USER'S GUIDE

MegaRAID® 8480 Storage Adapter

July 2007

LSI LOGIC ®

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Preface

This book is the primary reference and user's guide for the LSI MegaRAID® 8480 RAID Storage Adapter. It contains installation instructions and specifications for the adapter.

For details on how to configure the storage adapter, refer to the *MegaRAID 8480 Software User's Guide*. For information about the operating system drivers, refer to the *MegaRAID 8480 Device Driver Installation User's Guide*.

Audience

This document assumes that you have some familiarity with RAID controllers and related support devices. The people who benefit from this book are:

- Engineers who are designing a system that will include a MegaRAID 8480 SAS Storage Adapter

- Anyone installing a MegaRAID 8480 Storage Adapter in a RAID system

Organization

This document has the following chapters and appendix:

- Chapter 1, **Overview**, provides a general overview of the MegaRAID 8480 Storage Adapter.

- Chapter 2, **MegaRAID 8480 Hardware Installation**, describes the procedures for installing the MegaRAID 8480 Storage Adapter.

- Chapter 3, **MegaRAID 8480 Storage Adapter Characteristics**, provides the characteristics and technical specifications for the MegaRAID 8480 Storage Adapter.

- Appendix A, **Glossary of Terms and Abbreviations**, lists and explains the terms and abbreviations used in this manual.

Related Publications

MegaRAID Battery Backup Unit User's Guide

*IBM Document Numbe*r: 42D8847

This document explains how to install and use the LSI battery backup unit for MegaRAID 8480 Storage Adapter. The 8480 board uses the LSI intelligent Transportable Battery Backup Unit 02 (LSIiTBBU02).

MegaRAID 8480 Device Driver Installation User's Guide

*IBM Document Numbe*r: 42D8845

This document explains how to install the MegaRAID device driver for your operating system. The information in this document is independent of the back-end bus and applies to the Megaraid 8480 Storage Adapter.

MegaRAID 8480 Software User's Guide

*IBM Document Numbe*r: 42D8848

This document explains how to use the MegaRAID Storage Manager, WebBIOS, and Command Line Interface (CLI) utilities to configure, monitor, and maintain MegaRAID 8480 Storage Adapter and the storage-related devices connected to them.

Conventions

Throughout the manual, the conventions described in the following table are used to describe user interaction with the product:

Notation	Example	Meaning and Use
courier typeface	`.nwk` file	Names of commands, files, and directories as well as code and screen messages are shown in courier.
bold typeface	**fd1sp**	In a command line, keywords are shown in bold, non-italic typeface. Enter them exactly as shown.
italics	*module*	In command lines and names italics indicate user variables. Italicized text must be replaced with appropriate user-specified items. Enter items of the type called for, using lowercase.
Initial Capital letters	Undo Edit Apply	Names of menu commands, options, check buttons, text buttons, options buttons, text boxes, list boxes, and so on., are shown in text with Initial Capital lettering to avoid misreading. These elements may appear on your screen in all lowercase.
semicolon, and other punctuation		Use as shown in the text.

Note: Notes contain supplementary information that can affect system performance.

Attention: Attention notices identify actions that might adversely affect equipment operation, system performance, or data integrity.

Revision History

IBM Document Number	Date/Version	Remarks
42D8846	Version 1.2 July 2007	Revised Table 1.1 about the number of physical drives allowed for each RAID level.
42D8846	Version 1.1 April 2007	Made edits and added information about controller limitations, and the number of physical drives supported at each RAID level.
42D8846	Version 1.0 June 2006	Initial release of document.

IBM Customer Support

If you have feedback or questions, you can contact IBM.

E-mail:

askibm@vnet.ibm.com

Phone:

(Toll free) 1-800-IBM-4YOU (1-800-426-4968)

Web site:

https://www.ibm.com/support/us/fbmast.html

Safety Instructions

Use the following safety guidelines to help protect your computer system from potential damage and to ensure your own personal safety.

> Note: Use the MegaRAID 8480 Storage Adapter with UL-listed Information Technology Equipment (ITE) products only.

When Using Your Computer System – As you use your computer system, observe the following safety guidelines:

- Do not operate your computer system with any cover(s) (such as computer covers, bezels, filler brackets, and front-panel inserts) removed.

- To help avoid damaging your computer, be sure the voltage selection switch on the power supply is set to match the alternating current (AC) power available at your location:

    - 115 volts (V)/60 hertz (Hz) in most of North and South America and some Far Eastern countries such as Japan, South Korea, and Taiwan.

    - 230 V/50 Hz in most of Europe, the Middle East, and the Far East. Also be sure your monitor and attached peripherals are electrically rated to operate with the AC power available in your location.

- To help avoid possible damage to the system board, wait 5 seconds after you turn off the system before you remove a component from the system board or disconnect a peripheral device from the computer.

- To help prevent electric shock, plug the computer and peripheral power cables into properly grounded power sources. These cables are equipped with 3-prong plugs to ensure proper grounding.

- Do not use adapter plugs or remove the grounding prong from a cable. If you must use an extension cable, use a 3-wire cable with properly grounded plugs.

- To help protect your computer system from sudden, transient increases and decreases in electrical power, use a surge suppressor, line conditioner, or uninterruptible power supply (UPS).

- Be sure nothing rests on your computer system cables and that the cables are not located where they can be stepped on or tripped over.

- Do not spill food or liquids on your computer. If the computer gets wet, consult the documentation that came with it.

- Do not push any objects into the openings of your computer. Doing so can cause fire or electric shock by shorting out interior components.

- Keep your computer away from radiators and heat sources. Also, do not block cooling vents. Avoid placing loose papers underneath your computer; do not place your computer in a closed-in wall unit or on a rug.

When Working Inside Your Computer –

Attention: Always follow the installation and service instructions provided with your computer closely.

1. Review all of the safety information provided with your computer.

2. Turn off your computer and any peripherals.

3. Disconnect your computer and peripherals from their power sources. Also disconnect any telephone or telecommunications lines from the computer.

   Doing so reduces the potential for personal injury or shock.

Also note these safety guidelines:

- When you disconnect a cable, pull on its connector or on its strain-relief loop, not on the cable itself. Some cables have a connector with locking tabs; if you are disconnecting this type of cable, press in on the locking tabs before you disconnect the cable. As you pull connectors apart, keep them evenly aligned to avoid bending any connector pins. Also, before you connect a cable, make sure both connectors are correctly oriented and aligned.

- Handle components and cards with care. Do not touch the components or contacts on a card. Hold a card by its edges or by its metal mounting bracket. Hold a component such as a microprocessor chip by its edges, not by its pins.

Protecting against Electrostatic Discharge – Static electricity can harm delicate components inside your computer. To prevent static damage, discharge static electricity from your body before you touch any of your computer's electronic components, such as the microprocessor. You can do so by touching an unpainted metal surface, such as the metal around the card-slot openings at the back of the computer.

As you continue to work inside the computer, periodically touch an unpainted metal surface to remove any static charge your body may have accumulated. In addition to the preceding precautions, you can also take the following steps to prevent damage from electrostatic discharge:

- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the antistatic packing material until you are ready to install the component in your computer. Just before unwrapping the antistatic packaging, be sure to discharge static electricity from your body.

- When transporting a sensitive component, first place it in an antistatic container or packaging.

- Handle all sensitive components in a static-safe area. If possible, use antistatic floor pads and workbench pads.

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Chapter 1
Overview

This section provides a general overview of the Megaraid 8480 Storage Adapter with RAID control capabilities. It consists of the following sections:

1.1   Overview

The MegaRAID 8480 Storage Adapter is a high-performance intelligent PCI Express-to-SCSI/Serial ATA II adapter with RAID control capabilities. The MegaRAID 8480 Storage Adapter provides reliability, high performance, and fault-tolerant disk subsystem management. It is an ideal RAID solution for the internal storage of workgroup, departmental, and enterprise systems. The MegaRAID 8480 Storage Adapter offers a cost-effective way to implement RAID in a server.

SAS technology brings a wealth of options and flexibility with the use of SAS devices and Serial ATA (SATA) II devices within the same storage infrastructure. However, SAS and SATA devices bring individual characteristics that make each one a more suitable choice depending on your storage needs. MegaRAID gives you the flexibility to combine these

two similar technologies on the same controller and within the same enclosure.

> Note: You cannot mix SAS and SATA drives within the same *virtual disk(s)*.

The MegaRAID 8480 Storage Adapter is based on the LSI first-to-market SAS IC technology and proven MegaRAID technology. As the second-generation PCI Express storage adapter, the MegaRAID 8480 controller addresses the growing demand for increased data throughput and scalability requirements across midrange and enterprise-class server platforms. LSI offers a family of MegaRAID SAS adapters addressing the needs for both internal and external solutions.

The innovative LSI intelligent Transportable Battery Backup Unit 2 (LSIiTBBU02) is pre-installed on the MegaRAID 8480 RAID Controller. The LSIiTBBU02 provides cached data protection, which allows system builders to protect cached data even during the most catastrophic system failures.

> Note: You must charge the battery before use. Refer to the *MegaRAID Battery Backup Unit User's Guide* on the *MegaRAID 8480* CD for more information.

The MegaRAID 8480 RAID controller supports the ANSI *Serial Attached SCSI standard, version 1.1*. In addition, the controller supports the SATA II protocol defined by the *Serial ATA specification, version 1.0a*. Supporting both the SAS and SATA II interfaces, the controller is a versatile controller that provides the backbone of both server and high-end workstation environments.

Each port on the MegaRAID 8480 RAID controller supports SAS and/or SATA II devices using the following:

- SAS Serial SCSI Protocol (SSP), which enables communication with other SAS devices

- SATA II, which enables communication with other SATA II devices

- Serial Management Protocol (SMP), which communicates topology management information directly with an attached SAS expander device

- Serial Tunneling Protocol (STP), which enables communication with a SATA II device through an attached expander

1.2 MegaRAID 8480 RAID Controller Description

The MegaRAID 8480 Storage Adapter is available with eight PHYs. The MegaRAID 8480 has one Intel IOP333 I/O processor that controls eight external SAS/SATA ports through two SAS 4x external connectors.

1.2.1 Controller Limitations

The MegaRAID 8480 Storage Adapter has the following limitations:

- You can connect only one device per SAS PHY unless you use an expander

- You can use a maximum external cable length of six feet (LSI recommends using shorter cables, if possible)

- Cables have to meet the SAS specification

- Though you can mix SAS drives and SATA drives in the same virtual disk, LSI strongly discourages the practice

- See Section 3.3.4, "Electrical Characteristics," for information about the power requirements, and Section 3.3.5, "Operating and Non-operating Conditions" for information about the minimum and maximum temperature ranges

1.3 General Description

The MegaRAID 8480 Storage Adapter brings 3.0 Gbit/s Serial Attached SCSI and 3.0 Gbit/s Serial ATA II performance to host adapter, workstation, and server designs. The controller supports external storage devices, which allows you to use a system that supports enterprise-class SAS and desktop-class SATA II drives. Each MegaRAID 8480 Storage Adapter can connect to drives directly and can use expanders to connect to additional drives. Simplified cabling between devices is an additional benefit.

The RAID controller integrates eight high-performance SAS/SATA II PHYs and a PCI Express bus master DMA core. Each of the eight PHYs is capable of 3.0 Gbit/s SAS link rates and 3.0 Gbit/s SATA II link rates.

The RAID controller supports the SAS protocol as described in the *Serial Attached SCSI Standard*, *version 1.1*. The controller also supports the Serial ATA II (SATA II) protocol defined by the *Serial ATA specification, version 1.0a*. SATA II is an extension to SATA 1.0a. In addition, the RAID controller supports the following SATA II features:

- 3 Gbit/s SATA II

- Staggered spin-up

- Hot Plug

- Activity and fault indicators for each PHY

- Port Selector (for dual-port drives)

Each port on the RAID controller supports SAS or SATA II devices using the SSP, SMP, STP, and SATA II. The SSP enables communication with other SAS devices. SATA II enables the RAID controller to communicate with SATA II devices.

1.4   Configuration Scenario

The following is the main scenario in which you can use the MegaRAID 8480 RAID Controller:

- High-end external SAS or SATA II configurations: Disks can be either SATA II or SAS. External enclosure management through in-band, SCSI-enclosed storage. STP and SMP need to be supported.

Figure 1.1 shows a direct-connect configuration. The Inter-IC (I^2C) interface communicates with peripherals. The external memory bus provides a 32-bit memory bus, parity checking, and chip select signals for pipelined synchronous burst static random access memory (PSBRAM), nonvolatile static random access memory (NVSRAM), and Flash ROM.

Figure 1.1   Example of LSI SAS Direct-Connect Application
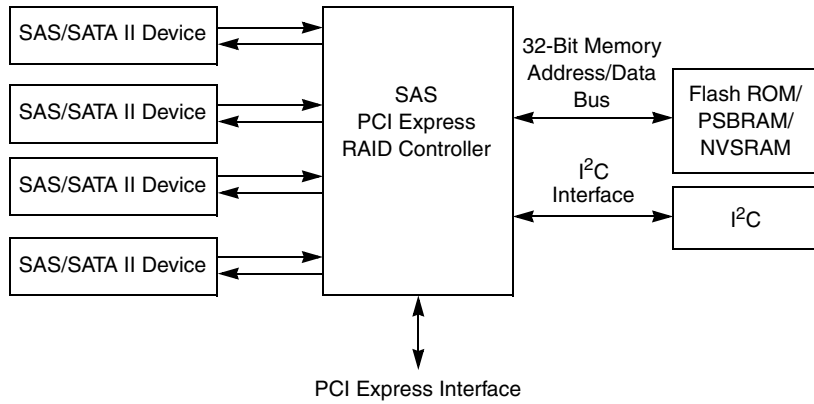
Figure 1.2 shows an example of a RAID controller configured with an LSISASx12 expander that is connected to SAS devices.

Figure 1.2   Example of RAID Controller Configured with LSISASx12 Expander
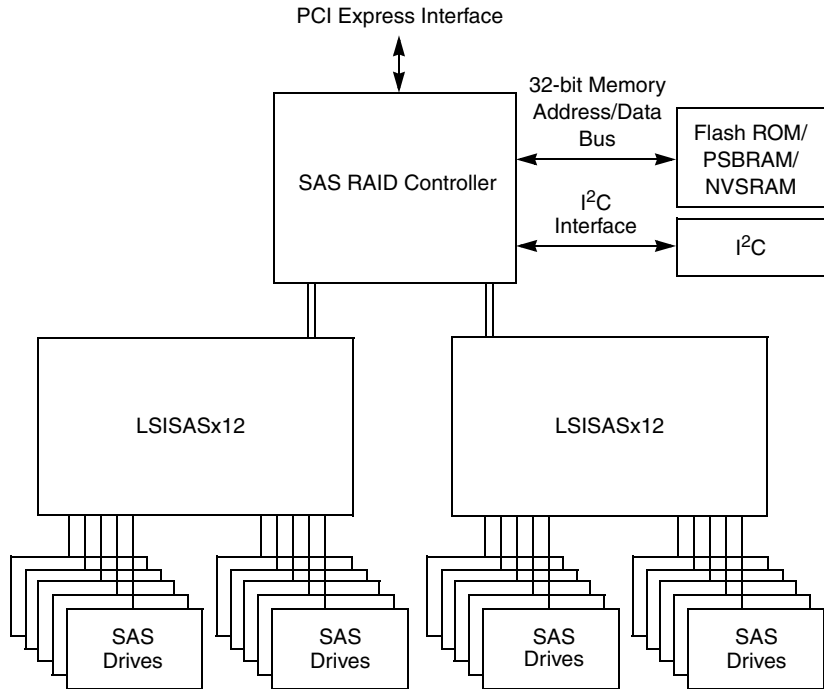
1.4.1   Number of Physical Disks Supported

Your configuration planning for the 8480 RAID controller depends in part on the number of physical disks that you want to use in a RAID array. The number of drives in an array determines the RAID levels that can be supported. Only one RAID level can be assigned to each virtual disk. Table 1.1 shows the minimum and maximum number of drives required for each RAID level.

Table 1.1   Physical Drives Required for Each RAID Level

RAID Level	Minimum # of Physical Drives	Maximum # of Physical Drives
0	1	32

Table 1.1   Physical Drives Required for Each RAID Level (Cont.)

RAID Level	Minimum # of Physical Drives	Maximum # of Physical Drives
1	2	2
5	3	32
10	4	16
50	6	32

1.5   Benefits of the SAS Interface

SAS is a serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. SAS is a convergence of the advantages of SATA II, SCSI, and fibre channel, and is the future mainstay of the enterprise and high-end workstation storage markets. SAS offers a higher bandwidth per pin than parallel SCSI, and improves signal and data integrity.

The SAS interface uses the proven SCSI command set to ensure reliable data transfers, while providing the connectivity and flexibility of point-to-point serial data transfers. The serial transmission of SCSI commands eliminates clock skew challenges. The SAS interface provides improved performance, simplified cabling, smaller connectors, lower pin count, and lower power requirements when compared to parallel SCSI.

The RAID controller leverages a common electrical and physical connection interface that is compatible with Serial ATA technology. The SAS and SATA II protocols use a thin, 7-wire connector instead of the 68-wire SCSI cable or 26-wire ATA cable. The SAS/SATA II connector and cable are easier to manipulate, allow connections to smaller devices, and do not inhibit airflow. The point-to-point SATA II architecture eliminates inherent difficulties created by the legacy ATA master-slave architecture, while maintaining compatibility with existing ATA firmware.

1.5.1 PCI Express Architecture

PCI Express is a local bus system designed to increase data transfers without slowing down the central processing unit (CPU). You can install MegaRAID PCI Express storage adapters in PCI Express computer systems with a standard bracket type. With these adapters in your system, you can connect SCSI and SATA II devices over the bus.

PCI Express goes beyond the PCI specification in that it is intended as a unifying I/O architecture for various systems: desktops, workstations, mobile, server, communications, and embedded devices.

1.5.2 Operating System Support

The MegaRAID 8480 Storage Adapter supports the following operating systems:

- Windows (2000 and Server 2003)
- Red Hat Linux
- SUSE Linux

The MegaRAID 8480 Storage Adapter uses Fusion-MPT™ architecture for all major operating systems, thinner drivers, and better performance.

1.6 Summary of MegaRAID 8480 RAID Controller Characteristics

This section provides a summary of the features and benefits of the MegaRAID 8480 RAID controller. It contains information on SAS features, SATA II features, PCI performance, integration, usability, and flexibility.

The MegaRAID 8480 Storage Adapter includes the following features:

- PCI Express x8 lane width (with support for downshifting for motherboards with x1 and x4 connections)
- PCI Express performance up to 2.5 Gbits/s per lane
- Support for a 256 Mbyte DDR2 400 MHz on-board SDRAM with LSIiTBBU02 intelligible transportable battery backup

- Two external connectors

- Support for RAID levels 0, 1, 5, 10, and 50

- Advanced array configuration and management utilities

- Online RAID level migration

- Drive migration

- Drive roaming

- Patrol Read

- No reboot necessary after expansion

- More than 200 Qtags per array

- User-specified rebuild rate

- 32 Kbyte nonvolatile random access memory (NVRAM) for storing RAID system configuration information; the MegaRAID SAS firmware is stored in flash ROM for easy upgrade.

1.6.1 SAS Features

The following list describes the SAS features:

- Provides eight fully independent PHYs

- Supports 3.0 Gbit/s SAS data transfers per PHY

- Supports SSP to enable communication with other SAS devices

- Supports SMP to communicate topology management information

- Provides a serial, point-to-point, enterprise-level storage interface

- Simplifies cabling between devices

- Provides a scalable interface that supports up to 128 devices through multiple expanders

- Supports wide ports consisting of 2, 3, or 4 PHYs within a single quad port

- Supports narrow ports consisting of a single PHY

- Transfers data using SCSI information units

1.6.2 SATA II Features

The following list describes the SATA II features:

- Supports SATA II data transfers of 3.0 Gbits/s

- Supports STP data transfers of 3.0 Gbits/s

- Provides a serial, point-to-point storage interface

- Simplifies cabling between devices

- Eliminates the master-slave construction used in parallel ATA

- Allows addressing of multiple SATA II targets through an expander

- Allows multiple initiators to address a single target (in a fail-over configuration) through an expander

1.6.3 PCI Express Performance

The following list describes the PCI Express performance features:

- Provides a PCI Express interface that:
  – Supports a dedicated PCI Express bus
  – Supports x4 or x8 lane configuration
  – Supports transfer rates of up to 2.5 Gbits/s per lane
  – Complies with the *PCI Express Specification*, *Revision 1.0a*

- Provides unequaled performance through the Fusion-MPT architecture

- Provides high throughput and low CPU utilization to offload the host processor

- Uses an Intel IOP333 I/O processor

1.6.4 Usability Features

The following list describes the usability features:

- Simplifies cabling with point-to-point, serial architecture

- Supports smaller, thinner cables that do not restrict airflow

- Provides drive spin-up sequencing control

- Provides up to two LED signals for each PHY to indicate link activity and faults

- Provides an I^2C interface for enclosure management

- Supports the internal SAS Sideband signal SFF-8485 (SGPIO) interface

1.6.5 Flexibility Features

These features increase the flexibility of the MegaRAID 8480 RAID controller:

- Supports a Flash ROM interface, a nonvolatile RAM (NVSRAM) interface, and a pipelined synchronous burst SRAM (PSBRAM) interface
- Allows connections to SAS or SATA II targets
- Leverages compatible connectors for SAS and SATA II connections
- Allows grouping of up to four PHYs in a single quad port to form a wide port

1.6.6 Drive Roaming

Drive roaming occurs when the hard drives are changed to different ports on the same controller. When the drives are placed on different channels, the controller detects the RAID configuration from the configuration data on the drives.

Configuration data is saved in both the NVRAM on the RAID controller and on the hard drives attached to the controller. This maintains the integrity of the data on each drive, even if the drives have changed their target ID.

> Note: If you move a drive that is being rebuilt, the rebuild operation will restart, not resume.

Follow these steps to use drive roaming:

Step 1. Review all safety information provided with the server; then, turn off the server and all attached devices and unplug the server and device power cords.

Step 2. Open the host system, following the instructions in the host system technical documentation.

Step 3. Move the drives to different positions on the backplane to change the targets.

Step 4. Determine the SAS target requirements.

Step 5. Perform a safety check.

    a. Make sure the drives are inserted properly.

    b. Close the cabinet of the host system.

    c. Turn power on after completing the safety check.

Step 6. Power-on the system.

The controller then detects the RAID configuration from the configuration data on the drives.

1.6.7 Drive Migration

Drive migration is the transfer of a set of hard drives in an existing configuration from one controller to another. The drives must remain on the same channel and must be reinstalled in the same order as in the original configuration. The controller to which you migrate the drives cannot have an existing configuration.

Note: Only complete configurations can be migrated; individual virtual disks cannot be migrated.

Note: Drive roaming and drive migration cannot be supported at the same time.

Follow these steps to migrate drives:

Step 1. Make sure that you clear the configuration on the system to which you migrate the drives, to prevent a configuration data mismatch between the hard drives and the NVRAM.

Note: When you migrate drives, move only the disks that make up the virtual disk (not all the physical disks in an array), so you do not see an NVRAM mismatch error (providing a configuration is on the destination controller). The NVRAM mismatch error appears only if you move all of the physical drives to the other controller.

Step 2. Review all safety information provided with the server; then, turn off the server and all attached devices and unplug the server and device power cords.

Step 3. Open the host systems by following the instructions in the host system technical documentation.

Step 4. Remove the SAS cable connectors from the internal drives or the shielded cables from the external drives you want to migrate.

    a. Make sure pin 1 on the cable matches pin 1 on the connector.

    b. Make sure that the SAS cables conform to all SAS specifications.

Step 5. Remove the hard drives from the first system and insert them into drive bays on the second system.

Step 6. Connect the SAS cables to the hard drives in the second system.

Step 7. Determine the SAS target requirements.

Step 8. Perform a safety check.

    a. Make sure all cables are properly attached.

    b. Make sure the RAID controller is properly installed.

    c. Close the cabinet of the host system.

    d. Turn power on after completing the safety check.

Step 9. Power-on the system.

The controller then detects the RAID configuration from the configuration data on the drives.

1.7 Hardware Specifications

You can install the MegaRAID 8480 Storage Adapter in a computer with a mainboard that has a PCI Express slot. Table 1.2 describes the hardware configuration features for the MegaRAID 8480 Storage Adapter.

Table 1.2   MegaRAID 8480 Storage Adapter Specifications

Specification	Megaraid 8480 Storage Adapter
RAID Levels	0, 1, 5, 10, and 50
Devices Supported per Port	Up to 15 SAS or SATA II devices (such as hard drives and expanders)
Ports	Eight external
Data Transfer Rate	Up to 3 Gbits/s per phy
Bus	PCI Express 1.0a
Cache Function	Write-back, write-through, adaptive read ahead, non-read ahead, read ahead, cache I/O, direct I/O
Multiple Virtual Disks/ Arrays per Controller	Up to 40 virtual disks per controller or per logical array
Online Capacity Expansion	Yes
Dedicated and Global Hot Spares	Yes
Hot Swap Devices Supported	Yes
Non-Disk Devices Supported	Yes
Mixed Capacity Physical Disks Supported	Yes
Number of External Connectors	MegaRAID 8480 – Two (x4 SAS Port) SFF-8470 SAS 4x connectors
Hardware Exclusive OR (XOR) Assistance	Yes
Direct I/O	Yes
Architecture	Fusion-MPT

1.8   Technical Support

See the *Warranty and Support Information* document for information about the technical support available for this product.

Chapter 2
MegaRAID 8480
Hardware Installation

This chapter describes the procedures used to install the MegaRAID 8480 Storage Adapter. It consists of the following sections:

- Section 2.1, "Requirements"

- Section 2.2, "Quick Installation"

- Section 2.3, "Detailed Installation"

- Section 2.4, "SAS Device Cables"

- Section 2.5, "Replacing a Failed Controller Containing Data in the LSIiTBBU02"

- Section 2.6, "After Installing the Storage Adapter"

2.1   Requirements

The following items are required for installation:

- A MegaRAID 8480 RAID Controller

- A host system with an available PCI Express expansion slot

- The *MegaRAID 8480* CD, containing the drivers and documentation

- The necessary internal and/or external cables

- SAS or SATA II physical disks

    Note: LSI strongly recommends using an uninterruptible power supply (UPS).

2.2   Quick Installation

The following steps are for quick MegaRAID 8480 Storage Adapter
installation. These steps are for experienced computer users/installers.
Section 2.3, "Detailed Installation," contains the steps for all others to
follow.

Step 1.   Review all safety information provided with the server; then,
turn off the server and all attached devices and unplug the
server and device power cords.

Step 2.   Open the cabinet of the host system by following the
instructions in the host system technical documentation.

Step 3.   Check the memory module on the adapter.

Step 4.   Install the MegaRAID 8480 Storage Adapter in the server and
connect SAS or SATA II devices to it. Ensure that the cables
you use conform to all specifications.

Step 5.   Perform a safety check.

a.   Ensure that all cables are properly attached

b.   Ensure that the MegaRAID 8480 Storage Adapter is
properly installed

c.   Close the cabinet of the host system

Step 6.   Turn power on after you complete the safety check.

2.3   Detailed Installation

This section provides detailed instructions for installing a MegaRAID
8480 Storage Adapter.

Step 1.   Unpack the Storage Adapter

Unpack and remove the MegaRAID 8480 Storage Adapter.
Inspect it for damage. If it appears damaged, or if any of the
following items are missing, contact your place of purchase.
The MegaRAID 8480 Storage Adapter is shipped with:

          –   A CD containing MegaRAID drivers for supported operating systems, an electronic version of this *User's Guide*, and other related documentation

          –   A license agreement

          –   Warranty information

Step 2.   Turn off the Power to the System

Review all safety information provided with the computer; then, turn off the computer, unplug the power cords from the power supplies, disconnect the computer from the network, and remove the computer cover. See the documentation provided with the computer for instructions. Before installing the controller, make sure that the computer is disconnected from the power and from any networks.

Step 3.   Review the MegaRAID Controller Connectors

Refer to Chapter 3, "MegaRAID 8480 Storage Adapter Characteristics" for a diagram of the MegaRAID 8480 RAID controller with its connectors.

Step 4.   Review the Controller Limitations

Review Section 1.2.1, "Controller Limitations" before you install the controller in the system.

Step 5.   Check the Memory Module

Ensure that the memory module is present and seated firmly in the dual-inline memory module (DIMM) socket.

Step 6.   Install the MegaRAID 8480 Storage Adapter

Select a PCI Express slot and align the controller's PCI Express bus connector to the slot. Press down gently but firmly to ensure that the card is properly seated in the slot. Secure the bracket to the computer chassis.

Figure 2.1 shows the installation of a RAID controller in a PCI Express slot.

Attention: To avoid damage to the computer, always remove the 8480 RAID Controller from the PCI Express slot before you relocate or ship the computer.

Figure 2.1   Example of MegaRAID Board Installation in a PCI Express Slot
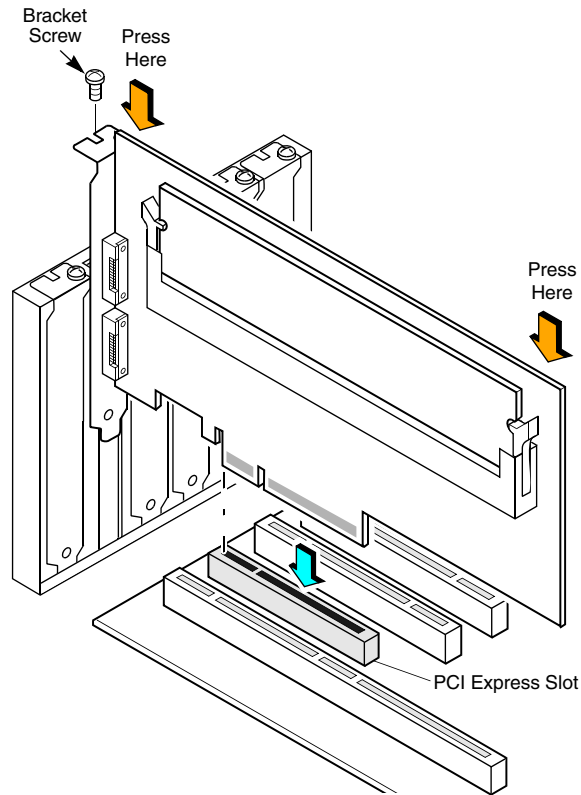
Step 7.   Configure and Install the SAS and/or the SATA II Devices in the Host Computer Case

Refer to the documentation for the devices for any preinstallation configuration requirements.

Step 8.   Connect SAS and/or SATA II Devices to the Storage Adapter

Use SAS cables to connect SAS and/or SATA II devices to the MegaRAID 8480 Storage Adapter. Refer to Section 2.4, "SAS Device Cables" for SAS cable information. Refer to Section 2.4.1, "Connecting the MegaRAID 8480 RAID Controller to Drive Boxes and Drive Expanders," on page 2-8 for details on connecting the controller to physical disks and expanders.

The maximum cable length is six external meters. You can connect one device per SAS PHY unless you use an expander.

System throughput problems can occur if the SAS cables are not the correct type. To minimize the potential for problems:

a. Use cables no longer than six meters (LSI recommends using shorter cables, if possible)

b. Use cables that meet the SAS specification

c. Route the SAS cables carefully

Step 9. Turn on the Power to the System

Replace the computer cover and reconnect the AC power cords; then, turn on the computer. Ensure that the SAS and/or SATA II devices are powered up before or at the same time as the host computer. If the computer is powered up before a SAS or SATA II device, the device might not be recognized.

During boot, a BIOS message appears. The firmware takes several seconds to initialize. The configuration utility prompt times out after several seconds. The second portion of the BIOS message displays the MegaRAID 8480 Storage Adapter number, firmware version, and cache SDRAM size. The numbering of the controller follows the PCI slot scanning order used by the host mainboard.

Step 10. Run the WebBIOS Configuration Utility

Run the WebBIOS Configuration Utility to configure the physical arrays and the logical drives. When the message `Press <Ctrl><H> for WebBIOS` appears on the screen, press CTRL+H immediately to run the utility.

Step 11. Install the Operating System Driver

The RAID controller can operate under various operating systems. To operate under these operating systems, you must install the software drivers.The *MegaRAID 8480* CD includes software drivers for the supported operating systems, along with documentation. You can download the latest drivers at http://www.ibm.com/support/. For updates, click **Downloads and drivers**.

For details on installing the driver, refer to the *MegaRAID 8480 Device Driver Installation User's Guide* on the *MegaRAID 8480*

CD. Be sure to use the latest Service Packs provided by the operating system manufacturer and to review the `readme` file that accompanies the driver.

2.4 SAS Device Cables

This section describes the cables used on the RAID controller and provides step-by-step instructions for connecting SAS and/or SATA II physical disks to the controller. The SAS and SATA II protocols use a thin, 7-wire connector instead of the 68-wire SCSI cable or 26-wire ATA cable.

Note: Use only straight SAS cables, not cross-over SAS cables.

Figure 2.2 displays the SAS cable that connects the internal connectors on a RAID controller to SAS drives.

Figure 2.2   Internal SAS Cable for Connection to SAS and/or SATA II Physical Disks
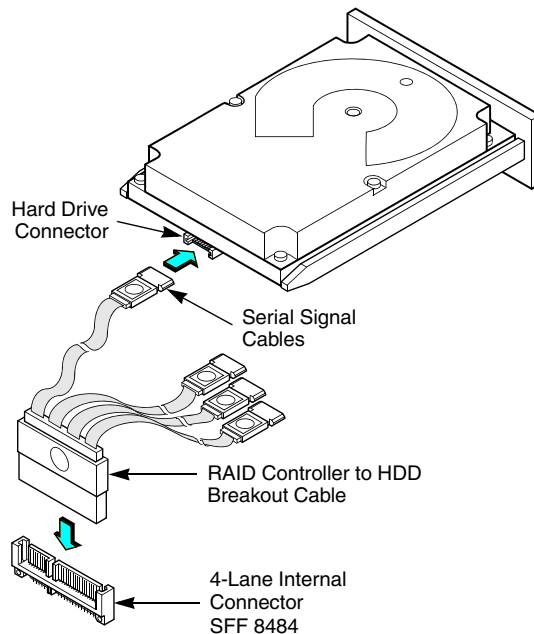
Figure 2.3 displays the SATA II device plug connector used to connect a RAID controller with internal connectors to the host receptable connector

on a backplane. A SATA II connector consists of a signal connector and a power connector.

Figure 2.3   SATA II Connectors
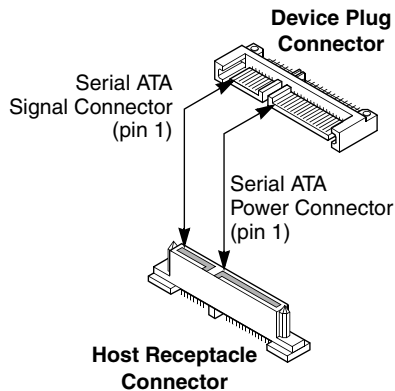
Figure 2.4 shows SAS and SATA II connectors on SAS and SATA II physical disks, respectively. Cables are used for connection between internal connectors on the RAID controller and connectors on SAS and/or SATA II drives, respectively. Both SAS and SATA II physical disks can connect to SAS backplane receptable connectors. The difference between the SAS connector and SATA II connector is the bridge between the SAS primary physical link and power connector on the SAS controller, which the SATA II connector does not have.

> Note: SAS backplane connectors can accept SAS or SATA II physical disks, but SATA II backplane connectors *cannot* accept SAS drives.

Figure 2.4   SAS and SATA II Plugs and SAS Backplane Receptacle Connector
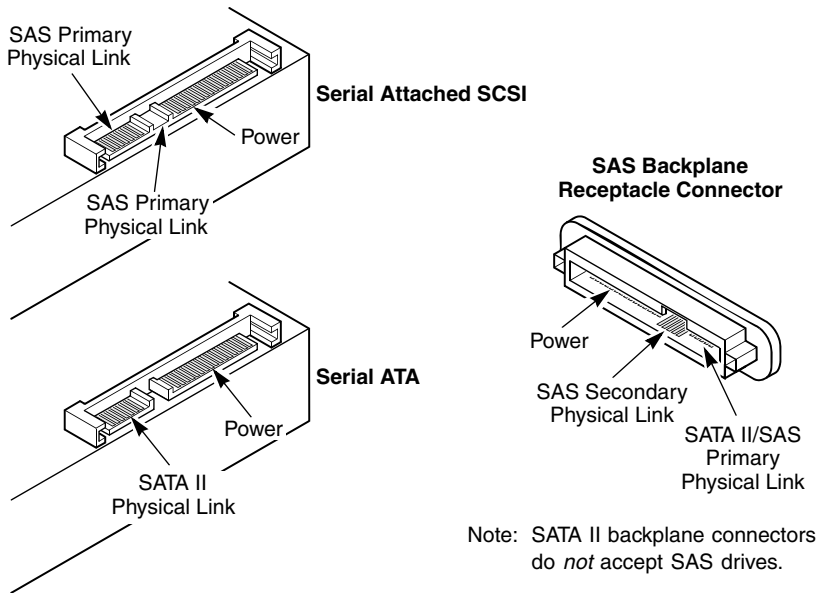
The following subsection provides step-by-step instructions for connecting the MegaRAID 8480 RAID controller to SAS and SATA II physical disks, either directly or through an expander. Figure 2.5 shows the controller connected to physical disks and to expanders, which then connect to physical disks.

2.4.1   Connecting the MegaRAID 8480 RAID Controller to Drive Boxes and Drive Expanders

Figure 2.5 shows how to connect the external SAS cable from the MegaRAID 8480 RAID controller to drive boxes or drive enclosures.

Follow these steps to connect a RAID controller with external connectors to a drive box or drive enclosure.

Step 1.   Connect the 4-lane external PCB receptacle plug on the external cable to the external connector on your RAID controller.

Step 2.   Connect the plug on the other end of the SAS cable to the connector on the drive box or drive enclosure.

**Figure 2.5   Connecting the MegaRAID 8480 RAID Controller with
External Connectors to a Drive Box or Drive Enclosure**

To Drive Box
or Expander Board

4-Lane
External PCB
Receptacle
and Plug and
Cable with
Jackscrews
SFF-8470
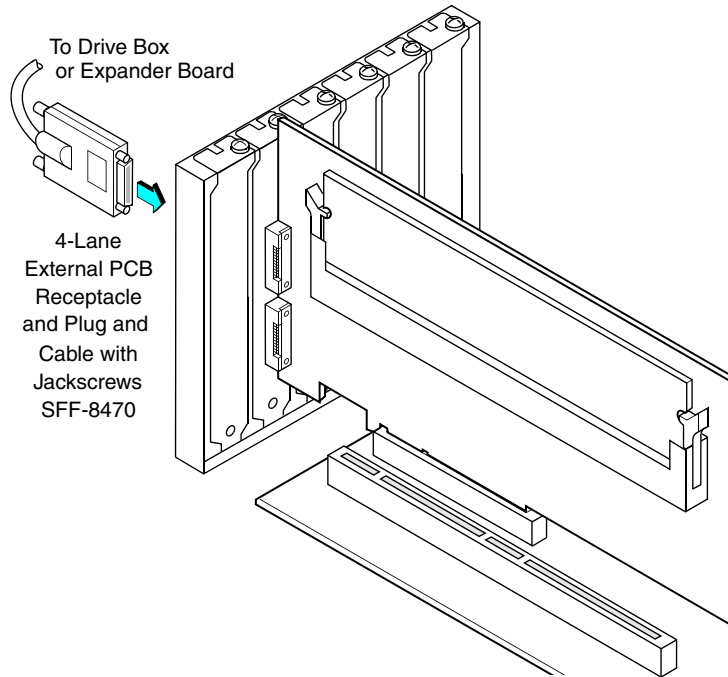
2.5   Replacing a Failed Controller Containing Data in the LSIiTBBU02

The MegaRAID intelligible Transportable Battery Backup Module 2
(LSIiTBBU02) is a cache memory module with an integrated battery
pack. The module provides an uninterrupted power source to the module
if power is unexpectedly interrupted while cached data is still present. If
the power failure is the result of the MegaRAID 8480 Storage Adapter
itself failing, then the LSIiTBBU02 can be moved to a new controller and
the data can be recovered. The replacement controller must have a
cleared configuration.

Note: See the *Warranty and Support Information* document for
the replacement battery part number and battery-disposal
instructions.

Follow these steps to replace a failed controller with data in the transportable battery backup unit.

Step 1.   Review all safety information provided with the server; then, power down the server and the drives.

Step 2.   Remove the failed controller from the system.

Step 3.   Remove the LSIiTBBU02 from the failed controller.

Step 4.   Insert the LSIiTBBU02 into the replacement controller.

Step 5.   Insert the replacement controller into the system.

Step 6.   Power-on the system.

The controller then reads the disk configuration into NVRAM and flushes cache data to the virtual disks.

Note: Refer to the *MegaRAID Battery Backup Unit User's Guide* for additional information about the LSIiTBBU02.

2.6   After Installing the Storage Adapter

After MegaRAID 8480 Storage Adapter installation, you must configure the MegaRAID 8480 Storage Adapter and install the operating system driver. The *MegaRAID 8480 Software User's Guide* instructs you on the configuration options and how to set them on your MegaRAID 8480 Storage Adapter. The *MegaRAID 8480 Device Driver Installation User's Guide* provides detailed installation instructions for operating system drivers.

Chapter 3
MegaRAID 8480 Storage Adapter Characteristics

This chapter describes the characteristics of the LSI MegaRAID Serial Attached SCSI/Serial ATA II 8480 RAID Storage Adapter. It consists of the following sections:

- Section 3.1, "MegaRAID 8480 RAID Controller"
- Section 3.2, "MegaRAID 8480 Storage Adapter Characteristics"
- Section 3.3, "Technical Specifications"

3.1   MegaRAID 8480 RAID Controller

The MegaRAID 8480 RAID controller is a dual PHY, SAS PCI Express adapter and is used in a system with a PCI Express slot. PCI Express goes beyond the PCI specification in that it is intended as a unifying I/O architecture for various systems: desktops, workstations, mobile, server, communications, and embedded devices.

The following subsections provide graphics and connector information for the MegaRAID 8480 RAID controller.

3.1.1 MegaRAID 8480 RAID Controller

The MegaRAID 8480 PCI Express Disk Array RAID Controller has one Intel IOP333 I/O processor, which controls eight internal SAS/SATA ports through two SAS 4x internal connectors.

This subsection provides the board layout and connector information for the MegaRAID 8480 RAID controller, which has eight external SAS/SATA connectors. Figure 3.1 displays the connectors on the controller, while Table 3.1 describes them.

Figure 3.1   Card Layout for the MegaRAID 8480 RAID Controller
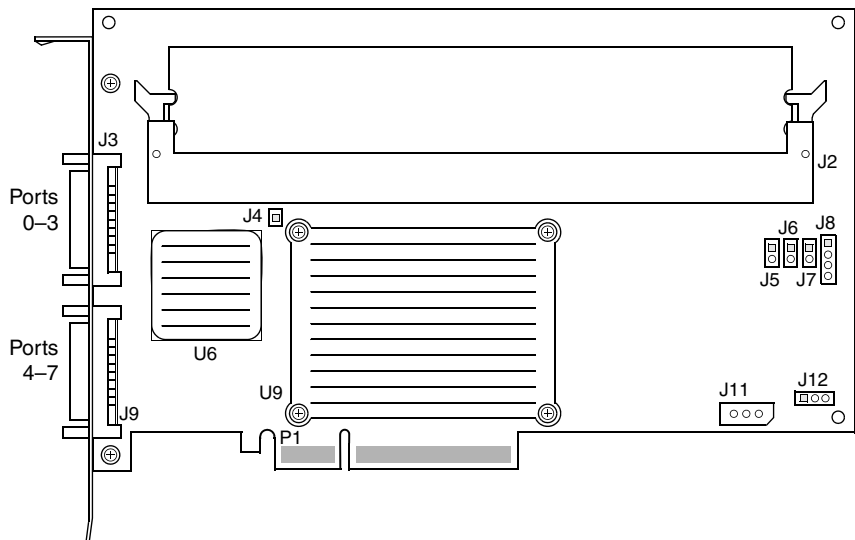
Table 3.1   MegaRAID 8480 RAID Controller – Connectors

Connector	Description	Type	Comments
J2	DIMM Socket	Socket	Holds cache memory module.
J3	Ports 0–3	x4 SAS ports	SAS 4x connector that connects to physical drives and expanders.
J5	Write Pending Indication LED	2-pin connector	Connector for enclosure LED. When lit, it indicates the on-board cache contains data and a write from the cache to the hard drives is pending. Optional.
J6	Firmware Initialization Mode 0 or 3 Select	2-pin connector	Reserved for LSI internal use.
J7	On-board BIOS Enable	2-pin connector	Reserved for LSI internal use.
J8	Universal Asynchronous Receiver/Transmitter (UART) debugging	4-pin connector	Reserved for LSI internal use.
J9	Ports 4–7	x4 SAS ports	SAS 4x connector that connects to physical drives and expanders.
J11	Keyed I^2C connector	3-pin connector	Used for enclosure management. Reserved for LSI internal use.
J12	Unkeyed I^2C connector	3-pin connector	Used for enclosure management. Reserved for LSI internal use.

3.2 MegaRAID 8480 Storage Adapter Characteristics

Table 3.2 shows the general characteristics for the MegaRAID 8480 RAID controller.

Table 3.2   MegaRAID 8480 Characteristics

Flash ROM[1]	Serial EEPROM[2]	SAS Data Transfers	SCSI Features	SCSI Termination
Yes	Yes	Up to 3 Gbits/s per port	Plug and Play Scatter/Gather Activity LED	Active

1. For boot code and firmware.
2. For BIOS configuration storage.

The MegaRAID 8480 RAID controller ensures data integrity by intelligently validating the compatibility of the SAS domain. The 8480 uses Fusion-MPT architecture, which allows for thinner drivers and better performance.

3.3 Technical Specifications

The design and implementation of the MegaRAID 8480 RAID controller minimizes electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. The adapter carries the following marks and certifications:

- CE mark
- C-Tick mark
- FCC Self-Certification logo
- Canadian Compliance Statement, Korean MIC
- Taiwan BSMI
- Japan VCCI

In addition, the adapter meets the requirements of CISPR Class B.

The MegaRAID 8480 RAID controller and the LSIiTBBU02 are CSA C22.2 No. 60950-1, UL 60950-1 First Edition listed Accessory, UL file number E257743.

3.3.1 Storage Adapter Specifications

Table 3.3 lists the specifications for the MegaRAID 8480 RAID controller.

Table 3.3   Storage Adapter Specifications

Specification	MegaRAID 8480 RAID Controller
Processor (PCI Express Host Controller to PCI Secondary I/O Controller)	Intel IOP333 I/O processor @ 500 MHz
Operating Voltage	+3.3 V, +12 V
Card Size	8480 RAID Controller: Standard height, half-length PCI Express adapter card size (4.376" x 6.6")
Array Interface to Host	PCI Express Rev 1.0a
Type of Drives Supported	Serial Attached SCSI (SAS) and Serial ATA II (SATA II)
PCI Express Bus Data Transfer Rate	• Up to 2.5 Gbits/s per lane • x8 lane width (with support for downshifting for motherboards with x1 and x4 connections) • Up to 2 Gbytes/s per direction for SAS x8 cards (4 Gbytes/s total)
Serial Port	3-pin RS232-compatible connector (for manufacturing use only)
SAS Controller(s)	One LSISAS1068 Single SAS controller
SAS Bus Speed	3 Gbits/s
SAS Ports	Two SAS connectors with four SAS ports each
Cache Configuration	8480 RAID controller: Integrated 256 Mbyte Double Data Rate II 400 MHz SDRAM intelligent transportable battery-backed DIMM module
Size of Flash ROM for Firmware	4 Mbytes
Nonvolatile Random Access Memory (NVRAM)	32 Kbytes for storing RAID configuration

3.3.2 Array Performance Features

Table 3.4 shows the MegaRAID 8480 Storage Adapter array performance features.

Table 3.4   Array Performance Features

Specification	MegaRAID 8480 RAID Controller
PCI Express Host Data Transfer Rate	2.5 Gbits/s per lane
Drive Data Transfer Rate	3.0 Gbits/s per lane
Maximum Scatter/Gathers	26 elements
Maximum Size of I/O Requests	6.4 Mbytes in 64 Kbyte stripes
Maximum Queue Tags per Drive	As many as the drive can accept
Stripe Sizes	8, 16, 32, 64, or 128 Kbyte
Maximum Number of Concurrent Commands	255
Support for Multiple Initiators	Yes

3.3.3 Fault Tolerance

Table 3.5 shows the fault tolerance features of the Megaraid 8480 Storage Adapter.

Table 3.5   Fault Tolerance Features

Specification	MegaRAID 8480 RAID Controller
Support for SMART[1]	Yes
Optional Battery Backup for Cache Memory	LSIiTBBU02 battery backup. 4.8V/880mAH battery pack; up to 72 hours of data retention for 256 Mbytes
Drive Failure Detection	Automatic
Drive Rebuild Using Hot Spares	Automatic
Parity Generation and Checking	Yes

1.   The Self Monitoring Analysis and Reporting Technology (SMART) detects up to 70 percent of all predictable disk drive failures. In addition, SMART monitors the internal performance of all motors, heads, and drive electronics.

3.3.4 Electrical Characteristics

This subsection provides the power requirements for the MegaRAID 8480 RAID controller. Table 3.6 lists the maximum power requirements.

Table 3.6   Maximum Power Requirements

RAID Controller	PCI Express +12 V	PCI Express +3.3 V
MegaRAID 8480	12 W; used only if battery is present	9 W

3.3.5 Operating and Non-operating Conditions

For the MegaRAID 8480 RAID controller, the operating (thermal and atmospheric) conditions are:

- Relative humidity range is 5% to 90% noncondensing
- Airflow must be at least 200 linear feet per minute (LFPM) to avoid operating the Intel IOP333 processor above the maximum ambient temperature

The parameters for the non-operating (such as storage and transit) environment for the 8480 are:

- Temperature range: −30 °C to +80 °C without battery backup unit
- Temperature range: 0 °C to +45 °C with LSIiTBBU02 battery backup

3.3.6 Safety Characteristics

The MegaRAID 8480 RAID controller meets or exceeds the requirements of UL flammability rating 94 V0. Each bare board is also marked with the supplier name or trademark, type, and UL flammability rating. The board is installed in a PCI Express bus slot, so all voltages are lower than the SELV 42.4 V limit.

MegaRAID 8480 Storage Adapter Characteristics

Appendix A
Glossary of Terms
and Abbreviations

active termination
The electrical connection required at each end of the SCSI bus, composed of active voltage regulation and a set of termination resistors.

array
An array of disk drives combines the storage space on the disk drives into a single segment of storage space. A hot spare drive does not actively participate in an array.

BIOS
Acronym for Basic Input/Output System. Software that provides basic read/write capability. Usually kept as firmware (ROM-based). The system BIOS on the mainboard of a computer boots and controls the system. The BIOS on your host adapter acts as an extension of the system BIOS.

configuration
Refers to the way a computer is set up, the combined hardware components (computer, monitor, keyboard, and peripheral devices) that make up a computer system, or the software settings that allow the hardware components to communicate with each other.

device driver
A program that allows a microprocessor (through the operating system) to direct the operation of a peripheral device.

domain validation
Domain Validation is a software procedure in which a host queries a device to determine its ability to communicate at the negotiated data rate.

EEPROM
Acronym for Electronically Erasable Programmable Read-Only Memory. It is a memory chip that typically stores configuration information, as it provides stable storage for long periods without electricity and can be reprogrammed. Refer to NVRAM.

external SAS device
A SAS device installed outside the computer cabinet. These devices are connected using specific types of shielded cables.

Fusion-MPT architecture
Fusion-MPT (Message Passing Technology) architecture consists of several main elements: Fusion-MPT firmware, the Fibre Channel and SCSI hardware, and the operating system level drivers that support these

architectures. Fusion-MPT architecture offers a single binary, operating system driver that supports both Fibre Channel and SCSI devices.

host

The computer system in which a storage adapter is installed. It uses the storage adapter to transfer information to and from devices attached to the SCSI bus.

host adapter board

A circuit board or integrated circuit that provides a device connection to the computer system.

hot spare

An idle, powered on, standby drive ready for immediate use in case of disk failure. It does not contain any user data. A hot spare can be dedicated to a single redundant array or it can be part of the global hot-spare pool for all arrays managed by the controller.

When a disk fails, the controller firmware automatically replaces and rebuilds the data from the failed drive to the hot spare. Data can be rebuilt only from virtual disks with redundancy (RAID levels 1, 5, 10, and 50; not RAID level 0), and the hot spare must have sufficient capacity.

internal SAS device

A SAS device installed inside the computer cabinet. These devices are connected by using a shielded cable.

main memory

The part of a computer's memory which is directly accessible by the CPU (usually synonymous with RAM).

NVRAM

Acronym for Nonvolatile Random Access Memory. An EEPROM (Electronically Erasable Read-Only Memory chip) that stores configuration information. Refer to EEPROM.

PCI

Acronym for Peripheral Component Interconnect. A high-performance, local bus specification that allows the connection of devices directly to computer memory. The PCI Local Bus allows transparent upgrades from 32-bit data path at 33 MHz to 64-bit data path at 33 MHz, and from 32-bit data path at 66 MHz to 64-bit data path at 66 MHz.

PCI Express

Acronym for Peripheral Component Interconnect Express. A high-performance, local bus specification that allows the connection of devices directly to computer memory. PCI Express is a two-way, serial connection that transfers data on two pairs of point-to-point data lines. PCI Express goes beyond the PCI specification in that it is intended as a unifying I/O architecture for various systems: desktops, workstations, mobile, server, communications, and embedded devices.

peripheral devices   A piece of hardware (such as a video monitor, disk drive, printer, or CD-ROM) used with a computer and under the control of the computer. SCSI peripherals are controlled through a MegaRAID 8480 Storage Adapter (host adapter).

PHY   The interface required to transmit and receive data packets transferred across the serial bus.

Each PHY can form one side of the physical link in a connection with a PHY on a different SATA device. The physical link contains four wires that form two differential signal pairs. One differential pair transmits signals, while the other differential pair receives signals. Both differential pairs operate simultaneously and allow concurrent data transmission in both the receive and the transmit directions.

RAID   Acronym for Redundant Array of Independent Disks (originally Redundant Array of Inexpensive Disks). An array of multiple independent physical disks managed together to yield higher reliability and/or performance exceeding that of a single physical disk. The RAID array appears to the controller as a single storage unit. I/O is expedited because several disks can be accessed simultaneously. Redundant RAID levels (RAID levels 1, 5, 10, and 50) provide data protection.

RAID levels   A set of techniques applied to disk groups to deliver higher data availability, and/or performance characteristics to host environments. Each virtual disk must have a RAID level assigned to it.

SAS   Acronym for Serial Attached SCSI. A serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. The SAS interface provides improved performance, simplified cabling, smaller connections, lower pin count, and lower power requirements when compared to parallel SCSI. The SAS controller leverages a common electrical and physical connection interface that is compatible with Serial ATA. The SAS controller supports the ANSI *Serial Attached SCSI standard, version 1.0*. In addition, the controller supports the Serial ATA II (SATA II) protocol defined by the *Serial ATA specification, version 1.0a*. Supporting both the SAS and SATA II interfaces, the SAS controller is a versatile controller that provides the backbone of both server and high-end workstation environments. Each port on the RAID controller supports SAS and/or SATA II devices.

A-3

SAS device   Any device that conforms to the SAS standard and is attached to the SAS bus by a SAS cable. This includes SAS storage adapters (host adapters) and SAS peripherals.

SATA   Acronym for Serial Advanced Technology Attachment. A physical storage interface standard, SATA is a serial link that provides point-to-point connections between devices. The thinner serial cables allow for better airflow within the system and permit smaller chassis designs.

SMP   Acronym for Serial Management Protocol. SMP enables communicates topology management information directly with an attached SAS expander device. Each PHY on the controller can function as an SMP initiator.

SSP   Acronym for Serial SCSI Protocol. SSP enables communication with other SAS devices. Each PHY on the SAS controller can function as an SSP initiator or SSP target.

STP   Acronym for Serial Tunneling Protocol. STP enables communication with a SATA II device through an attached expander. Each PHY on the SAS controller can function as an STP initiator.

stripe size   The total disk space consumed by a stripe not including a parity disk. For example, consider a stripe that contains 64 Kbytes of disk space and has 16 Kbytes of data residing on each disk in the stripe. In this case, the stripe size is 64 Kbytes and the stripe element size is 16 Kbytes. The stripe depth is four (four physical disks in the stripe). You can specify stripe sizes of 8 Kbytes, 16 Kbytes, 32 Kbytes, 64 Kbytes, or 128 Kbytes for each virtual disk. A larger stripe size produces improved read performance, especially if most of the reads are sequential. For mostly random reads, select a smaller stripe size.

striping   Disk striping writes data across two or more disks. Each stripe spans two or more disks but consumes only a portion of each disk. Each disk, therefore, may have several stripes. The amount of space consumed by a stripe is the same on each disk included in the stripe. The portion of a stripe that resides on a single disk is a stripe element. Striping by itself does not provide data redundancy; striping in combination with parity provides data redundancy.

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