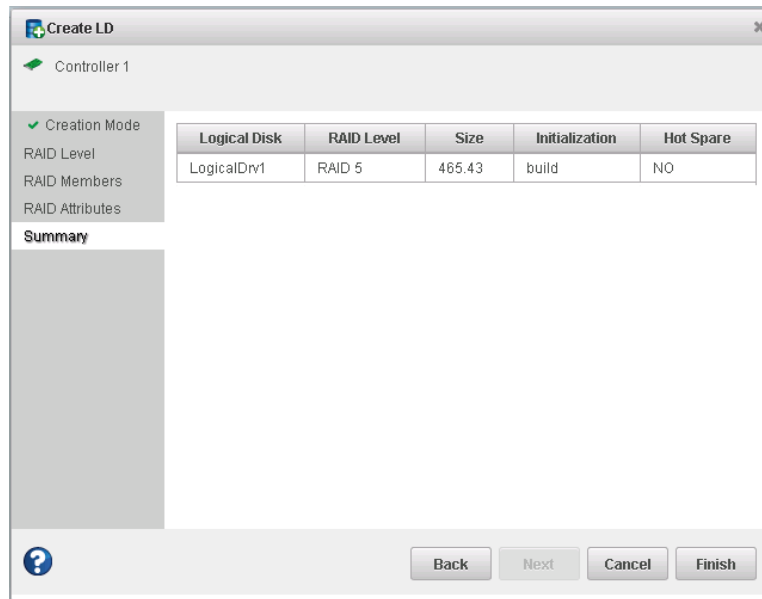
7. Click **Finish**.

    maxView Storage Manager builds the logical drives.

8. Partition and format the logical drive(s).

    The logical drives you created appear as a physical disk drives on your operating system. You *must* partition and format these logical drives before you can use them to store data.

9. Close all windows, remove the bootable USB drive, then restart your system.

    For information about installing and using maxView Storage Manager as a full software application, see the *maxView Storage Manager User's Guide*.

10. Continue with the following section.

6.3   Making Your Array Bootable

Use the ARC Utility to make the array bootable (see *Creating Bootable Arrays*).

Then continue with *Installing the Driver and an Operating System*.

7   Installing the Driver and an Operating System

This chapter explains how to install your   driver and an operating system on a bootable array (see *Creating a Bootable Array*).

> **Note:**
>
> 1. To install the driver on an existing operating system, see *Installing the Driver on an Existing Operating System*.
>
> 2. To install the Linux drivers from source with Dynamic Kernel Module Support (for persistence across across kernel updates), download the Linux Driver Source Code package from the support page for your product at *start.microsemi.com*, then follow the instructions in the embedded Readme.

7.1   Before You Begin

- Install and connect your RAID controller and internal disk drives (see *Installing the Controller and Disk Drives*).
- Create a bootable array (see *Creating a Bootable Array*).
- Download drivers from the web
- Create a driver disk (see the following section)

7.2   Creating a Driver Disk

Download the latest drivers from the Web, then create a driver disk by completing the steps below. You will need a USB flash drive to complete this task. If the driver binary is an iso image, use a writable CD instead of a flash drive.

To download drivers and create a driver disk:

1. Open a browser window, then type `start.microsemi.com` in the address bar.

2. Select your RAID controller family and controller model.

3. Select your operating system version, then select the appropriate driver from the list.

   > **Note:** For Linux OSs, the list of drivers typically includes a rpm file and an Images file. Select the Images file only if you are installing the driver on an existing operating system (for more information, see *Installing the Driver on an Existing Operating System*).

4. Click **Download Now** and accept the license agreement.

5. When the download completes, extract the contents of the driver archive file to a temporary location. If the archive includes drivers for multiple operating system versions (Windows, for instance), each driver is stored in a separate folder.

6. Change to the folder for your operating system version, as needed.

7. Copy the driver binary file or the entire driver folder contents to a USB flash drive. For Debian, Ubuntu, and Fedora Linux, be sure to extract the contents of the .tgz files first.

   If the driver binary is an iso image, see Step *[8]* .

8. If the driver binary is an iso image–for instance, for Citrix XenServer–burn the iso to a writeable CD. Use whatever tool you prefer to burn the CD, such as an interactive, GUI-based, tool or the Linux command line.

   > **Note:** For VMware ESXi 5.5 and VMware ESXi 6.0, see *Installing with VMware ESXi* .

9. Remove and label the driver disk.

10. Continue the installation with the instructions for your operating system.

7.3 Installing with Windows

> **Note:** The following instructions apply to all supported Windows operating systems. You need the Windows installation DVD (or equivalent virtual media/iso image) to complete this task.

To install the driver while installing Windows:

1. Insert your Windows DVD, then restart the computer.

2. Follow the on-screen instructions to begin the Windows installation.

3. When prompted to specify a location for Windows, select **Load Driver**.

4. Insert the USB driver disk, browse to the driver location, then click **OK**.

5. When the driver is found, press **Next**.

> **Note:** You may see the message 'No drives were found'. Repeat *[3]* , *[4]* (browse to driver location), and *[5]* . On the second attempt, the driver will load successfully.

6. Click **Next** again to accept the default partition configuration, or refer to your Windows documentation to configure partitions manually.

7. Follow the on-screen instructions to complete the installation.

8. Continue with *Managing Your Storage Space*.

7.4 Installing with Red Hat Linux or CentOS

> **Note:** You will need the Installation DVD (or equivalent virtual media/iso image) for your operating system to complete this task. You must have root privilege to install the driver image.

To install the driver while installing Red Hat Linux or CentOS:

1. Insert your installation DVD.

2. Restart your computer.

3. When the first installation screen appears, insert the USB driver disk.

4. Type this command at the Boot: prompt, then press `Enter`:

   `linux dd`

5. Select **Yes** to indicate that you have a driver disk, browse the USB drive (typically, `/dev/sda1`), then select the driver image.

6. Verify that the driver is loaded, then complete the installation following the on-screen instructions.

7. Continue with *Managing Your Storage Space*.

7.5 Installing with SuSE Linux Enterprise Server

> **Note:** You need the SuSE installation DVD (or equivalent virtual media/iso image) to complete this task.

To install the driver while installing SuSE Linux:

1. Insert the SuSE Installation DVD.

2. Restart your system.

3. When the installation selection screen appears, choose the type of installation you want, press `F5` (SuSE 10) or `F6` (SuSE 11), then select **Yes** to indicate that you have a driver disk.

4. Insert the USB driver disk.

5. (*SuSE 11 SP3 only*) Add 'brokenmodules=aacraid dud=1' to the Boot menu. This step ensures that the installer loads from the driver disk, not the in-box driver.

6. When prompted to "Please choose the Driver Update medium", highlight the USB partition, then select **OK**.

    Note: If the "choose Driver Update medium" screen is displayed again, assume that the driver was accepted; select **Back**, then press `Enter`.

7. (*SuSE 11 SP3 only*) On the "Welcome screen", switch to the console by typing `CTRL+ALT+F2`, then type this command:

    `insmod ./update/000/modules/aacraid.ko`

    Press `CTRL+ALT+F7` to return to the Welcome screen.

8. Complete the installation, following the on-screen instructions.

9. Continue with *Managing Your Storage Space*.

7.6   Installing with Ubuntu Linux

Note:

For Ubuntu 20.x and above, install using the inbox driver, then see *Installing the DKMS Deb Package on Ubuntu Systems* on page 36.

Note: You need the Ubuntu installation DVD (or equivalent virtual media/iso image) to complete this task. You must have root privilege to install the driver image.

To install the driver while installing Ubuntu Linux:

1. Insert the Ubuntu Installation DVD, then restart your computer.

2. When the installation menu appears, select **Install Ubuntu Server**. Continue the installation until the "Configure Network" screen appears, then type `CTRL+ALT+F2` to switch to the console.

3. Insert the USB driver disk, then type the following command to scan for the device:

    ```
    fdisk -l
    ```

4. Assuming the USB drive is assigned to `/dev/sda1`, type the following commands to begin loading the driver:

    `mkdir mnt2 /AACRAID`
    `mount /dev/sda1 /mnt2`
    `cp -R /mnt2/* /AACRAID`
    `umount /mnt2`

    Note: The following steps assume you are installing Ubuntu 12 or higher.

5. Copy the driver file to the /lib/modules directory:

    `rmmod aacraid`
    `cp -f /AACRAID/aacraid.ko`
    `/lib/modules/3.16.0-23-generic/kernel/drivers/scsi/aacraid/aacraid.ko`

6. Remove the USB drive.

7. Install the loadable module:

```
insmod /lib/modules/3.16.0-23-generic/kernel/drivers/scsi/aacraid/aacraid.ko
```

8. Press `CTRL+ALT+F1` to switch back to the installation screen, then follow the on-screen prompts to continue the installation.

   Note: Do not press Continue at the end of the installation until you complete Step *[9]*!

9. When prompted to reboot the system, press `CTRL+ALT+F2` to switch to the console.

10. Type the following commands to complete the driver installation:

```
cp -f /AACRAID/aacraid.ko
/target/lib/modules/3.16.0-23-generic/kernel/drivers/scsi/aacraid/aacraid.ko
chroot /target
/sbin/depmod -a 2.6.32-28-server
update-initramfs -u -v
exit
```

11. Press `CTRL+ALT+F1` to switch back to the installation screen, then reboot.

12. Continue with *Managing Your Storage Space*.

7.7 Installing with VMware

Note: You will need a writable CD or USB flash drive to complete this task. You must have administrator privileges to create the driver disk and install the driver image.

To install the driver with VMware ESXi 6.0 or VMware ESXi 6.5, you must create a custom boot image using the ESXi-Customizer tool. This tool automates the process of customizing the ESXi install-ISO and runs as a script under Microsoft PowerShell.

You can download the ESXi-Customizer tool, `ESXi-Customizer-PS-v2.5.ps1`, from *https://www.v-front.de/p/esxi-customizer-ps.html* and other locations on the Web.

Note: Be sure to install the prerequisite software first, including Powershell and VMware POWERCLI, before you install ESXi-Customizer.

Note: VMware 6.0 driver supports VMware 6.5.

To install the driver while installing VMware:

1. Download and install Microsoft PowerShell and VMware POWERCLI, as needed. You can download PowerShell from the Microsoft Download Center at *www.microsoft.com/download*, and POWERCLI from *my.vmware.com*.

   Note: PowerShell is pre-installed on many Windows systems, including Windows Server 2012 and Windows Server 2016.

2. Download the ESXi-Customizer tool from *https://www.v-front.de/p/esxi-customizer-ps.html* or other Web location. Then, unpack the archive to a local directory on your Windows system; `C:\ESXi-Customizer`, for instance.

3. Copy the VMware driver vib for your OS version to a temp directory, such as `C:\temp\pkg`. The driver vib files (listed below, where xxxxxxx is the driver version number) should be in the driver download directory on your Windows system (see *Creating a Driver Disk*).

Option	Description
ESXi 6.5/6.0	VMware-VMvisor-Installer-6.0.0-2494585.x86_64.iso

Option	Description
	vmware-esxi-drivers-scsi-aacraid-600.6.2.1.XXXXX.-1.0.6.2159203.x86_64 .vib

4. Run ESXi-Customizer from the installation directory:

```
C:\ESXi-Customizer>ESXi-Customizer.cmd
```

5. In PowerShell, enter the following command:

```
.\ESXi-Customizer-PS-v2.5.ps1 –Vxx -pkgDir C:\temp\pkg
```

where Vxx is the VMware OS version: `V60` for VMmare 6.0, `V65` for VMware 6.5.

PowerShell begins creating the custom ESXi install-ISO with embedded RAID controller driver. It displays "All done" when the ISO is ready.

6. Burn the custom ISO image to a writable CD or USB drive.

> **Note:** Use whatever tool you prefer to burn the CD or USB drive.

Remove the CD or USB drive after you finish burning the image.

7. On the VMware ESXi machine, insert the custom boot CD/USB, then restart your computer.

8. Follow the on-screen instructions to begin the VMware installation.

9. Complete the VMware installation, following the on-screen instructions.

10. Remove the custom boot CD or USB drive, then reboot your computer.

7.8   Installing with Citrix XenServer

> **Note:** To install the driver with Citrix XenServer, you must burn the XenServer driver iso image to a writeable CD; USB driver disks are not supported for XenServer (see *Creating a Driver Disk* on page 27). You will be prompted to insert the XenServer driver CD *twice*. You need the XenServer installation DVD (or equivalent virtual media/iso image) to complete this task. You must have administrator privilege to install the driver image.

To install the driver while installing Citrix XenServer:

1. On the machine where you want to install the OS and driver, insert the XenServer installation DVD, then restart your computer.

2. When prompted to add a driver, press `F9`.

3. Remove the XenServer installation DVD and insert the driver CD.

4. When the driver update is complete, remove the driver CD and insert the XenServer installation DVD.

5. Continue the XenServer installation, following the on-screen instructions.

6. When prompted to add a driver (at the end of the OS installation),remove the XenServer installation DVD and insert the driver CD.

7. Complete the XenServer installation, following the on-screen instructions.

8. Remove the driver CD, then reboot your computer.

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8   Installing the Driver on an Existing Operating System

This chapter explains how to install your driver on an existing operating system.

Note:

1. To install the driver while you're installing an operating system, see *Installing the Driver and an Operating System*

2. To install the Linux drivers from source with Dynamic Kernel Module Support (for persistence across across kernel updates), download the Linux Driver Source Code package from the support page for your product at *start.microsemi.com*, then follow the instructions in the embedded Readme.

8.1   Before You Begin

- Install and connect your RAID controller and internal disk drives (see *Installing the Controller and Disk Drives*).
- Download drivers from the web site
- Create a driver disk (see the following section)

8.2   Creating a Driver Disk

Download the latest drivers from the Web, then create a driver disk by completing the steps below. You will need a USB flash drive to complete this task.

To download drivers and create a driver disk:

1. Open a browser window, then type `start.microsemi.com` in the address bar.

2. Select your RAID controller family and controller model.

3. Select your operating system version, then select the appropriate driver from the list.

    Note: For Linux OSs, the list of drivers typically includes a rpm file and an Images file. You can use either one to install the driver on an existing operating system. The instructions in this chapter use the rpm.

4. Click **Download Now** and accept the license agreement.

5. When the download completes, extract the contents of the driver archive file to a temporary location. If the archive includes drivers for multiple operating system versions (Windows, for instance), each driver is stored in a separate folder, including one each for 32-bit and 64-bit operating systems.

6. Change to the folder for your operating system version, as needed.

7. Copy the driver binary file or the entire driver folder contents to a USB flash drive.

    Note: For VMware and Citrix XenServer, use a remote copy utility to copy the driver to the local machine; see *Installing on VMware* and *Installing on Citrix XenServer*.

8. Remove and label the driver disk.

9. Continue the installation with the instructions for your operating system.

8.3   Installing on Windows

Note: The following instructions apply to all supported Windows operating systems.

To install the driver on Windows:

1. Start or restart Windows.

2. In the Control Panel, launch the Device Manager, right-click your , then select **Update Driver Software**.

3. Insert the driver disk, then select **Browse my computer for driver software**.

4. Browse to the driver disk location, then click **Next**.

5. Select the driver from the list, then click **Next**.

6. When the installation is complete, remove the driver disk and restart your computer.

7. Continue with *Managing Your Storage Space*.

8.4 Installing on Red Hat, CentOS, SuSE, or Fedora Linux

Note: If your Red Hat 7, SLES 11 SP3, or SLES 12 system is booted with uEFI Secure Boot, you will need to add a public key to the MOK list (Machine Owner Key) before completing the steps below. See the Readme for more information.

To install the driver on Red Hat Linux, CentOS, SuSE Linux, or Fedora Linux:

1. Insert and mount the driver disk (assuming the USB drive is `/dev/sda1`):

   ```
   mount /dev/sda1 /mnt/usb
   ```

2. Install the module RPM:

   rpm -ivh *mount-point/xxx/yyy.rpm*

   where *mount-point* is the mount point on the Linux system, *xxx* is the driver path, and *yyy.rpm* is the rpm file name.

3. Reboot your computer to ensure the driver loaded correctly.

4. Continue with *Managing Your Storage Space*.

8.5 Installing on Ubuntu Linux

Note:

For Ubuntu 20.x and above, see *Installing the DKMS Deb Package on Ubuntu Systems* on page 36.

Note: For driver installation on Ubuntu Linux, you may need to create the root account and password. Enter these commands: `sudo bash; sudo passwd root`. You must have root privilege to install the driver image.

Note: Microsemi's pre-built driver supports the kernel that is delivered as part of the ISO. For other kernels, use DKMS process.

To install the driver on Ubuntu Linux:

1. Update the Ubuntu package index:

   ```
   sudo apt-get update
   ```

2. Load the Ubuntu unpacking tools:

   ```
   sudo apt-get install build-essential
   ```

3. Insert and mount the driver disk (assuming the USB drive is `/dev/sda1`):

```
mount /dev/sda1 /mnt/usb
```

4. Install the DEB driver package (where xxxxx is the build number):

   Ubuntu 11:

   **sudo dpkg -i
   /mnt/usb/aacraid-1.2.1-xxxxx-Ubuntu11.10+12.04+12.04.1+12.04.2-all.deb**

   Ubuntu 14:

   sudo dpkg -i /mnt/usb/aacraid-1.2.1-xxxxx-Ubuntu14.10-x86_64.deb

   Ubuntu 16:

   sudo dpkg -i /mnt/usb/aacraid-1.2.1-xxxxx-Ubuntu16.10-x86_64.deb

5. Reboot your computer to ensure the driver loaded correctly.

6. Continue with *Managing Your Storage Space*.

8.6 Installing on VMware

Note: You must remove the old driver before you can install the new one. You must have root privilege to install the new driver.

Note: To copy the driver VIB file to the VMware ESXi server (in *[2]* below), you must have access to a remote copy utility, such as WinSCP, putty, or Linux scp.

To install the driver on VMware:

1. At the VMware console screen, type these commands to remove the old driver from a VMware system:

   **esxcli software vib list | grep -i aacraid (list driver packages)
   esxcli software vib remove --vibname=scsi-aacraid --maintenance-mode (remove
   package)**

2. Using a remote copy utility, copy the driver VIB file for your operating system version to a local directory on the ESXi server. This example uses Linux scp to copy the driver to /tmp/aacraid (where xxxxx is the build number):

   **scp
   /mnt/sda1/linux/driver/vmware-esxi-drivers-scsi-aacraid-600.6.2.1.xxxxx.-1.0.6.2159203.x86_64.vib
    root@<esx-server-ip>:/tmp/aacraid**

3. Install the VIB module (where xxxxx is the build number):

   **esxcli software vib install -f -v
   file:/tmp/aacraid/vmware-esxi-drivers-scsi-aacraid-600.6.2.1.xxxxx.-1.0.6.2159203.x86_64.vib**

4. Reboot your computer.

8.7 Installing on Citrix XenServer

Note: To copy the driver RPM file to XenServer (in *[1]* below), you must have access to a remote copy utility, such as WinSCP, putty, or Linux scp. You must have root privilege to install the driver.

To install the driver on XenServer (where xxxxx is the build # and .x is the OS version):

1. Using a remote copy utility, copy the driver RPM file to a local directory on XenServer. This example uses Linux scp to copy the driver to /tmp/aacraid:

```
scp /mnt/sda1/linux/driver/citrix-aacraid-1.2.1-xxxxx.xen-6.x.rpm
root@<xen-server-ip>:/tmp/aacraid
```

2. Install the driver module rpm:

```
rpm -ivh /tmp/aacraid/citrix-aacraid-1.2.1-xxxxx.xen-6.x.rpm
```

3. Reboot your computer.

9 Installing Dynamic Kernel Module Support

This chapter explains how to install the DKMS driver.

9.1 Installing the DKMS Deb Package on Ubuntu Systems

The following steps are for installing the DKMS deb package on an Ubuntu System.

1. Since DKMS involves changing system-level kernel files, it requires superuser permissions.

```
$sudo su
```

2. DKMS requires build-essential (which installs all packages that are required to build an executable on Ubuntu), the current kernel headers, and DKMS.

```
# apt-get install dkms build-essential linux-headers-`uname -r`
```

3. Once the dependency packages have been installed, the DKMS deb package can be installed. Now DPKG calls DKMS internally, which builds the driver and installs it to the current kernel. XXXXX is the driver release version.

```
# dpkg -i aacraid-dkms_1.2.1.XXXXX_all.deb
```

4. After the DKMS install is done, the system needs to be rebooted for the new driver to take effect.

```
# apt-get install linux-headers-`uname -r`
```

> **Note:** When the Ubuntu Linux kernel is updated, then DKMS will attempt to build the driver for the newly updated kernel and fail, since the headers for the new kernel have not been installed yet. Reboot the system and select the newly updated kernel. Once it boots up, previous command will install headers for the updated kernel and install AACRAID driver on it as well.

9.2 Installing the DKMS RPM Package

The DKMS executable package is available in the EPEL repository.

1. Retrieve the EPEL repository file (the "X" denotes the major version).

```
$ wget https://dl.fedoraproject.org/pub/epel/epel-release-latest-X.noarch.rpm
```

2. Install the EPEL repository.

```
$ sudo rpm -Uvh epel-release-latest-X.noarch.rpm
```

3. Install DKMS.

```
$ sudo yum install dkms
```

9.3   DKMS Reference

This section contains information on the other functions of DKMS.

1. Build and install a driver.

```
# dkms add -m aacraid -v 1.2.1.XXXXX
# dkms build -m aacraid -v 1.2.1.XXXXX
# dkms install -m aacraid -v 1.2.1.XXXXX
```

2. Build a driver for a different system other than native.

```
# dkms build -k 2.4.21-4.ELsmp -m aacraid -v 1.2.1.XXXXX
# dkms install -k 2.4.21-4.ELsmp -m aacraid -v 1.2.1.XXXXX
```

3. Make a driver disk from a set of built drivers.

```
# dkms mkdriverdisk -k 2.4.21-4.ELBOOT,2.4.21-4.ELsmp,2.4.21-4.EL \
        -d redhat -m aacraid -v 1.2.1.52009
# dkms mkdriverdisk -k 2.6.11.4-20a-default,2.6.11.4-20a-smp \
        -d suse -m aacraid -v 1.2.1.52009
```

4. Check current status of DKMS.

```
# dkms status
```

10 Managing Your Storage Space

Once you have installed your RAID controller, disk drives (or other devices), and device driver, you can begin to build and manage your storage space.

This chapter introduces maxView Storage Manager, and describes the other utilities included with your RAID controller.

10.1 About maxView Storage Manager

maxView Storage Manager is a browser-based software application that helps you build a storage space for your online data, using RAID controllers and disk drives.

With maxView Storage Manager, you can group disk drives into logical drives and build in redundancy to protect your data and improve system performance.

From a single workstation, you can use maxView Storage Manager to monitor and manage all the controllers and disk drives in your storage space.

When maxView Storage Manager is installed on a computer, the *maxView Storage Manager Agent* (and other related services) is also installed automatically. The Agent is designed to run in the background, without user intervention. Its job is to monitor system health, manage event notifications, task schedules, and other on-going processes on a system. It sends notices when tasks are completed successfully, and notifies you when errors or failures occur on that system.

If your storage space includes systems that won't be connected to monitors (and therefore won't require the graphical user interface), you can choose to run the *Agent only* on those systems instead of the full application. For more information, refer to the *maxView Storage Manager User's Guide*.

10.1.1 Installing maxView Storage Manager

For details about installing maxView Storage Manager on different operating systems, refer to the *maxView Storage Manager User's Guide*.

10.2 About the RAID Controller Configuration Utility

The RAID Controller Configuration (ARCCONF) is a command line utility that you can use to perform basic array and configuration management functions.

With ARCCONF, you can:
- Create and delete logical drives
- Modify and copy configuration settings
- Recover from disk drive failures and troubleshoot your system

For information about installing and using ARCCONF, refer to the *RAID Controller Command Line Utility User's Guide*.

10.3 About the RAID Configuration Utility

The RAID Configuration (ARC) utility is a BIOS-based utility that you can use to create and manage controllers, disk drives and other devices, and arrays. The ARC utility comprises these tools:
- Logical Device Configuration—For creating and managing arrays, and initializing and rescanning disk drives.
- Controller Settings—For modifying your controller and disk drive settings.
- Disk Utilities—For formatting or verifying disk drives.

The ARC utility is included in your controller's BIOS. For more information, see *Using the RAID Configuration Utility*.

> **Note:** The ARC utility is primarily intended for pre-operating system installation configuration.

10.4 About the Adaptec Flash Utility

The Adaptec Flash Utility (AFU) is a text-based DOS utility that you can use to update, save, or verify your RAID controller's firmware.

> **Caution:** Although the AFU contains safeguards to prevent you from accidentally damaging your RAID controller's flash contents, it is still important to use the AFU carefully and correctly to avoid rendering your RAID controller inoperable. We recommend that only advanced users familiar with working in DOS use the AFU. You can also use maxView Storage Manager to update the controller firmware. See the *maxView Storage Manager User's Guide* for more information.

10.5 Which Utility Should I Use?

To create a bootable array, we recommend that you use the BIOS-based ARC utility (See *Using the RAID Configuration Utility*).

For subsequent storage management tasks on most supported operating systems, including VMware Guest OSs, we recommend that you install and use maxView Storage Manager (see *About maxView Storage Manager*). As a full-featured software application with a graphical user interface, it is the easiest to use and offers the widest range of management functions. For operating systems that do not support the maxView Storage Manager GUI, such as FreeBSD, use the ARCCONF command line utility to configure and manage arrays.

11 Solving Problems

This chapter provides basic troubleshooting information and solutions for solving controller problems.

11.1 Troubleshooting Checklist

If you encounter difficulties installing or using your , check these items first:

- With your computer powered off, check the connections to each disk drive, power supply, LED connector, and so on.
- Try disconnecting and reconnecting disk drives from the .
- Check that your is installed in a compatible PCIe expansion slot. To double-check the bus compatibility of your controller, see *About Your RAID Controller*.
- Ensure that your is firmly seated and secured in the PCIe expansion slot.
- If your is not detected during system boot, try installing it in a different compatible expansion slot. (See *Installing the Controller* for instructions.)
- Did the driver install correctly?
- If you have external disk drives (or other devices), are they powered on?
- Check the Readme for compatibility issues and known problems.

If you are still unable to resolve a problem, you can find additional troubleshooting information and direction at *www.adaptec.com* or the Support Knowledgebase at *ask.adaptec.com*.

11.2 Monitoring Disk Drives Status

You can use the 'blink' feature in the ARC utility and maxView Storage Manager to monitor the status of your SAS and SATA disk drives. When you blink a specific disk drive or set of disk drives, the LED(s) on the selected disk drives flash.

This table describes the LED flash states.

Controller Device State	Slot State	LED Flash State
Failed	Device is faulty	On
Rebuilding	Device is rebuilding	Slow flash
Blink	Identify the device	Fast flash
Other	No error	Off

For more information about using maxView Storage Manager to monitor your disk drives, refer to the *maxView Storage Manager User's Guide* or the online Help.

11.3 Silencing the Alarm

If your includes an alarm, the alarm will sound when an error occurs. To silence the alarm, use maxView Storage Manager (see *Managing Your Storage Space*.) OR the ARC utility (see *Modifying Your Controller's Configuration*.)

11.4 Recovering from a Disk Drive Failure

This section explains how to recover when a disk drive or SSD fails:

- If the array was protected by a hot spare, see *Failed Disk Drive Protected by a Hot Spare*.

- If the array was *not* protected by a hot spare, see *Failed Disk Drive Not Protected by a Hot Spare*.
- If there is a disk drive failure in more than one array simultaneously, see *Failure in Multiple Arrays Simultaneously*.
- If it is a RAID 0 array, see *Disk Drive Failure in a RAID 0 Array*.
- If multiple disk drives fail within the same array, see *Multiple Failures in the Same Array*.
- If the drive is part of the maxCache Device, see *Failed SSD in maxCache Device*.

> **Note:** maxView Storage Manager uses the term *logical drives* or *logical devices* when referring to *arrays* (see *Terminology Used in this Guide*).

11.4.1 Failed Disk Drive Protected by a Hot Spare

When an array is protected by a hot spare, if a disk drive in that array fails the hot spare is automatically incorporated into the array and takes over for the failed drive.

To recover from the failure:

1. Remove and replace the failed disk drive.

2. *If copyback is not enabled*—In maxView Storage Manager, remove the 'hot spare' designation from the original hot spare (the disk drive that was built into the array). Then, designate a new hot spare to protect the arrays on that controller.

   If copyback is enabled—Data is automatically moved back to its original location once the controller detects that the failed drive has been replaced. No action is required.

11.4.2 Failed Disk Drive *Not* Protected by a Hot Spare

When an array is not protected by a hot spare, if a disk drive in that array fails, remove and replace the failed disk drive. The controller detects the new disk drive and begins to rebuild the array.

If the controller fails to rebuild the array, check that the cables, disk drives, and controllers are properly installed and connected. Make sure that the new disk drive is equal or greater in size than the failed disk drive. Then, if necessary, use maxView Storage Manager to rebuild the array. For instructions, refer to the *maxView Storage Manager User's Guide* or the online Help.

11.4.3 Failure in Multiple Arrays Simultaneously

If there's a disk drive failure in more than one array at the same time (one failure per array), and the arrays have hot spares protecting them, the controller rebuilds the arrays with these limitations:

- A hot spare must be of equal or greater size than the failed disk drive it's replacing.
- Failed disk drives are replaced with hot spares in the order in which they failed. (The array that includes the disk drive that failed first is rebuilt first, assuming an appropriate hot spare is available—see bullet above.)

If there are more disk drive failures than hot spares, see *Failed Disk Drive Not Protected by a Hot Spare*.

If copyback is enabled, data is moved back to its original location once the controller detects that the failed drive has been replaced.

11.4.4 Disk Drive Failure in a RAID 0 Array

Because RAID 0 volumes do not include redundancy, if a disk drive fails in a RAID 0 array, the data can't be recovered.

Correct the cause of the failure or replace the failed disk drives. Then, restore your data (if available).

11.4.5 Multiple Failures in the Same Array

Except in RAID 6 and RAID 60 arrays (see *Understanding RAID*), if more than one disk drive fails at the same time in the same array, the data normally can't be recovered.

You *may* be able to recover the data by forcing the logical drive online or by recreating the logical drive without the initialization step. You can use the BIOS utility, ARC (see *About the RAID Configuration Utilityconcept*), the command-line utility, ARCCONF, or maxView Storage Manager. For more information, refer to the *RAID Controller Command Line Interface User's Guide* and *maxView Storage Manager User's Guide*.

> **Note:** In some instances, RAID 10 and RAID 50 arrays *may* survive multiple disk drive failures, depending on which disk drives fail.

11.4.6   Failed SSD in maxCache Device

Because the maxCache Device is a redundant logical device, comprised of SSDs only, it is rebuilt automatically when a failed SSD is replaced, just like an ordinary array. Once you identify the failed SSD, for example, by using *maxView Storage Manager's* rapid fault isolation feature, replace it with a new one (see *Connecting Solid State Drives (SSDs)*). The controller detects the new SSD and begins rebuilding the maxCache Device.

11.5   Resetting the Controller

You may need to reset, or *flash*, your   if it becomes inoperable or if a firmware upgrade is unsuccessful. s support a reset protocol called HDA mode flash. For information about HDA mode, see the Readme or contact your support representative. To locate the flash jumper on your RAID controller board, see the illustrations in *About Your RAID Controller*.

A   Introduction to SAS

This section provides a basic overview of the main features of SAS, introduces some common SAS terms, and explains how SAS differs from parallel SCSI.

> **Note:** For technical articles and tutorials about SAS, refer to the SCSI Trade Association (STA™) Web site at *www.scsita.org*.

A.1   Terminology Used in This Appendix

For convenience, SAS HBAs and SAS RAID controllers are referred to generically in this chapter as *SAS cards*. HBAs, RAID controllers, disk drives, and external disk drive enclosures are referred to as *end devices* and expanders are referred to as *expander devices*.

For convenience, this chapter refers to end devices and expander devices collectively as *SAS devices*.

A.2   What is SAS?

Legacy parallel SCSI is an interface that lets devices such as computers and disk drives communicate with each other. Parallel SCSI moves multiple bits of data *in parallel* (at the same time), using the SCSI command set.

SAS is an evolution of parallel SCSI to a point-to-point serial interface. SAS also uses the SCSI command set, but moves multiple bits of data one at a time. SAS links end devices through direct-attach connections, or through expander devices.

SAS cards can typically support up to 128 end devices and can communicate with both SAS and SATA devices. (You can add 128 end devices—or even more—with the use of SAS expanders. See *SAS Expander Connections*.)

> **Note:** Although you can use both SAS and SATA disk drives in the same *SAS domain* (see *SAS Expander Connections*), we recommend that you do not combine SAS and SATA disk drives within the same array or logical drive. The difference in performance between the two types of disk drives may adversely affect the performance of the array.

Data can move in both directions simultaneously across a SAS connection (called a *link*—see *How Do SAS Devices Communicate?*). Link speed is 300 MB/sec in half-duplex mode. Therefore, a SAS card with eight links has a bandwidth of 2400 MB/sec.

Although they share the SCSI command set, SAS is conceptually different from parallel SCSI physically, and has its own types of connectors, cables, connection options, and terminology, as described in the rest of this chapter.

To compare SAS to parallel SCSI, see *How is SAS Different from Parallel SCSI?*.

A.3   How Do SAS Devices Communicate?

SAS devices communicate with each other through links. A *link* is a physical connection between two phys.

As shown in the following figure, SAS devices contain ports (see *What's a SAS Port?*), ports contain *phys*, and each phy contains one transmitter and one receiver—one transceiver. A phy can belong to one port only.
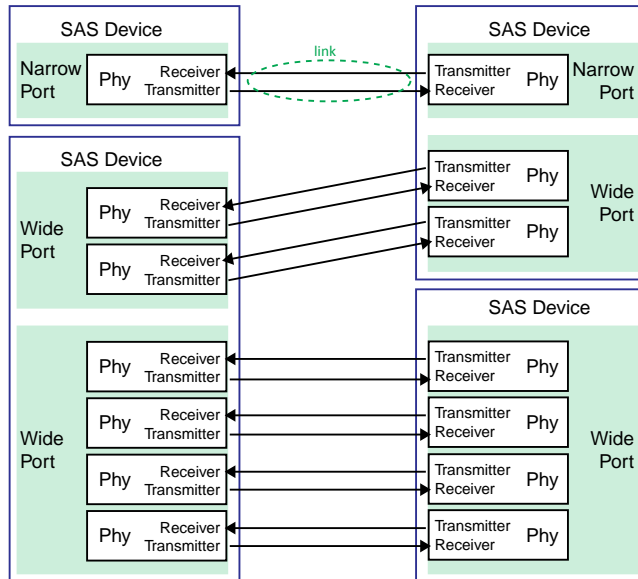
A.4   What's a Phy?

Phys are part of the physical communication connection between SAS devices. Each phy contains a transceiver that sends data back and forth between SAS devices.

When a connection is formed between two end devices, a link is established from a phy in one port to a phy in the other port. As shown in the figure above, a wide port can support multiple independent links simultaneously.

Phys are internal, within SAS connectors (see *What's a SAS Connector?*).

SAS cables physically connect one or more phys on one SAS device to one or more phys on another SAS device.

A.5   What's a SAS Port?

> **Note:** Because the physical link between SAS devices is from phy to phy, rather than port to port, a "port" is more of a virtual concept, different from what is normally considered a port on other types of RAID controllers and storage devices.

A *port* is one or more phys. A *narrow port* contains one phy. A *wide port* typically contains four phys.

Each port has its own unique SAS address (see *How are Disk Drives Identified in SAS?*), and all the phys in a port share that same SAS address.

SAS card port options vary. A SAS card with four phys could be configured with one wide port, with two wide ports that comprise two phys, or with four narrow ports each containing one phy. (A wide port with four phys is referred to as a *4-wide* or *4x* port.)

A.6   What's a SAS Address?

Each SAS port is identified with a unique SAS address, which is shared by all phys on that port.

For example, a SAS disk drive might have two narrow ports. Each port has one unique SAS address. The single phy in each port uses its port's SAS address.

In another example, a SAS device might have one 4-wide port. That port has one SAS address, which is shared by all four phys in the port.

Unlike SCSI devices and SCSI IDs, SAS devices self-configure their SAS addresses. User intervention is not required to set SAS addresses, and SAS addresses cannot be modified.

A.7 What's a SAS Connector?

A SAS or mini-SAS connector is the physical plug or receptacle that you see on a SAS device. It's what you plug a SAS cable into, or the end of the SAS cable that's being plugged in. (See *Cables*.)

A connector is what forms physical links between phys. Some SAS connectors can support multiple links. The number of links a SAS connector can support is referred to as its *width*. *Narrow* connectors support a single link; *wide* connectors supports more than 1 link.

A single SAS device may have one or more connectors. A single SAS connector may help form links between more than two SAS devices. (For instance, as shown in the figure in *Connecting Drives Directly to the Controller*, the 4-wide internal SAS connector forms links with four independent disk drives.)

A.8 What do SAS Cables Look Like?

Internal standard SAS cables are narrower than internal parallel SCSI cables. The connectors vary in size depending on the number of links they support, from single link connectors to 4-wide (or larger) connectors. Internal fan-out cables let you attach four disk drives to a single 4-wide connector.

Mini-SAS connectors support both internal and external SAS connections. The mini-SAS connectors are smaller than the standard SAS internal and external connectors. Mini-SAS connectors support single and multilinks with the ability to scale to future speed needs.

For examples of some internal SAS/mini-SAS cables and an external SAS/mini-SAS cables, see *Cables*.

A.9 How are Disk Drives Identified in SAS?

In the BIOS and in the management utilities (see *Identifying Disk Drives*), disk drives are identified in the following formats:

- CNX:DevY = Device Y is attached to Connector X (see *Direct-attach Connections* for more information)
- BoxX:SlotX = Enclosure X is attached to a disk drive in Slot X (see *Backplane Connections* for more information)
- ExpX:PhyX = Expander X is attached to Phy X (see *SAS Expander Connections* for more information)

where X is the count number.

> **Note:** Devices other than disk drives (CDROM, tape drives, etc...) are listed in order after your system disk drives.

In parallel SCSI, XX is the disk drive's channel number, YY is the target number, and ZZ is the logical unit number (LUN).

A.10 What are the SAS Connection Options?

You can connect end devices to each other through direct cable connections and through backplane connections. When you use one or more expander devices (see *SAS Expander Connections*), you can create large configurations.

A.10.1 Direct-attach Connections

In a direct-attach connection, SAS or SATA disk drives are connected directly to a SAS card with SAS or mini-SAS cables. One disk drive is attached to one SAS/mini-SAS connector with one SAS/mini-SAS cable (or multiple disk drives are attached to one SAS/mini-SAS connector with one fan-out cable). The figure in *Connecting Drives Directly to the Controller* shows an example of direct-attach connections.

The number of direct-attached disk drives is limited to the number of *phys* supported by the SAS card. (Note that there may be multiple phys within a single connector. See *SAS Expander Connections*.)

A.10.2   Backplane Connections

In a backplane connection, disk drives and SAS cards are attached to and communicate with each other through a system backplane.

There are two types of backplane connections, *passive* and *active*. When connecting to either backplane, it's important to properly connect your disk drive LEDs in order to identify disk drive conditions. See *About Your RAID Controller* for your RAID controller Activity LED connections and locations.

Once you have connected to a backplane, use maxView Storage Manager to manage your disk drives. For more information, refer to the *maxView Storage Manager User's Guide*.

The number of end devices is limited to the number of slots available on the backplane.

Some backplanes support daisy-chain expansion to other backplanes, allowing you to connect multiple enclosures to a single SAS card in a host system.

A.10.3   SAS Expander Connections

A SAS expander device literally expands the number of end devices that you can connect together. Expander devices, typically embedded into a system backplane (see *Backplane Connections*), support large configurations of SAS end devices, including SAS cards and SAS and SATA disk drives. With expander devices, you can build large and complex storage topologies.

There are two types of SAS expanders: *fanout expanders* and *edge expanders*. Each performs a different role in a storage system. (For more information about how SAS expanders work, refer to the STA Web site at www.scsita.org.)

You can connect up to 128 SAS ports to an edge expander. (A single edge expander can therefore support up to 128 SAS addresses.)

You can connect up to 128 edge expanders to a fanout expander.

You can use only one fanout expander in any single SAS *domain* (a topology of SAS—and possibly SATA—end devices and expander devices). A single SAS domain can therefore comprise up to 16,384 SAS ports (and therefore up to 16,384 SAS addresses including the fanout expander).

The next figure illustrates (in very basic terms) a SAS domain and shows how SAS cards, SAS and SATA disk drives, and expander devices can fit together in a large data storage topology.

SAS Domain
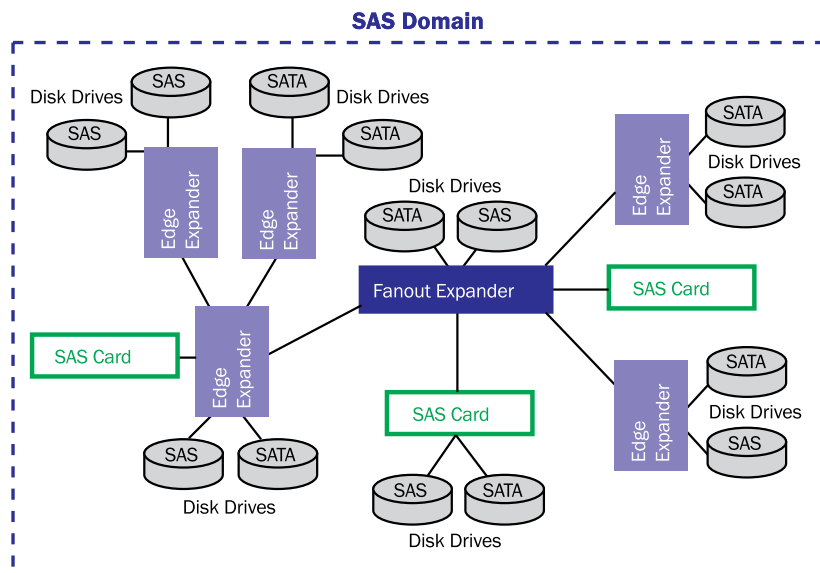
A.11 How is SAS Different from Parallel SCSI?

In summary, although SAS and parallel SCSI both use the SCSI command set, how they move data from one place to another is very different. To support point-to-point *serial* data transport, SAS introduces new types of connectors, cables, connection options, and terminology.

Generally speaking, SAS is faster and more flexible than parallel SCSI, and provides more options for building your storage space. SAS lets you mix SAS and SATA disk drives together, and lets you connect many, *many* more devices.

This table describes many of the main differences between the two interfaces.

Parallel SCSI	Serial Attached SCSI
Parallel interface	Serial interface
Maximum speed 320 MB/sec shared by all devices on the bus	Maximum speed 300 MB/sec per phy when in half-duplex mode
Supports SCSI devices only	Supports SATA and SAS disk drives simultaneously
Up to 16 devices per SCSI channel	More than 100 disk drives per SAS card, using an expander (see *SAS Expander Connections*) or 50 SATAII disk drives.
Supports single-port devices only	Supports single- and dual-port devices
Uses SCSI IDs to differentiate between devices connected to the same adapter	Uses unique SAS addresses to differentiate between devices
User intervention required to set SCSI IDs	SAS addresses self-configured by SAS devices
Requires bus termination	Requires no bus termination
Standard SCSI connectors	SAS connectors (see *Cables*)

B   Understanding RAID

When you create arrays (or logical drives), you can assign a RAID level to protect your data.

Each RAID level offers a unique combination of performance and redundancy. RAID levels also vary by the number of disk drives they support.

This appendix describes the RAID levels supported by your RAID controller, and provides a basic overview of each to help you select the best level of protection for your data storage.

B.1   Understanding Drive Segments

A *drive segment* is a disk drive or portion of a disk drive that is used to create an array. A disk drive can include both *RAID segments* (segments that are part of an array) and available segments. Each segment can be part of only one logical device at a time. If a disk drive is not part of any logical device, the entire disk is an available segment.

B.2   Non-redundant Arrays (RAID 0)

An array with RAID 0 includes two or more disk drives and provides data *striping*, where data is distributed evenly across the disk drives in equal-sized sections. However, RAID 0 arrays do not maintain redundant data, so they offer *no data protection*.

Compared to an equal-sized group of independent disks, a RAID 0 array provides improved I/O performance.

Drive segment size is limited to the size of the smallest disk drive in the array. For instance, an array with two 250 GB disk drives and two 400 GB disk drives can create a RAID 0 drive segment of 250 GB, for a total of 1000 GB for the volume, as shown in this figure.

Disk Drives in Logical Drive

RAID 0 Logical Drive = 1000 GB

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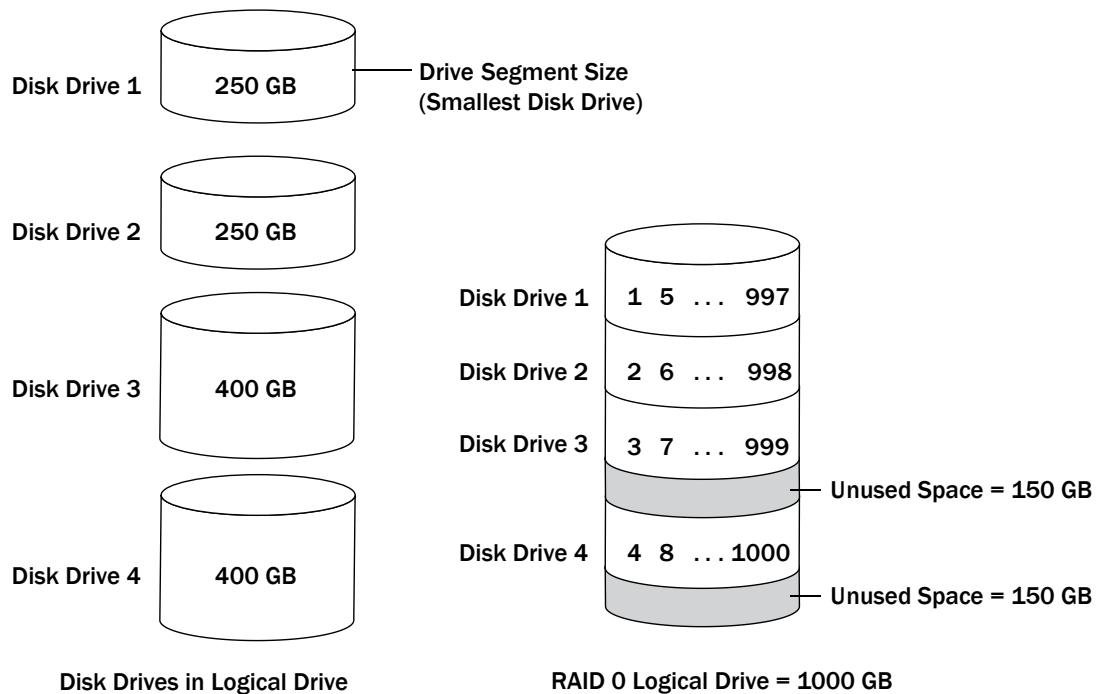
B.3 RAID 1 Arrays

A RAID 1 array is built from two disk drives, where one disk drive is a *mirror* of the other (the same data is stored on each disk drive). Compared to independent disk drives, RAID 1 arrays provide improved performance, with up to twice the read rate and an equal write rate of single disks. However, capacity is only 50 percent of independent disk drives.

If the RAID 1 array is built from different- sized disk drives, the free space, drive segment size is the size of the smaller disk drive, as shown in this figure.
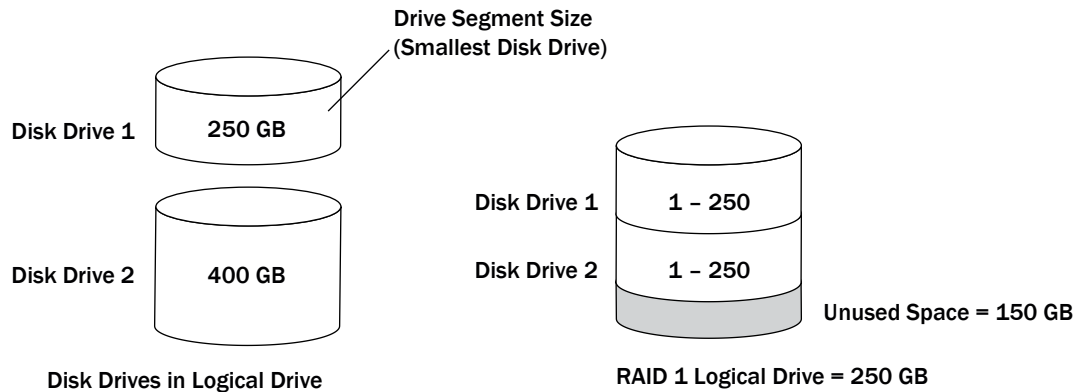
B.4 RAID 1 Enhanced Arrays

A RAID 1 Enhanced (RAID 1E) array—also known as a *striped mirror*—is similar to a RAID 1 array except that data is both mirrored *and* striped, and more disk drives can be included. A RAID 1E array can be built from three or more disk drives.

In this example, the large bold numbers represent the striped data, and the smaller, non-bold numbers represent the mirrored data stripes.

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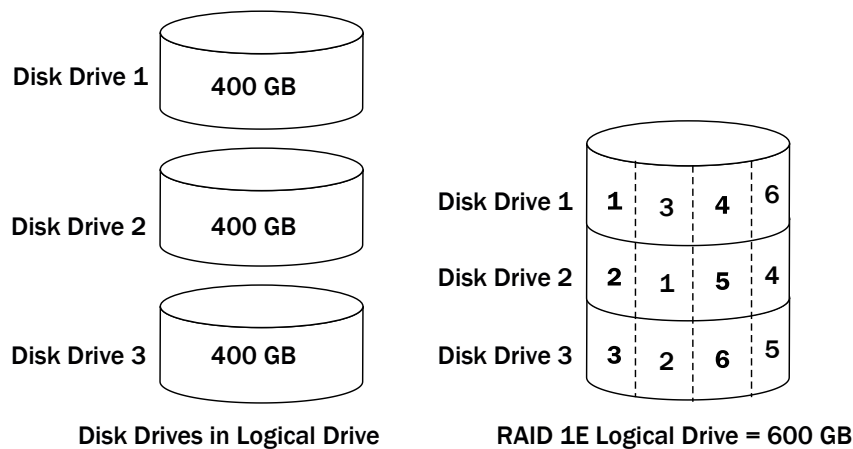
B.5　　RAID 10 Arrays

A RAID 10 array is built from two or more equal-sized RAID 1 arrays. Data in a RAID 10 array is both striped and mirrored. Mirroring provides data protection, and striping improves performance.

Drive segment size is limited to the size of the smallest disk drive in the array. For instance, an array with two 250 GB disk drives and two 400 GB disk drives can create two mirrored drive segments of 250 GB, for a total of 500 GB for the array, as shown in this figure.

Disk Drive 1　250 GB — Drive Segment Size (Smallest Disk Drive)

Disk Drive 2　250 GB

Disk Drive 3　400 GB

Disk Drive 4　400 GB

Disk Drive 1　1　3　. . .　499
Disk Drive 2　2　4　. . .　500
Disk Drive 3　1　3　. . .　499
— Unused Space = 150 GB
Disk Drive 4　2　4　. . .　500
— Unused Space = 150 GB

Disk Drives in Logical Drive　　　　**RAID 10 Logical Drive = 500 GB**
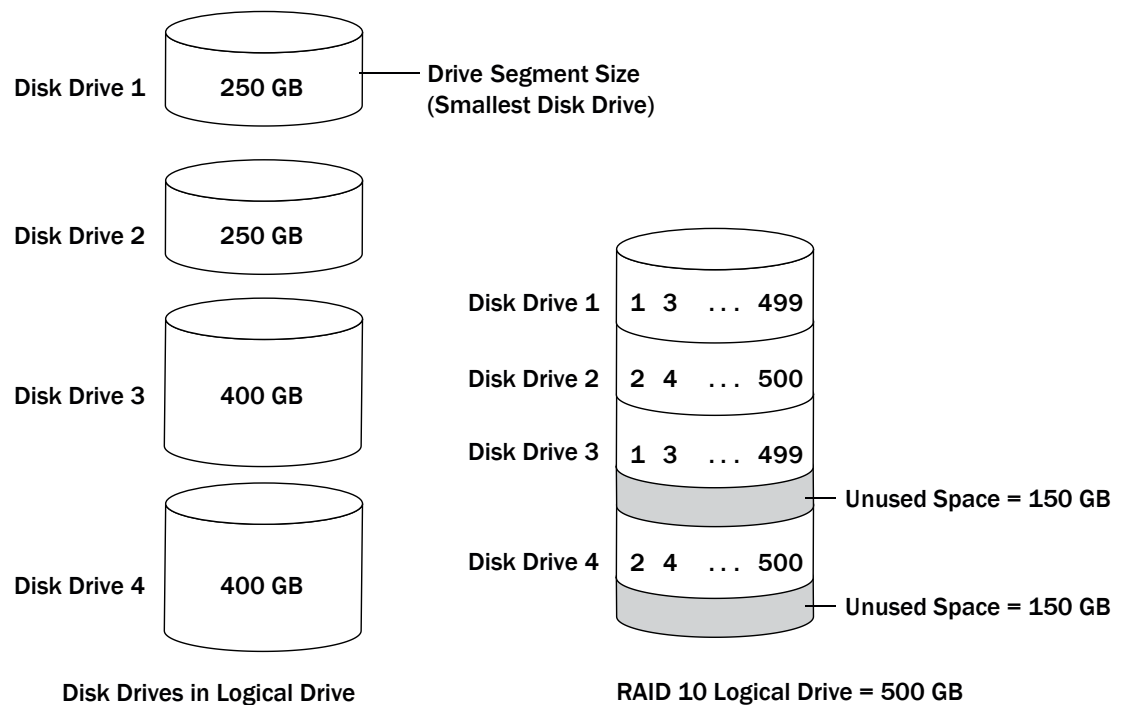
B.6   RAID 5 Arrays

A RAID 5 array is built from a minimum of three disk drives, and uses data striping and *parity* data to provide redundancy. Parity data provides data protection, and striping improves performance.

Parity data is an error-correcting redundancy that's used to re-create data if a disk drive fails. In RAID 5 arrays, parity data (represented by Ps in the next figure) is striped evenly across the disk drives with the stored data.

Drive segment size is limited to the size of the smallest disk drive in the array. For instance, an array with two 250 GB disk drives and two 400 GB disk drives can contain 750 GB of stored data and 250 GB of parity data, as shown in this figure.

Disk Drives in Logical Drive   RAID 5 Logical Drive = 750 GB plus Parity
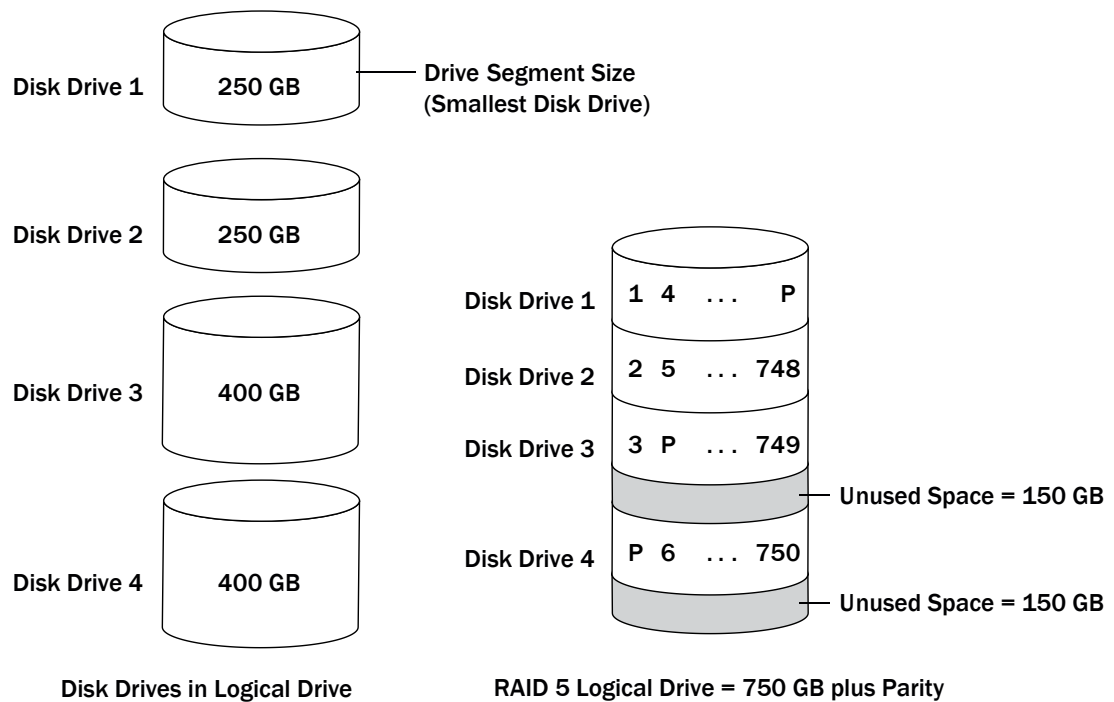
B.7 RAID 5EE Arrays

A RAID 5EE array—also known as a *hot space*—is similar to a RAID 5 array except that it includes a *distributed spare* drive and must be built from a minimum of four disk drives.

Unlike a hot spare, a distributed spare is striped evenly across the disk drives with the stored data and parity data, and can't be shared with other logical disk drives. A distributed spare improves the speed at which the array is rebuilt following a disk drive failure.

A RAID 5EE array protects your data and increases read and write speeds. However, capacity is reduced by two disk drives' worth of space, which is for parity data and spare data.

In this figure, S represents the distributed spare, P represents the distributed parity data.

Disk Drives in Logical Drive

Based on the drive segment sizes used:
RAID 5EE Logical Drive = 500 GB plus parity and hot spare
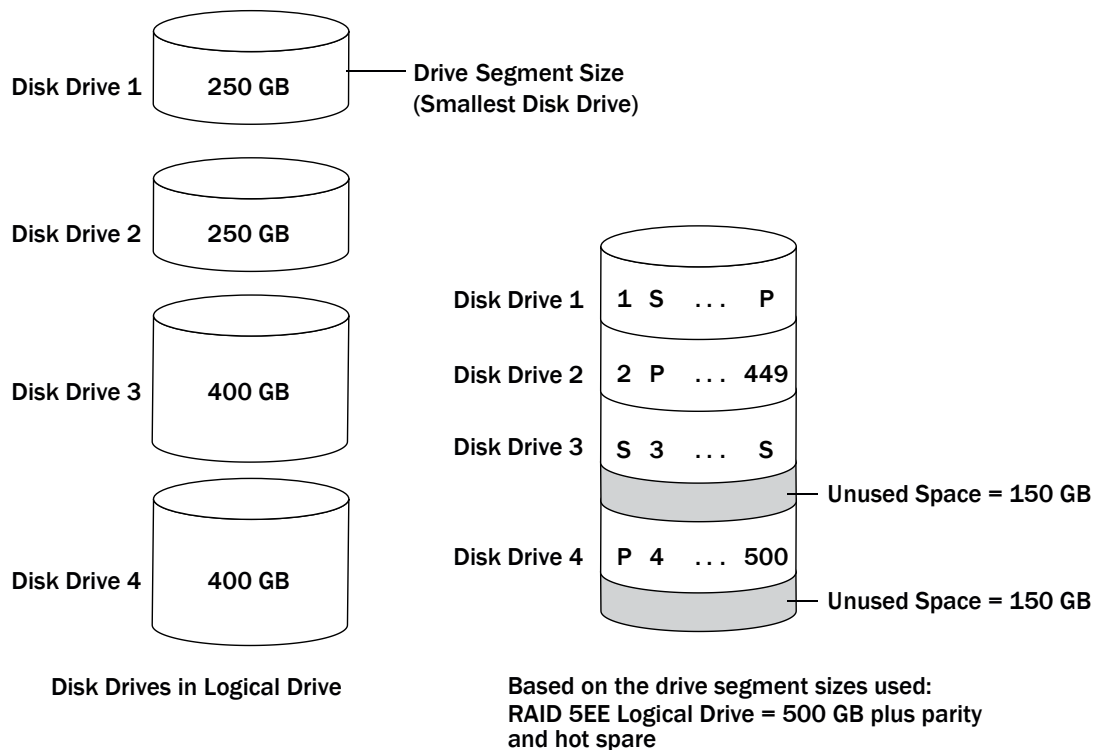
B.8　RAID 50 Arrays

A RAID 50 array is built from six to forty-eight disk drives configured as two or more RAID 5 arrays, and stripes stored data and parity data across all disk drives in both RAID 5 arrays. (For more information, see *RAID 5 Arrays*.)

The parity data provides data protection, and striping improves performance. RAID 50 arrays also provide high data transfer speeds.

Drive segment size is limited to the size of the smallest disk drive in the array. For example, three 250 GB disk drives and three 400 GB disk drives comprise two equal-sized RAID 5 arrays with 500 GB of stored data and 250 GB of parity data. The RAID 50 array can therefore contain 1000 GB (2 x 500 GB) of stored data and 500 GB of parity data.

In this figure, P represents the distributed parity data.
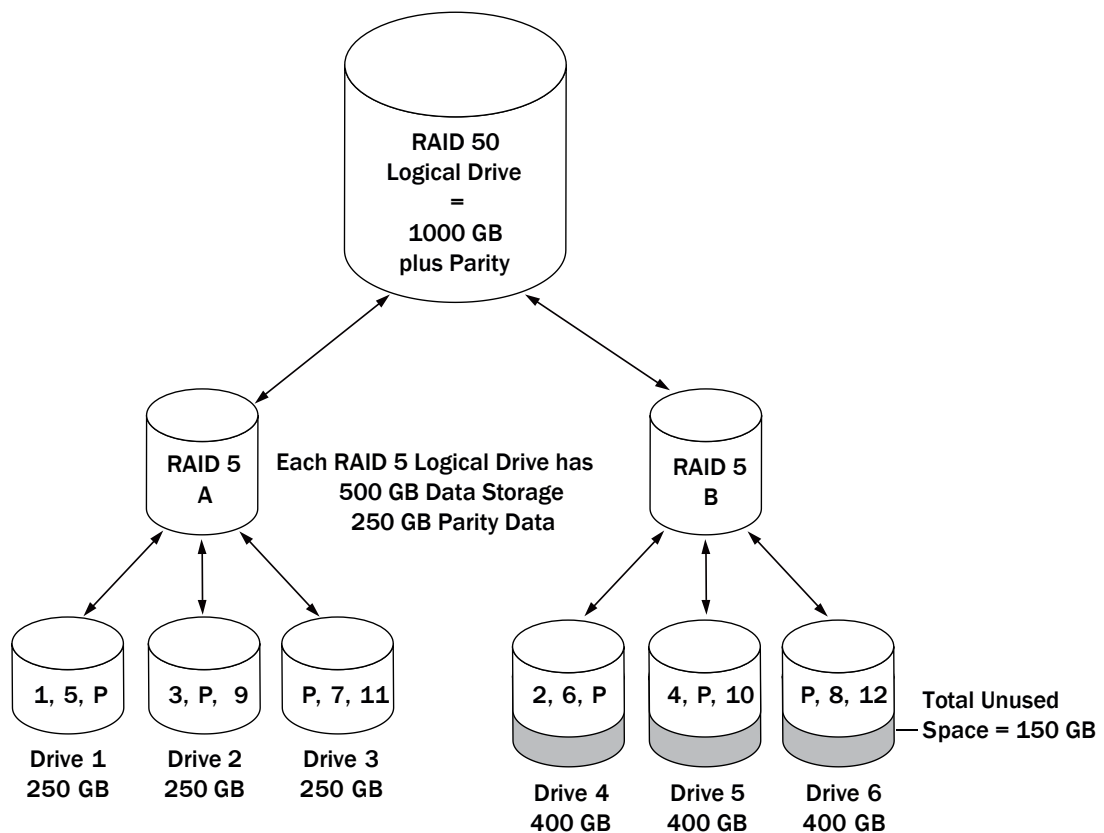
B.9 RAID 6 Arrays

A RAID 6 array—also known as dual drive failure protection—is similar to a RAID 5 array because it uses data striping and parity data to provide redundancy. However, RAID 6 arrays include *two* independent sets of parity data instead of one. Both sets of parity data are striped separately across all disk drives in the array.

RAID 6 arrays provide extra protection for your data because they can recover from two simultaneous disk drive failures. However, the extra parity calculation slows performance (compared to RAID 5 arrays).

RAID 6 arrays must be built from at least four disk drives. Maximum stripe size depends on the number of disk drives in the array.
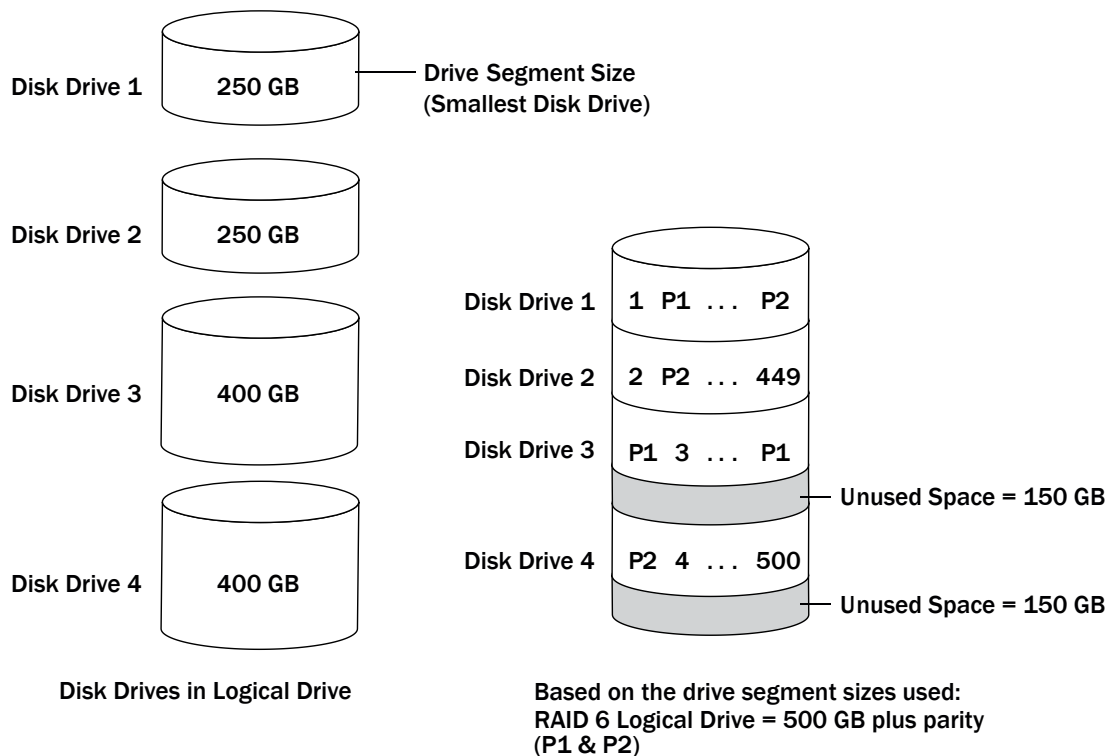
B.10 RAID 60 Arrays

Similar to a RAID 50 array (see *RAID 50 Arrays*), a RAID 60 array—also known as dual drive failure protection—is built from eight disk drives configured as two or more RAID 6 arrays, and stripes stored data and two sets of parity data across all disk drives in both RAID 6 arrays.

Two sets of parity data provide enhanced data protection, and striping improves performance. RAID 60 arrays also provide high data transfer speeds.

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B.11   Comparing RAID Levels

Use this table to select the RAID levels that are most appropriate for the logical drives on your storage space, based on the number of available disk drives and your requirements for performance and reliability.

RAID Level	Redundancy	Disk Drive Usage	Read Performance	Write Performance	Built-in Hot Spare	Minimum Disk Drives
RAID 0	No	100%	***	***	No	2
RAID 1	Yes	50%	**	**	No	2
RAID 1(ADM)	Yes	33%	**	**	No	3
RAID 1E	Yes	50%	**	**	No	3
RAID 10	Yes	50%	**	**	No	4
RAID 10(ADM)	Yes	33%	**	**	No	6
RAID 5	Yes	67 – 94%	***	*	No	3
RAID 5EE	Yes	50 – 88%	***	*	Yes	4
RAID 50	Yes	67 – 94%	***	*	No	6
RAID 6	Yes	50 – 88%	**	*	No	4
RAID 60	Yes	50 – 88%	**	*	No	8

Disk drive usage, read performance, and write performance depend on the number of drives in the logical drive. In general, the more drives, the better the performance.

C   Using the RAID Configuration Utility

The RAID Configuration (ARC) utility is a BIOS-based utility that you can use to create arrays and manage controllers, disk drives and other devices.

C.1   Introduction to the ARC Utility

The ARC utility comprises these tools:

- Logical Device Configuration—For creating and managing arrays, and initializing and rescanning disk drives (see *Using the ARC Utility to Create and Manage Arrays* on page 57).

- Controller Settings—For modifying your controller settings (see *Using the ARC Utility to Modify Controller Settings* on page 60).
- Disk Utilities—For formatting or verifying disk drives (see *Formatting and Verifying Disk Drives*), locating disk drives, or setting the drive-specific write cache policy.
- Administration (*uEFI only*)—For flashing the controller, updating the CPLD, and creating a support archive (see *Updating the Controller Firmware* on page 66).

C.1.1   Ctrl-A or uEFI/HII?

Your supports two interfaces to the BIOS-level RAID configuration options of the ARC utility: Ctrl-A and uEFI/HII. On computers that support the Unified Extensible Firmware Interface, or uEFI (version 2.10 or higher), the BIOS-level RAID configuration options are presented with a HII interface, or Human Interaction Infrastructure, rather than the Ctrl-A interface described in this chapter. uEFI/HII provides an architecture-independent mechanism for initializing add-in cards, like the , and rendering contents to the screen in a uniform way.

In the uEFI/HII interface, access to the configuration options is provided through the computer's standard BIOS. How you access the BIOS varies, depending on the computer manufacturer, but typically it's started by simply pressing DEL. Once you enter setup, navigate to the "**PMC maxView Storage Manager**" option, typically on the BIOS' "Advanced" menu, then scan for and select a controller.

From that point on, the uEFI/HII menus and the Ctrl-A menus for configuring your are almost identical. For example, the top-most menu contains the same three options: Logical Device Configuration, Controller Settings, Disk Utilities (described above). But it also contains the Administration option, which is available only in the uEFI/HII menu. Options in the lower-level menus are also similar.

In both interfaces, all the tools are menu-based and instructions for completing tasks appear on-screen. Menus can be navigated using the arrows, Enter, Esc, and other keys on your keyboard.

This chapter provides instructions for navigating and completing tasks with the Ctrl-A interface. To complete tasks with the uEFI/HII interface:

- Refer to the on-screen instructions for keyboard navigation and selection options.
- Refer to the option descriptions in this chapter for details about individual RAID configuration settings and tasks.

> **Note:** Some RAID configuration options are available only in the uEFI/HII interface. uEFi options are noted in the task descriptions below.

C.1.2   Running the ARC Utility

If your controller is connected to a RAID enclosure, power on your enclosure (or enclosures) before you power on your computer.

Start or restart your computer. When prompted, press **Ctrl+A**.

During boot up, if your system has insufficient memory this message displays:

"Adaptec RAID Configuration Utility will load after, system initialization. Please wait... Or press <Enter> Key to attempt loading the utility forcibly [Generally, not recommended]"

"RAID Configuration Utility will load after, system initialization. Please wait... Or press <Enter> Key to attempt loading the utility forcibly [Generally, not recommended]"

> **Note:** The first time you power on your computer after you install a new controller, the BIOS may display a configuration that doesn't match your system's configuration. This is normal.

C.2 Using the ARC Utility to Create and Manage Arrays

To use the ARC utility to create and manage arrays, start the ARC utility (see *Running the ARC Utility*), select your controller (if you have more than one), then press `Enter`. Select **Logical Device Configuration** from the ARC main menu, then press `Enter`.

Follow the on-screen instructions to create and manage arrays, and initialize, rescan, and erase disk drives.

C.2.1 Creating a New Array

To begin creating an array, select **Create Arrays** from the Logical Device Configuration menu.

Only disk drives that can be used in a new array are available for selection. (Disk drives must be initialized before they can be used in an array. See *Initializing Disk Drives* for more information.)

> **Note:**
> - To create a hybrid array that leverages the performance benefits of the SSDs in your system, you must select an equal number SSDs and HDDs. You can create a hybrid RAID1 or hybrid RAID10 only.
> - When you create an all SSD array, we recommend *disabling* all caching, including maxCache caching. If any caching is enabled when you create the array, you will be prompted to turn caching off.

Use the Array Properties menu to modify the array's RAID level, size, name, stripe size, cache settings, and maxCache settings.

> **Note:** For more information about RAID levels and using disk drives to create arrays, see *Choosing a RAID Level*. For more information about maxCache, see *Modifying Cache Settings*.

C.2.2 Managing Existing Arrays

To view or modify existing arrays, select **Manage Arrays** from the Logical Device Configuration menu.

From the Manage Arrays menu, you can:
- View the properties of an array.
  > **Note:** Failed drives are displayed in a different text color.
- Make an array bootable (see *Creating Bootable Arrays*).
- Assign or remove hot spares.
- Modify power management settings.
- Change the cache settings for an array.
- Delete an array.
  > **Caution:** Before deleting an array, back up the data to avoid permanently losing it.

C.2.2.1   Creating Bootable Arrays

> **Note:** You may need to change the system BIOS to modify the boot order. For more information, refer to your computer documentation.

The controller always uses the lowest numbered array as its bootable array.

To make an array bootable:

1. Select **Manage Arrays** from the Logical Device Configuration menu.
2. Select the array that you want to make bootable, then press `Ctrl+B`.

> **Note:** You cannot make an array bootable while it's building, verifying, or rebuilding.

The array's number changes to Array 00, which makes this array the controller's boot array.

3. Restart your computer.

C.2.2.2   Modifying Power Management Settings

Power management settings switch the array to low power state when it is inactive for a specific time.

To modify power management settings:

1. Select **Manage Arrays** from the Logical Device Configuration menu.
2. Select the array, then press `Ctrl+W`.

In the power management console, enter these details:

Option	Description
Power Management	When enabled, switches the array to low power state, when the array/drive is inactive.
Slow Down Drive After	The duration of inactive state of the array/drive after which it is slowed down to low power mode. This is an optional setting. **Note:** The disk drive should support low power mode.
Power Off Drive After	The duration of inactive state of the array/drive after which it is powered off. This is an optional setting. **Note:** Power Off Drive After duration should be greater than Slow Down Drive After Duration.
Verify Drive After	The regular time interval at which the system performs a health check of the array/drive.

C.2.2.3   Modifying Cache Settings

You can modify the read and write cache settings for an array. You can also modify the maxCache settings. maxCache uses the compatible Solid State Drives (SSDs) in your system as fast cache memory to improve performance for both read and write operations in I/O-intensive applications with mixed workloads.

> **Note:** maxCache SSD Caching is supported on Series Q controllers only.

To modify the cache settings for an array:

1. Select **Manage Arrays** from the Logical Device Configuration menu.
2. Select the array, then press `Ctrl+C`.

The Modify Cache Settings window opens.

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3. Enable or disable read caching.

4. Press `Tab`.

5. Enable or disable write caching:
   - Select Enable always for "write-back" caching
   - Select Enable with Backup Unit if your controller has a zero-maintenance cache protection module
   - Select Disable for "write-through" caching

6. Press `Tab`.

7. Select the maxCache Read Cache setting (Enable/Disable).

8. Select the maxCache Write Cache setting (Enable/Disable).

9. Press `Enter` to accept the values.

C.2.3   Initializing Disk Drives

If a disk drive appears grayed-out (unavailable for use in a new array), it may need to be initialized.

To begin initializing a disk drive, select **Initialize Drives** from the Logical Device Configuration menu. You can initialize one drive or multiple drives. If an error occurs during initialization, the message "Initializing drives...FAILED x of n" is displayed. Press `Enter` to see a list of drives that failed to initialize. Press `Esc` to continue.

> **Caution:** Do not initialize a disk drive that is part of an array. Initializing a disk drive that's part of an array may make the array unusable. Back up all data from your disk drive before you initialize it.

C.2.4   Rescanning Disk Drives

To begin rescanning a disk drive, select **Rescan Drives** from the Logical Device Configuration menu.

C.2.5   Secure Erasing Disk Drives

When you perform a secure erase on a disk drive, all data on that disk drive is completely and irretrievably eradicated. Secure erase performs three distinct writing passes to the disk drive being erased—it does not just write zeros.

Performing a secure erase takes up to six times longer than clearing (or zeroing) a disk drive; on a 2TB or 3TB drive, often it takes hours, possibly as long as a day! You may want to perform a secure erase only on disk drives that contain confidential or classified information.

> **Note:** To erase (or zero) a disk drive with non-classified information, you may choose to *format* it (see *Formatting and Verifying Disk Drives*) instead, or *initialize* it using maxView Storage Manager—both options take much less time than the secure erase option.

To begin a secure erase, select **Secure Erase** from the Logical Device Configuration menu, then select `Y` (yes). To return to the main Logical Device Configuration menu once the secure erase has begun, press `Esc`.

> **Note:** For newer SATA drives, you can choose to perform a Secure ATA Erase, which implements the secure erase feature at the drive firmware level. To start a Secure ATA Erase, select a SATA drive, then type `Ctrl-S` to open the Secure ATA Erase dialog. You will see this dialog only if the drive supports Secure ATA Erase.

The selected disk drive(s) cannot be used until the erase is complete.

C.2.5.1   Stopping a Secure Erase

To stop a secure erase in progress:

1. In the Logical Device Configuration menu, select **Secure Erase**.

2. Select the disk drive being secure erased, then press `Ctrl+Q`.
   The secure erase stops and you return to the main Logical Device Configuration menu.

C.2.6 Uninitializing Disk Drives

Uninitializes one or more physical drives. This option clears metadata and reserved space and any OS partitions from a drive; any existing data on the drive is destroyed. Drives can uninitialized only if they are not part of any array.

> **Note:** Uninitialized drives are surfaced to the OS as RAW Pass Through Devices. Typically, they are used with the controller in HBA mode. Uninitialized drives are also compatible with any HBA and can be exchanged with drives on the motherboard's SATA interface. For more information about uninitialized devices and controller modes, see *General Controller Settings* on page 61.

To begin uninitializing a disk drive, select **Uninitialize Drives** from the Logical Device Configuration menu, then type `Y` to continue.

C.2.7 Managing Global Hot Spares

A hot spare is a disk drive that automatically replaces any failed drive in a logical drive. A *global* hot spare is not assigned to a specific logical drive. It protects any logical drive on the controller (except RAID 0 logical drives). You can create and delete global hot spares even if no arrays exist.

To create and delete global hot spares:

1. Select **Global Hotspares** from the Logical Device Configuration menu.

   The Global Hotspare Management window opens.

2. Using the arrow keys, select a drive from the list. Existing hot spares are highlighted.

3. Press `Ins` to create a new global hot spare. Press `Del` to delete a hot spare.

4. Press `Enter` to save your changes and return to the main menu.

C.3 Using the ARC Utility to Modify Controller Settings

The ARC Controller Settings tool allows you to modify the settings of your controller and the disk drives connected to it.

C.3.1 Opening the Controller Settings Tool

To open the ARC Controller Settings tool, start the ARC utility (see *Running the ARC Utility* on page 56), select **Controller Settings** from the ARC main menu, then press `Enter`.

Follow the on-screen instructions to modify the settings of your controller and connected disk drives, as needed.

C.3.2 Applying Changes and Exiting

1. To exit the Controller Settings tool, press `Esc` until you are prompted to exit.

   If you modified any settings, you are prompted to save the changes before you exit.

2. Select `Yes` to exit, then press any key to restart your computer.

   Any changes you made take effect after the computer restarts.

C.3.3 Modifying Your Controller's Configuration

> **Note:** Default controller settings are suitable for most computers. We recommend that you *do not* change the default setting.

To modify your controller's basic settings, select **Controller Configuration** from the main Controller Settings menu.

To modify your controller's power management settings, select **Advanced Configuration**.

Some options may not be available for your controller.

C.3.3.1 General Controller Settings

> **Note:** Default settings are shown in **bold** type.

Option	Description
Drive's Write Cache	When set to Enable All, write cache is enabled on all disk drives on the controller. (Enabling the write cache overrides any individual drive settings in maxView Storage Manager or the BIOS.) When set to Disable All, write cache is not used on the disk drives. When set to Drive Specific, write cache is enabled/disabled on a per-drive basis. Default is **Drive Specific**. **Caution:** When write cache is enabled, there is a slight possibility of data loss or corruption during a power failure.
Runtime BIOS	When **enabled**, the controller BIOS allows the controller to act as a bootable device. Disabling the BIOS allows another controller to act as a bootable device.
Automatic Failover	When **enabled**, the controller automatically rebuilds an array when a failed disk drive is replaced. When disabled, the array must be rebuilt manually.
Array Background Consistency Check	When enabled, the controller constantly verifies a redundant array. Note that there may be a significant performance reduction. Default is **disabled**.
Device-based BBS Support	When enabled in systems that support BBS, the controller presents attached bootable devices up to the BIOS for boot device selection. This is relevant for logical arrays. Default is **disabled**.
SATA Native Command Queuing (NCQ)	When enabled, NCQ is enabled. Only available with SATA II disk drives.
Physical Drives Display During POST	When enabled, connected disk drives are displayed during system Power On Self Test (POST). Displaying the disk drives adds a few seconds to the overall POST time. Default is **disabled**.
DVD/CD-ROM Boot Support	When **enabled**, the system can be booted from a bootable DVD/CD. (This setting is not available on all models.)
Removable Media Devices Boot Support	When **enabled**, removable media devices, such as CD drives, are supported. (This setting is not available on all models.)
Alarm Control	When enabled, the alarm sounds. Default is **enabled**. **Note:** When the alarm is turned off (disabled), it will remain off after a reboot.
Default Background Task Priority	Sets the default priority for background tasks on the controller (such as logical drive creation) to High, Medium, or Low. Default is **High**. **Note:** This setting applies to new tasks. It does not affect currently running tasks.
Backplane Mode	Series 8 Controllers:

Option	Description
	When set to Default, controller automatically sets the backplane mode to IBPI. To set the backplane mode explicitly, select IBPI, SGPIO, or Disabled. Default is **IBPI**. **Note:** With the default IBPI setting, the firmware sends a SGPIO "Backplane_TYPE" signal if it recognizes that a SGPIO Backplane is connected. If any connected SGPIO backplane does not support the "Backplane_TYPE" signal, or it does not support the IBPI protocol, you can manually set the Backplane Mode to "SGPIO".

Table 1 • IBPI LED Blink Pattern

Interpretation	2 LEDs per Slot		3 LEDs per Slot		
	Activity LED	Status LED	Activity LED	Locate LED	Fail LED
Drive not present	Off	X	Off	X	X
Drive present, no activity	On	X	On	X	X
Drive present, activity	4 Hz (Blink)	X	4 Hz (Blink)	X	X
Locate (Identify)	4 Hz (Blink)	4 Hz (Blink)	X	4 Hz (Blink)	Off
Fail	X	On	X	Off	On
Rebuild	X	1 Hz (Blink)	X	Off	1 Hz (Blink)

Table 2 • SGPIO LED Blink Pattern

Interpretation	Activity LED	Locate LED	Fail LED
Activity	On	X	X
No activity	Off	X	X
Locate (Identify)	X	On	Off
Fail	X	Off	On
Rebuild	X	On	On

Option	Description
Selectable Performance Mode	When set to Dynamic, performance criteria adjusts automatically based on controller usage, RAID level, and disk drive type. When set to OLTP/Db, performance criteria is optimized for transaction-oriented applications, such as data entry and retrieval. When set to Big Block Bypass, DRAM write cache is bypassed based on IO write size; performance criteria is optimized for serving Web pages, file serving, and data retrieval. When set to User Defined, you are prompted to use the OS tools to set individual parameters (contact support for more information). Default is **Dynamic**.
Controller Mode	• When set to RAID: Expose RAW mode, all RAID functions of the controller are enabled. Attached drives without metadata are surfaced to the host operating system as RAW Pass Through devices (similar to JBODs on legacy Adaptec controllers). • When set to RAID: Hide RAW mode, all RAID functions of the controller are enabled, but RAW devices are not exposed to the operating system. • When set to HBA Mode, attached drives are surfaced as RAW devices. The intent of this mode is to allow the RAID controller to act and be used as an HBA. Changing into HBA mode is allowed only if there are no drives with metadata attached to the controller,

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Option	Description
	including hot spare drives (see *Uninitializing Disk Drives* on page 60 for more information). Uninitialized drives are compatible with *any* HBA and can be exchanged with drives on the motherboard's SATA interface. • When set to Auto Volume Mode, attached drives without metadata, but with an OS partition, are surfaced to the host operating system as RAW devices, where the RAID layer of the controller firmware is bypassed when the host issues commands to the device. Attached drives without meta-data and without OS partitions, are automatically configured as Simple Volumes (single drives with meta-data). In Auto Volume Mode, you can create up to a maximum of 128 Simple Volumes; no other RAID types are supported. Auto Volume Mode enables DRAM caching on rotating media to help reduce latency and accelerate performance. • When set to Simple Volume mode, you can create Simple Volumes only (up to a maximum of 128 volumes); no other RAID types are supported. **Note:** Before you can change into Auto Volume mode or Simple Volume mode, you must delete existing RAID arrays, maxCache Devices, and hot spares drives (if any). Default is **RAID: Expose RAW** mode.
Max Link Speed (uEFI only)	Sets the maximum connection speed for SAS devices to 6 Gb/s or 12 Gb/s. Default is taken from firmware.

C.3.3.2 Power Management Settings

Note: Default settings are shown in **bold** type.

Option	Description
Power Management Settings	When enabled, switches the system to low power state, based on the specified settings.
Time Zone	The time zone of the place in which the system is located. Time specific power management settings are implemented based on the set time zone. By default, it is set to **00:00**. The valid range for the time zone settings is -12:00 to +12:00.
Stay Awake Start	The time from which the system should operate in the full power mode, irrespective of other power management settings, daily. By default it is set to **00:00**. The valid range is 00:00 to 23:59.
Stay Awake End	The time until which the system should operate in the full power mode, irrespective of other power management settings, daily. By default it is set to **00:00**. The valid range is 00:00 to 23:59.
Spin Up Limit (Internal)	The number of internal drives to be spun up at wakeup. By default it is set to **0**. In the default setting, all the internal drives will spin up.
Spin Up Limit (External)	The number of external drives to be spun up at wakeup. By default it is set to **0**. In the default setting, all the external drives will spin up.

C.3.3.3 Preserving the Controller Cache

Note: This option is available in the uEFI interface only.

Follow the on-screen instructions to toggle the controller's cache preservation policy; clear the preserved cache for one or more logical drives; and check the controller cache preservation state.

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C.3.3.3.1 Enabling and Disabling Controller Cache Preservation

This option toggles the controller cache preservation state. With cache preservation enabled, the system preserves the controller's DDR cache to prevent data loss in the event of (1) a power failure or unsafe shutdown of external enclosures while the host system, with the controller, still has power; and (2) connectivity problems with drives.

"Dirty pages" (data that have not been committed to disk) are restored to the cache when power is restored and the logical drives on the controller are back online. Once the preserved cache is restored, the controller flushes the data to disk using its normal scheduling mechanism.

> **Note:** You cannot enable maxCache read and/or write caching on a controller with cache preservation enabled. In addition, the following operations are not permitted on a controller in the cache preserved state:
> - Creating a logical drive
> - Changing the Performance mode
> - Running a consistency check
> - Changing the RAID Level of a logical drive
> - Forcing a logical drive online or offline
> - Changing the cache page size

To enable controller cache preservation:

1. Start the ARC utility in uEFI mode (see *Ctrl-A or uEFI/HII?*).

2. Scan for controllers, then select the controller you want.

3. Select **Controller Settings**.

4. Select **Controller Configuration**, then select **Cache Preservation**.

5. Select **Enabled**.

C.3.3.3.2 Clearing the Controller Cache

You can clear the preserved dirty cache (data not committed to disk) for a specific logical drive or for all logical drives on the controller if you expect a failed enclosure or logical drive to remain offline.

To clear the cache for all logical drives on the controller:

1. Start the ARC utility in uEFI mode (see *Ctrl-A or uEFI/HII?*).

2. Scan for controllers, then select the controller you want.

3. Select **Controller Settings**.

4. Select **Clear Cache Preserved on Controller**.

To clear the cache for a specific logical drive:

1. Start the ARC utility in uEFI mode (see *Ctrl-A or uEFI/HII?*).

2. Scan for controllers, then select the controller you want.

3. Select **Logical Device Configuration**, then select a logical drive.

4. Select **Clear Cache Preserved**.

C.3.3.3.3 Checking the Cache Preservation Status

To check the controller's cache preservation status, select **Controller State** from the Controller Settings, Advanced Configuration menu. With cache preservation enabled, the controller enters the Cache Preserved state; otherwise, it remains in the Optimal state.

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C.3.4   Checking Backup Unit Status

To check the status of the controller's flash backup unit, select **Backup Unit Status** from the Controller Settings menu. *Table 3 • Backup Unit Status* on page 65 describes the backup unit states. This option is available only if the controller is configured with a flash backup unit.

Table 3 • Backup Unit Status

Status	Meaning
Not Present, Not Ready	Supercapacitor not present, suffered a fatal error, or backup unit temperature exceeded allowed maximum.
Preparing	Backup unit preparing the NAND flash for backup. The supercapacitor can take up to 10 minutes to charge to 100% from zero charge and report Ready status.
Ready	Backup unit is ready to be enabled if NAND is prepared and supercapacitor is charged.
Invalid, Not Supported	Green backup feature not enabled in firmware.
Failed, Fatal	Firmware could not retrieve backup unit information or configuration due to hardware issues, over-voltage, etc.
Health Normal/Low/Dead	Indicates overall energy holding ability of the supercapacitor. Dead status means that supercapacitor should be replaced.

C.4   Formatting and Verifying Disk Drives

You can use the ARC Disk Utilities tool to low-level format or verify your disk drives. (New disk drives are low-level formatted at the factory and do not need to be low-level formatted again.)

> **Caution:** Before you format a disk drive, back up all data. Formatting destroys all data on a disk drive.

To format or verify a disk drive:

1. Start the ARC utility (see *Running the ARC Utility*).

2. Select the controller you want, then press `Enter`.

3. Select **Disk Utilities**.

4. Select the disk drive you want, then press `Enter`.

5. Select **Format Disk** or **Verify Disk Media**.

C.5   Locating Disk Drives

You can use the Identify Drive feature to physically locate a disk drive by blinking the LED.

> **Note:** This feature is only available with disk drives that have an activity LED.

To locate a disk drive:

1. Start the ARC utility (see *Running the ARC Utility*).

2. Select the controller you want, then press `Enter`.

3. Select **Disk Utilities**.

4. Select the disk drive you want, then press `Enter`.

5. Select **Identify Drive**, then press `Enter`.

6. When you have finished locating your disk drive, press any key to stop the blinking.

C.6 Identifying Disk Drives

You can identify disk drives by viewing the list of disk drives on your system. Only physical drives that display during POST are shown.

To identify a disk drive:

1. Start the ARC utility (see *Running the ARC Utility*).

2. Select the controller you want, then press `Enter`.

3. Select **Disk Utilities**.

   The Disk Utilities view provides you with the following information:

Location	Model	Rev#	Speed	Size
CN1=DEV1 Box0=Slot0 Exp0=phy0	The manufacturer information.	The revision number of the disk drive.	The speed of the disk drive.	The size of the disk drive.

   The location information of a disk drive is determined by three types of connections:
   - Direct attached drives—The connection is determined by the cable connected to a device, for example CN1 (connector 1) is connected to DEV1 (device 1). For more information, see *Direct-attach Connections*.
   - Storage Enclosure Processor (SEP) managed devices—The connection is determined by an active backplane. Box0 (enclosure 0) is connected to slot0 (disk drive slot 0 in the enclosure). For more information, see *Backplane Connections*.
   - Expanders—The connections is determined by an expander. Exp0 (expander 0) is connected to phy0 (phy 0 within a connector). For more information, see *SAS Expander Connections*.

     Note: Devices other than disk drives (CDROM, tape drives, etc...) are listed in order after your system disk drives.

C.7 Setting the Drive Write-Cache Policy

If the global write cache policy is set to "Drive Specific" (see *General Controller Settings* on page 61), you can set the write-cache policy for individual disk drives on the controller. (If the global write-cache policy is set to Enable All or Disable All, this option is grayed out.)

To set the drive-specific write-cache policy:

1. Start the ARC utility (see *Running the ARC Utility*).

2. Select the controller you want, then press `Enter`.

3. Select **Disk Utilities**.

4. Select the disk drive you want, then press `Enter`.

5. Select **Write Cache**, then choose the policy for the drive: **Write-Back (Enable)** or **Write-Through (Disable)**.

6. Select **Submit**.

C.8 Updating the Controller Firmware

   Note: This option is available in the uEFI interface only.

Use this option to flash the controller's firmware.

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To update the controller firmware:

1. Start the ARC utility in uEFI mode (see *Ctrl-A or uEFI/HII?* on page 56).

2. Select **Administration**, then select **FW update from Media**.

3. Select the device you want to flash, then press `Enter`.

4. Browse the folder hierarchy, select the firmware update (.UFI) file, then press `Enter`.

5. Select **Update Firmware**.
   The firmware is sent to the controller and the system verifies the operation to ensure that it was successful.

6. When the verification is complete, press `Enter` to reboot the server.

C.9   Updating the Controller CPLD

> **Note:** This option is available in the uEFI interface only.

Use this option to update the controller CPLD. (The CPLD includes reset logic, determines board type and feature set, and also provides cable management functions.) You should update the CPLD if the version running on the controller is lower than the version in flash.

> **Note:** CPLD Update is for advanced users only. It is typically used in manufacturing by an OEM/ODM/System Integrator when building a new machine. For more information, contact Support.

To update the controller CPLD:

1. Start the ARC utility in uEFI mode (see *Ctrl-A or uEFI/HII?* on page 56).

2. Select **Administration**, then select **CPLD Information**.
   The system displays the current (running) version of the CPLD and the version available in flash.

3. If the version in flash is newer than the running version, select **Update CPLD**.

4. When prompted, restart the computer.

C.10   Creating a Support Archive

> **Note:** This option is available in the uEFI interface only.

Use this option to save configuration and status information to help Customer Support diagnose a problem with your system. Saved information includes (but is not limited to) device logs, drive logs, event logs, error logs, controller logs, and statistics.

To create a support archive:

1. Start the ARC utility in uEFI mode (see *Ctrl-A or uEFI/HII?* on page 56).

2. Select **Administration**, then select **Save Support Archive**.

3. Select the device where the support archive information will be gathered and stored, then press `Enter`.
   The system gathers the logs and statistics for the device and displays the path where the information is saved.

4. Press any key to complete the operation and exit.

C.11   Viewing the Event Log

The BIOS-based event log records all firmware events, such as configuration changes, array creation, and boot activity.

Some events are not stored indefinitely—the event log is cleared of any non-persistent events each time you restart your computer; additionally, once the log is full, new events overwrite old events.

To view the event log:

1. Start the ARC utility (see *Running the ARC Utility*).

2. Select the controller you want, then press `Enter`.

3. When the ARC utility menu appears, press `Ctrl+P`.

4. Select **Controller Log Information**, then press `Enter`.

   The current event log opens.

D   Using the Adaptec Flash Utility

This chapter describes how to use the Adaptec Flash Utility (AFU), a text-based DOS utility that you can use to update, save, or verify the RAID controller's firmware.

> **Caution:** Although the AFU contains safeguards to prevent you from accidentally damaging your RAID controller's flash contents, it is still important to use the AFU carefully and correctly to avoid rendering your RAID controller inoperable. We recommend that only advanced users familiar with working in DOS use the AFU. For more information, see *Managing Your Storage Space*.

D.1   System Requirements

- DOS version 5.0 or later.

  > **Note:** You can't run the AFU from a DOS command prompt window under any version of Windows.

- At least 8 MB of extended memory.

D.1.1   Compatibility Notes

- Supports HIMEM.SYS; compatible with other DOS drivers running under HIMEM.SYS (for example, SMARTDRV.SYS and SETVER.SYS).
- *Does not* support DOS extenders installed in memory, such as EMM386.SYS and DOS4GW.

D.2   Before You Begin

1. Obtain the firmware (see the following section).

2. Create firmware disk (see *Creating the Firmware Update Disk*).

There are two ways to run the AFU:

1. Using the AFU menus (see *Running the Menu-based AFU*)

2. From the command line (see *Running the AFU from the Command Line*)

D.2.1   Obtaining the Firmware

To obtain RAID controller firmware, you can:

- Download a new firmware file from the Web to get the most recent version of firmware/BIOS and the AFU executable (AFU.exe). The flash image comprises a single User Flash Image (UFI) file.

Visit *www.adaptec.com* for more information.

D.2.2   Creating the Firmware Update Disk

To create the firmware update disks:

1. Copy these files to a USB flash drive or writable CD:

   - AFU.exe
   - A*xxxx*01.ufi

where *xxx* is the model number of your controller.

> **Note:** Most controller model numbers have a suffix. Check that the .ufi file is the correct file for your controller before copying.

2. To use a menu-based AFU, see the following section.
   To run the AFU from the command line, see *Running the AFU from the Command Line*.

D.3 Running the Menu-based AFU

To run the menu-based AFU:

1. Shut down your operating system and reboot to DOS from from a DOS partition on a bootable drive. (You can use a disk drive connected to the controller you are updating.) If your computer isn't set up to boot from a bootable device other than a disk drive, enter the system setup utility to change the setting.

2. Insert the firmware update disk (created using the steps above) containing AFU.exe

3. At the DOS command prompt, type AFU with no arguments.

   The AFU's main menu is displayed.

4. Select **Select Controllers**, then select the RAID controller(s) to be flashed.

   To update multiple RAID controllers in the same system, update the boot controller's flash first, restart the computer, then update the flash for the remaining controllers.

5. Select **Select an Operation**.

6. Choose the operation you want, then follow the on-screen instructions to complete the task:
   - **Update flash image**—Updates all the flash components on a RAID controller with the flash image data from the UFI file.
   - **Save flash image**—Reads the contents of a RAID controller's flash components and saves the data to a UFI file, which you can use to restore a RAID controller's flash if required.
   - **Verify flash image**—Reads the contents of a RAID controller's flash components and compares it to the contents of the specified UFI file.
   - **Display flash information**—Displays version information about a RAID controller's flash components.

7. Complete the flash operation and restart your computer before trying to use the RAID controller again. (You can not use your RAID controller while you are updating its flash.)

   The AFU processes the selected command and reports either success or an error message code.

D.4 Running the AFU from the Command Line

> **Note:** You can also run a menu-based AFU (see *Running the Menu-based AFU*).

To run the AFU from the command line:

1. Shut down your operating system and reboot to DOS from a DOS partition on a bootable drive. (You can use a disk connected to the controller you're updating.) If your computer isn't set up to boot from a bootable device other than a disk drive, enter the system setup utility to change the setting.

2. Insert the firmware update disk containing AFU.exe.

3. At the DOS command, type AFU followed by a command (see *AFU Commands*) and any switches you want.

   > **Note:** To find a controller number, type AFU LIST, then press Enter.

   The AFU processes the command and reports either success or an error message code.

To update a RAID controller's flash using the command line utility ARCCONF, see *Updating the Flash Using the AFU Command Line*.

D.4.1 AFU Commands

This section lists the available AFU commands.

D.4.1.1 List

Displays the AFU-supported RAID controllers installed on your computer. Also displays the ID numbers assigned to each controller.

You don't have to restart the computer after completing this command.

```
This example shows a typical system response to a LIST command:

A:\> AFU LIST
Adaptec Flash Utility V4.0-0 B5749 (c)Adaptec Inc. 1999-2005. All
Rights Reserved.
Controllers Detected and Recognized:
Controller #0 (03:05:00) Adaptec RAID 51645
```

D.4.1.2 Save

Saves the contents of a RAID controller's flash in a UFI file. The name of the UFI file is based on the controller type and can't be changed.

You must restart the computer following a SAVE command.

The command syntax for the SAVE command is:

```
AFU SAVE [/C<Controller ID>] [/D <UFI File Path>]
```

These switches are available:

- /C <Controller ID>—One or more RAID controller IDs representing the set of RAID controllers on which to perform the specified command. The default is 0; if the computer has multiple RAID controllers, the AFU defaults to controller 0 unless you specify otherwise.

  For example:

  To specify a single RAID controller ID: /C 0

  To specify multiple IDs separated by commas: /C 0,2

  To indicate all RAID controllers:ALL

  If you are using multiple RAID controllers, you must specify the controller you want by using the /C switch; otherwise, the AFU displays an error message and exits.

- /D <UFI File Path>—Specifies the path where the UFI files are located. If you do not specify the /D switch, the AFU looks for (or creates) its UFI files in the default location.

  You cannot specify the name of a UFI file, only its path. UFI filenames are predefined, based on the RAID controller type.

  In this example, the AFU saves flash contents from RAID controller 0 to a UFI file in the current default drive and directory:

  ```
  A:\> AFU SAVE /C 0
  ```

  In this example, the AFU saves flash contents from Controller 1 to a UFI file in C:\UFI_FILES:

  ```
  A:\> AFU SAVE /C 1 /D C:\UFI_FILES
  ```

D.4.1.3 Update

Updates the flash components of one or more RAID controllers on your computer from the flash image data in a UFI file. You must restart the computer following an UPDATE command.

The command syntax for the UPDATE command is:

```
AFU UPDATE [/C<Controller ID>] [/D <UFI File Path>]
```

> This example shows a typical system response after an update.
>
> ```
> A:\> AFU UPDATE /C 0
> Adaptec Flash Utility V4.0-0 B5749
> (c)Adaptec Inc. 1999-2005. All Rights Reserved.
> Updating Controller 0 (Adaptec RAID 31205)
> Reading flash image file (Build 5749)
> AFU is about to update firmware on controllers Adaptec RAID 51645
> ***PLEASE DO NOT REBOOT THE SYSTEM DURING THE UPDATE***
> This might take a few minutes.
> Writing Adaptec RAID 51645 (4MB) Flash Image to controller 0...OK.
>
> Verifying...OK
> Please restart the computer to allow firmware changes to take effect.
> ```

D.4.1.4 Verify

Compares the contents of each of the flash components on a RAID controller to the corresponding image in a UFI file, and indicates whether they match. After using the VERIFY command, you must restart the computer.

The command syntax for the VERIFY command is as follows:

```
AFU VERIFY [/C<Controller ID>] [/D <UFI File Path>]
```

> This example shows a typical system response after a VERIFY command.
>
> ```
> A:\> AFU VERIFY /C 0
> Adaptec Flash Utility V4.0-0 B5749 (c)Adaptec Inc. 1999-2005. All
> Rights Reserved.
> Reading flash image file (Build 5748) Controller #0: Adaptec RAID
> 51645
> ROM: Checksum: 797B [VALID] (Build 5748)
> File: Checksum: 797B [VALID] (Build 5748)
>                 Image Compares Correctly
> ```

D.4.1.5 Version

Displays version information about the flash components on a RAID controller. After using the VERSION command, restart your computer.

The command syntax for the VERSION command is:

```
AFU VERSION [/C<Controller ID>]
```

> This example displays version information about all supported RAID controllers.
>
> ```
> A:\> AFU VERSION /C 0
> Adaptec Flash Utility V4.0-0 B5749 (c)Adaptec Inc. 1999-2005.
> All Rights Reserved.
> Version Information for Controller #0 (Adaptec RAID 51645)
> ROM: Build 5748 [VALID] Fri Sep 27 13:28:40 EDT 2005
> A:\> AFU VERSION /C ALL
> ```

D.4.1.6 Help

Displays a summary of `AFU` functions and command switches.

```
For example:

 A:\> AFU HELP


 A:\> AFU /?
```

D.5 Updating the Flash Using the AFU Command Line

1. Create the firmware update disk (see *Creating the Firmware Update Disk*).

2. Shut down your operating system and reboot to DOS from a DOS partition on a bootable drive. (You can use a disk connected to the controller you're updating.) If your computer isn't set up to boot from a bootable device other than a disk drive, enter the system setup utility to change the setting.

3. Insert the firmware update disk containing AFU.exe

4. At the DOS command, if you have multiple controllers and you don't know the number of the controller you want to update, type `AFU LIST`, then press `Enter`. Otherwise, skip to the next step.

5. At the DOS command, type AFU followed by a command (see *AFU Commands*) and any switches you want.

6. Update the flash using the instructions suitable for your requirements:

   • To update a single RAID controller:

     `AFU UPDATE /C <cont_number>`

     Where *<cont_number>* is the number of the RAID controller whose firmware you are updating. For example, to upgrade Controller 0, type `AFU UPDATE /C 0`

   • To update multiple RAID controllers:

     `AFU UPDATE /C <cont_number_a>,<cont_number_b>`

     Where *<controller_number_a>* and *<controller_number_b>* are the numbers of the RAID controllers whose firmware you are updating. For example, to upgrade controllers 0, 2, and 3, type `AFU UPDATE /C 0, 2, 3`

   • To update all RAID controllers simultaneously:

     `AFU UPDATE /C all`

     Note: The UFI file identifies the RAID controllers, so you don't have to worry about flashing the wrong controller.

7. When prompted, insert the firmware disk.
   The AFU processes the command and reports either success or an error message code.

E   Safety Information

To ensure your personal safety and the safety of your equipment:

- Keep your work area and the computer clean and clear of debris.
- Before opening the system cabinet, unplug the power cord.

E.1   Electrostatic Discharge (ESD)

Caution: ESD can damage electronic components when they are improperly handled, and can result in total or intermittent failures. Always follow ESD-prevention procedures when removing and replacing components.

To prevent ESD damage:

- Use an ESD wrist or ankle strap and ensure that it makes skin contact. Connect the equipment end of the strap to an unpainted metal surface on the chassis.
- Avoid touching the controller against your clothing. The wrist strap protects components from ESD on the body only.
- Handle the controller by its bracket or edges only. Avoid touching the printed circuit board or the connectors.
- Put the controller down only on an antistatic surface such as the bag supplied in your kit.
- If you are returning the controller to Product Support, put it back in its anti-static bag immediately.

If a wrist strap is not available, ground yourself by touching the metal chassis before handling the controller or any other part of the computer.

F Technical Specifications

F.1 Environmental Specifications

Note: s require adequate airflow to operate reliably. The recommended airflow is 200 LFM (linear feet per minute), minimum. Forced airflow is **required**.

Ambient temperature with forced airflow	0 °C to 55 °C
Ambient temperature with Flash Backup Unit	0 °C to 55 °C
Relative humidity	10% to 90%, non-condensing
Altitude	Up to 3,000 meters

Note: Ambient temperature is measured 1 inch from the processor.

F.2 DC Power Requirements

Bus Type	Description	Requirements
PCIe	Ripple and noise	50 mV peak-to-peak (max.)
PCIe	DC voltage	3.3 V ± 9%, 12 V ± 8%

F.3 Current Requirements

Controller Model	Typical Current
RAID 8405/8405E	0.1 A at 3.3 VDC; 1.2 A at 12.0 VDC
RAID 8805/8805E	0.1 A at 3.3 VDC; 1.2 A at 12.0 VDC
RAID 8885/8885Q	0.1 A at 3.3 VDC; 1.2 A at 12.0 VDC
RAID 81605Z/81605ZQ	1.0 A at 3.3 VDC; 1.1 A at 12.0 VDC

F.4 Supercapacitor Ratings

Specification	Flash Backup Module AFM-700
Maximum voltage	5.4 V
Minimum voltage	2.5 V
Maximum rated charge current	0.5 A
Maximum rated discharge current	0.5 A
Charge rate	1C

Specification	Flash Backup Module AFM-700
Discharge rate	1C
Operating temperature	0 °C to 55 °C
Storage temperature	−20 °C to 70 °C

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