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HARDWARE GUIDE

MegaRAID® SCSI 320-1 RAID Controller

September 2002

LSI LOGIC®

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This document describes the initial release of LSI Logic Corporation's MegaRAID SCSI 320-1 Controller and will remain the official reference source for all revisions/releases of this product until rescinded by an update.

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Warning: 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 instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a specific installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, try to correct the interference by one or more of the following measures:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and the receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/TV technician for help.

Shielded interface cables must be used with this product to ensure compliance with the Class B FCC limits.

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Preface

This book is the primary reference and Hardware Guide for the LSI Logic MegaRAID® SCSI 320-1 Controller. It contains instructions for installing the MegaRAID controller and for configuring RAID arrays. It also contains background information on RAID.

The MegaRAID SCSI 320-1 controller supports single-ended and low-voltage differential (LVD) SCSI devices on an Ultra320 and Wide SCSI channel with data transfer rates up to 320 Mbytes/s.

Audience

This document is intended for people who need to install the MegaRAID SCSI 320-1 Controller in a server and then create and configure RAID arrays.

Organization

This document has the following chapters and appendixes:

- Chapter 1, **Overview**, provides an overview of the MegaRAID SCSI 320-1 and basic SCSI features.
- Chapter 2, **Introduction to RAID**, introduces important RAID concepts.
- Chapter 3, **RAID Levels**, describes each supported RAID level and the factors to consider when choosing a RAID level.
- Chapter 4, **Features**, explains the features of the MegaRAID SCSI 320-1.
- Chapter 5, **Configuring Physical Drives, Arrays, and Logical Drives**, explains how to configure SCSI physical drives, arrays, and logical drives.

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- Chapter 6, **Hardware Installation**, explains how to install the MegaRAID SCSI 320-1 controller.
- Chapter 7, **Troubleshooting**, provides troubleshooting information for the MegaRAID SCSI 320-1 controller.
- Appendix A, **SCSI Cables and Connectors**, describes the SCSI cables and connectors used with the MegaRAID SCSI 320-1 controller.
- Appendix B, **Audible Warnings**, explains the meaning of the warning tones generated by the MegaRAID SCSI 320-1 controller.
- Appendix C, **Glossary**, defines many terms used in this manual.

Technical Support

If you need help installing, configuring, or running the MegaRAID SCSI 320-1 Controller, you may be able to find the information you need at the MegaRAID support page at http://megaraid.lsilogic.com

If this does not resolve your problem, you can call your LSI Logic OEM Technical Support representative at 678-728-1250. Before you call, please complete the **MegaRAID Problem Report** form.

MegaRAID Problem Report Form

Customer Information	**MegaRAID Information**
Name:	Today's Date:
Company:	Date of Purchase:
Address:	Invoice Number:
City/State:	Serial Number:
Country:	
Email Address:	Cache Memory:
Phone:	Firmware Version:
Fax:	BIOS Version:
System Information	
Motherboard:	BIOS manufacturer:

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MegaRAID Problem Report Form (Cont.)

Operating System:	BIOS Date:
Op. Sys. Ver.:	Video Adapter:
MegaRAID Driver Ver.:	CPU Type/Speed:
Network Card:	System Memory:
Other disk controllers installed:	Other adapter cards Installed:
Description of problem:	
Steps necessary to re-create problem: 1. 2. 3. 4.	

Logical Drive Configuration

Use this form to record the configuration details for your logical drives.

Logical Drive Configuration

Logical Drive	RAID Level	Stripe Size	Logical Drive Size	Cache Policy	Read Policy	Write Policy	# of Physical Drives
LD0							
LD1							
LD2							
LD3							
LD4							
LD5							
LD6							

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Logical Drive Configuration (Cont.)

Logical Drive	RAID Level	Stripe Size	Logical Drive Size	Cache Policy	Read Policy	Write Policy	# of Physical Drives
LD7							
LD8							
LD9							
LD10							
LD11							
LD12							
LD13							
LD14							
LD15							
LD16							
LD17							
LD18							
LD19							
LD20							
LD21							
LD22							
LD23							
LD24							
LD25							
LD26							
LD27							
LD28							
LD29							
LD30							
LD31							

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Logical Drive Configuration (Cont.)

Logical Drive	RAID Level	Stripe Size	Logical Drive Size	Cache Policy	Read Policy	Write Policy	# of Physical Drives
LD32							
LD33							
LD34							
LD35							
LD36							
LD37							
LD38							
LD39							

Physical Device Layout

Use this form to record the physical device layout.

Physical Device Layout

	Channel 0
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	

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Physical Device Layout (Cont.)

	Channel 0
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	

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Physical Device Layout (Cont.)

	Channel 0
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	

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Physical Device Layout (Cont.)

	Channel 0
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	

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Chapter 1
Overview

This chapter provides an overview of the MegaRAID® SCSI 320-1 and basic SCSI features. It contains the following sections:

- Section 1.1, “Features”
- Section 1.2, “SCSI Channel”
- Section 1.3, “NVRAM and Flash ROM”
- Section 1.4, “SCSI Connectors”
- Section 1.5, “Single-Ended and Differential SCSI Buses”
- Section 1.6, “Maximum Cable Length for SCSI Standards”
- Section 1.7, “SCSI Bus Widths and Maximum Throughput”
- Section 1.8, “Documentation”

RAID controller is a high-performance, intelligent PCI-to-SCSI host adapter with RAID control capabilities. The MegaRAID SCSI 320-1 provides reliability, high performance, and fault-tolerant disk subsystem management.

The MegaRAID SCSI 320-1 is part of the LSI Logic Intel GC80302-based MegaRAID controller family. The MegaRAID SCSI 320-1 is an entry level- to mid-range RAID controller solution. MegaRAID SCSI 320-1 offers a cost-effective way to implement RAID in a server.

The MegaRAID SCSI 320-1 has an Ultra320 and Wide SCSI channel supporting data transfer rates up to 320 Mbytes/s per channel. The SCSI channel supports up to fifteen non-Ultra SCSI devices. The MegaRAID SCSI 320-1 includes MegaRAID features and performance.

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1.1 Features

MegaRAID SCSI 320-1 features include:

- A high-performance input/output (I/O) migration path while preserving existing PCI-SCSI software
- SCSI data transfers up to 320 Mbytes/s
- Synchronous operation on a Wide low-voltage differential (LVD) SCSI bus
- Support for up to 15 LVD SCSI devices on the Wide bus
- An Intel GC30302 chip that performs RAID calculations and routing
- Support for 32 or 64 Mbytes of SDRAM on-board cache memory, used for read and write-back caching and for RAID 5 parity generation

1.2 SCSI Channel

The MegaRAID SCSI 320-1 upgrade card includes one Ultra3 SCSI channel. The channel is powered by an LSI Logic 53C1020 Ultra320 SCSI processor.

1.3 NVRAM and Flash ROM

A 32 KB x 8 NVRAM stores RAID system configuration information. The MegaRAID SCSI 320-1 firmware is stored in flash ROM for easy upgrade.

1.4 SCSI Connectors

The MegaRAID SCSI 320-1 has one very high-density 68-pin external connector for external storage subsystem, and one high-density 68-pin internal connector.

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1.5 Single-Ended and Differential SCSI Buses

The SCSI standard defines two electrical buses:

- Single-ended bus
- Low-voltage differential bus

1.6 Maximum Cable Length for SCSI Standards

Table 1.1 lists the maximum SCSI cable length and number of disk drives that you can use, depending on the SCSI speeds and type of device.

Table 1.1 Maximum Cable Length for SCSI Standards

Standard	Single Ended SCSI	Low-Voltage Differential SCSI	Maximum # of Drives
Ultra SCSI	1.5 m	12 m	7
Ultra SCSI	3 m	12 m	3
Wide Ultra SCSI		12 m	15
Wide Ultra SCSI	1.5 m	12 m	7
Wide Ultra SCSI	3 m	12 m	3
Ultra 2 SCSI		25 m	1
Ultra 2 SCSI		12 m	7
Wide Ultra 2 SCSI		25 m	1
Wide Ultra 2 SCSI		12 m	15
Ultra160 SCSI		25 m	1
Ultra160 SCSI		12 m	7
Wide Ultra160 SCSI		25 m	1
Wide Ultra160 SCSI		12 m	15
Ultra320		12 m	15
Ultra320		20 m	1

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1.7 SCSI Bus Widths and Maximum Throughput

Table 1.2 lists the SCSI bus widths and maximum throughput, based on the SCSI speeds.

Table 1.2 SCSI Bus Widths and Maximum Throughput

SCSI Standard	SCSI Bus Width	SCSI Throughput
Fast Wide SCSI	16 bits	20 Mbytes/s
Wide Ultra SCSI	16 bits	40 Mbytes/s
Wide Ultra 2 SCSI	16 bits	80 Mbytes/s
Wide Ultra 160 SCSI	16 bits	160 Mbytes/s
Ultra 320 SCSI	16 bits	320 Mbytes/s

1.8 Documentation

The MegaRAID SCSI 320-1 documentation set includes:

- The *MegaRAID SCSI 320-1 Hardware Guide*
- The *MegaRAID Configuration Software Guide*
- The *MegaRAID Operating System Driver Installation Guide*

1.8.1 MegaRAID SCSI 320-1 Hardware Guide

The Hardware Guide contains the RAID overview, RAID planning, and RAID system configuration information you need first. Read this document first.

1.8.2 MegaRAID Configuration Software Guide

This manual describes the software configuration utilities that you can use to configure and modify RAID systems.

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1.8.3 MegaRAID Operating System Driver Installation Guide

This manual provides detailed information about installing the MegaRAID SCSI 320-1 operating system drivers.

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Chapter 2
Introduction to RAID

This chapter introduces important RAID concepts. It contains the following sections:

- Section 2.1, “RAID Benefits”
- Section 2.2, “MegaRAID SCSI 320-1 – Host-Based RAID Solution”
- Section 2.3, “RAID Overview”

RAID (Redundant Array of Independent Disks) is a data storage method in which data, along with parity information, is distributed among two or more hard disks (called an *array*) to improve performance and reliability. The RAID array appears to the host computer as a single storage unit or as multiple logical units. I/O is expedited because several disks can be accessed simultaneously. RAID systems provide improved data storage reliability and fault tolerance compared to single-drive computers. If a disk drive in a RAID array fails, data can be reconstructed from the data and parity information on the remaining disk drives.

2.1 RAID Benefits

RAID is widely used because it improves I/O performance and increases storage subsystem reliability. RAID provides data security through fault tolerance and redundant data storage. The MegaRAID SCSI 320-1 management software configures and monitors RAID disk arrays.

2.1.1 Improved I/O

Although disk drive capabilities have improved drastically, actual performance of individual disk drives has been improved only three to four times in the last decade. RAID provides a way to achieve much better data throughput.

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2.1.2 Increased Reliability

The electromechanical components of a disk subsystem operate more slowly, require more power, and generate more noise and vibration than electronic devices. These factors reduce the reliability of data stored on disks. RAID provides a way to achieve much better fault tolerance and data reliability.

2.2 MegaRAID SCSI 320-1 – Host-Based RAID Solution

RAID products are either host-based or external.

The MegaRAID SCSI 320-1 controller is a host-based RAID solution. The MegaRAID SCSI 320-1 is a PCI adapter card that is installed in any available PCI expansion slot in a host system.

2.2.1 Host-Based RAID

A host-based RAID product puts all of the RAID intelligence on an adapter card that is installed in a network server. A host-based RAID product provides the best performance. MegaRAID SCSI 320-1 is part of the file server, so it can transmit data directly across the computer's buses at data transfer speeds up to 532 Mbytes/s.

The available sequential data transfer rate is determined by the following factors:

- The sustained data transfer rate on the motherboard PCI bus
- The sustained data transfer rate on the GC80302 PCI-to-PCI bridge
- The sustained data transfer rate of the SCSI controller
- The sustained data transfer rate of the SCSI devices
- The number of SCSI channels
- The number of SCSI disk drives

Host-based solutions must provide operating system-specific drivers.

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2.2.2 SCSI-to-SCSI External RAID

A SCSI-to-SCSI external RAID product puts the RAID intelligence inside the RAID chassis and uses a plain SCSI host adapter installed in the network server. The data transfer rate is limited to the bandwidth of the SCSI channel. A SCSI-to-SCSI external RAID product that has two Wide SCSI channels operating at speeds up to 320 Mbytes/s must squeeze the data into a single Wide SCSI (320 Mbytes/s) channel back to the host computer.

In SCSI-to-SCSI external RAID products, the disk drive subsystem uses only a single SCSI ID, which allows you to connect multiple drive subsystems to a single SCSI controller.

2.3 RAID Overview

RAID is a collection of specifications that describes a system for ensuring the reliability and stability of data stored on large disk subsystems. A RAID system can be implemented in a number of different versions (or RAID levels). MegaRAID SCSI 320-1 supports standard RAID levels 0, 1, and 5, and RAID levels 10 and 50, special RAID versions supported by MegaRAID SCSI 320-1.

2.3.1 Physical Array

A RAID array is a collection of physical disk drives governed by the RAID management software. A RAID array appears to the host computer as one or more logical drives.

2.3.2 Logical Drive

A *logical drive* is a partition in a physical array of disks that is made up of contiguous data segments on the physical disks. A logical drive can consist of any of the following:

- An entire physical array
- More than one entire physical array
- A part of an array
- Parts of more than one array

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- A combination of any two of the above conditions

2.3.3 Consistency Check

A *consistency check* verifies the correctness of redundant data in a RAID array. For example, in a system with distributed parity, checking consistency means computing the parity of the data drives and comparing the results to the contents of the parity drives.

2.3.4 Fault Tolerance

Fault tolerance is achieved through cooling fans, power supplies, and the ability to hot swap drives. MegaRAID SCSI 320-1 provides hot swapping through the hot spare feature. A hot spare drive is an unused online available drive that MegaRAID SCSI 320-1 instantly plugs into the system when an active drive fails.

After the hot spare is automatically moved into the RAID subsystem, the failed drive is automatically rebuilt. The RAID disk array continues to handle request while the rebuild occurs.

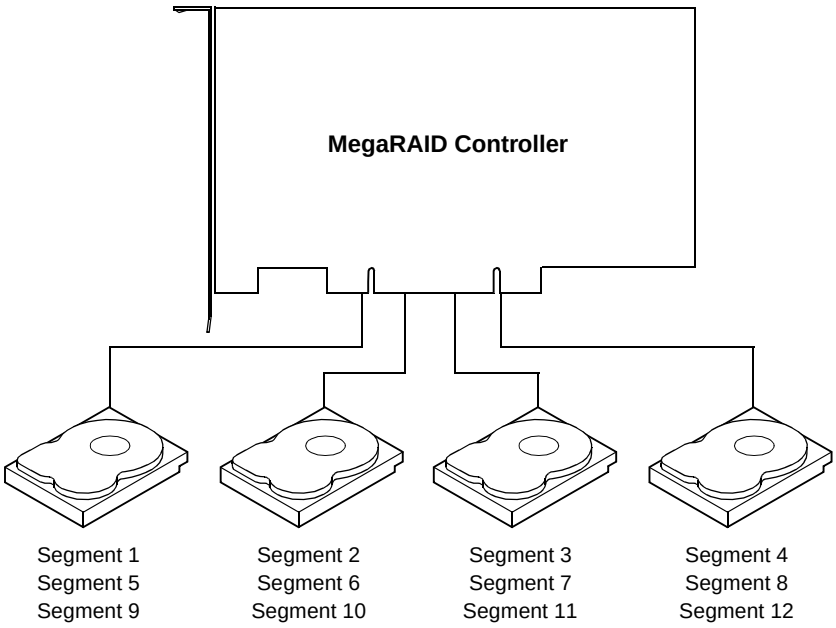
2.3.5 Disk Striping

Disk striping writes data across multiple disk drives instead of just one disk drive, as shown in Figure 2.1.

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Figure 2.1 Disk Striping



Disk striping involves partitioning each disk drive's storage space into stripes that can vary in size from 2 to 128 Kbytes. These stripes are interleaved in a repeated, sequential manner. The combined storage space is composed of stripes from each drive. MegaRAID SCSI 320-1 supports stripe sizes of 2, 4, 8, 16, 32, 64, or 128 Kbytes.

For example, in a four-disk system using only disk striping (as in RAID level 0), segment 1 is written to disk 1, segment 2 is written to disk 2, and so on. Disk striping enhances performance because multiple drives are accessed simultaneously; but disk striping does not provide data redundancy.

2.3.5.1 Stripe Width

Stripe width is a measure of the number of disks involved in an array where striping is implemented. For example, a four-disk array with disk striping has a stripe width of four.

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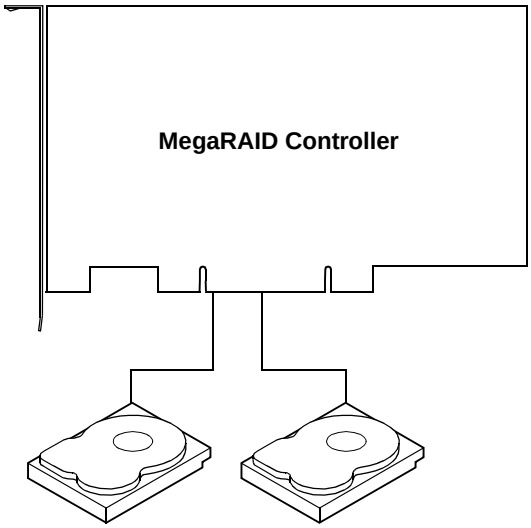
2.3.5.2 Stripe Size

The *stripe size* is the length of the interleaved data segments that MegaRAID SCSI 320-1 writes across multiple drives. MegaRAID SCSI 320-1 supports stripe sizes of 2, 4, 8, 16, 32, 64, or 128 Kbytes.

2.3.6 Disk Mirroring

With *disk mirroring* (used in RAID 1), data written to one disk drive is simultaneously written to another disk drive, as shown in Figure 2.2.

Figure 2.2 Disk Mirroring



If one disk drive fails, the contents of the other disk drive can be used to run the system and reconstruct the failed drive. The primary advantage of disk mirroring is that it provides 100% data redundancy. Since the contents of the disk drive are completely written to a second drive, it does not matter if one of the drives fails. Both drives contain the same data at all times. Either drive can act as the operational drive.

Although disk mirroring provides 100% redundancy, it is expensive because each drive in the system must be duplicated.

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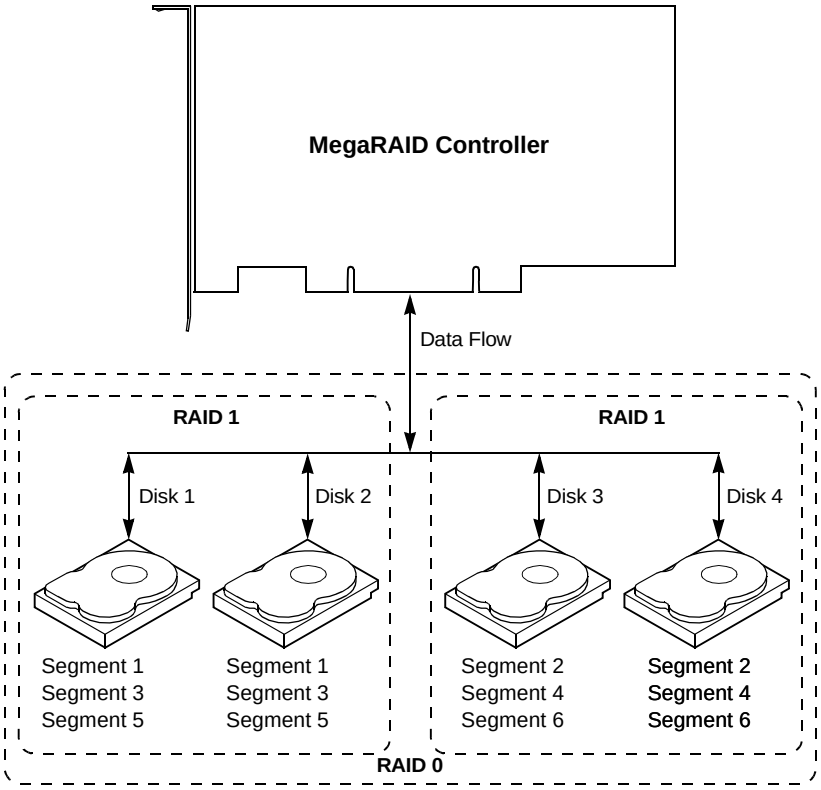
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2.3.7 Disk Spanning

Disk spanning allows multiple disk drives to function like one big drive. Spanning overcomes lack of disk space and simplifies storage management by combining existing resources or adding relatively inexpensive resources. For example, four 60 Gbyte disk drives can be combined to appear to the operating system as one single 240 Gbyte drive.

Disk spanning alone does not provide reliability or performance enhancements. Spanned logical drives must have the same stripe size and must be contiguous. In Figure 2.3, two RAID 1 arrays are turned into a RAID 10 array.

Figure 2.3 Disk Spanning



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Table 2.1 describes how disk spanning is used for RAID 10 and RAID 50.

Table 2.1 Spanning for RAID 10 and RAID 50

Level	Description
10	Configure RAID 10 by spanning two contiguous RAID 1 logical drives. The RAID 1 logical drives must have the same stripe size.
50	Configure RAID 50 by spanning two contiguous RAID 5 logical drives. The RAID 5 logical drives must have the same stripe size.

Note: Spanning two contiguous RAID 0 logical drives does not produce a new RAID level or add fault tolerance. It does increase the size of the logical volume and improves performance by doubling the number of spindles.

2.3.8 Parity

Parity generates a set of redundancy data from two or more parent data sets. The redundancy data can be used to reconstruct one of the parent data sets. Parity data does not fully duplicate the parent data sets. In RAID, this method is applied to entire drives (dedicated parity) or to stripes across all disk drives in an array (distributed parity).

RAID 5 combines distributed parity with disk striping. If a single disk drive fails, it can be rebuilt from the parity and the data on the remaining drives. Parity provides redundancy for one drive failure without duplicating the contents of entire disk drives, but parity generation can slow the write process.

2.3.9 Hot Spares

A *hot spare* is an extra, unused disk drive that is part of the disk subsystem. It is usually in standby mode, ready for service if a drive fails. Hot spares permit you to replace failed drives without system shutdown or user intervention.

MegaRAID SCSI 320-1 implements automatic and transparent rebuilds using hot spare drives, providing a high degree of fault tolerance and zero downtime. The MegaRAID SCSI 320-1 RAID Management software allows you to specify physical drives as hot spares. When a hot spare is needed, the MegaRAID SCSI 320-1 controller assigns the hot spare that

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has a capacity closest to and at least as great as that of the failed drive to take the place of the failed drive.

Note: Hot spares are employed only in arrays with redundancy—for example, RAID levels 1, 5, 10, and 50. A hot spare connected to a specific MegaRAID SCSI 320-1 controller can be used only to rebuild a drive that is connected to the same controller.

2.3.10 Hot Swapping

Hot swapping is the manual replacement of a defective physical disk unit while the computer is still running. When a new drive has been installed, you must issue a command to rebuild the drive.

2.3.11 Disk Rebuild

You rebuild a disk drive by recreating the data that had been stored on the drive before the drive failed. Rebuilding can be done only in arrays with data redundancy such as RAID level 1, 5, 10, and 50.

Standby (warm spare) rebuild is employed in a mirrored (RAID 1) system. If a disk drive fails, an identical drive is immediately available. The primary data source disk drive is the original disk drive.

A hot spare can be used to rebuild disk drives in RAID 1, 5, 10, or 50 systems. If a hot spare is not available, the failed disk drive must be replaced with a new disk drive so that the data on the failed drive can be rebuilt.

The MegaRAID SCSI 320-1 controller automatically and transparently rebuilds failed drives with user-definable rebuild rates. If a hot spare is available, the rebuild starts automatically when a drive fails. MegaRAID SCSI 320-1 automatically restarts the system and the rebuild if the system goes down during a rebuild.

2.3.11.1 Rebuild Rate

The *rebuild rate* is the fraction of the compute cycles dedicated to rebuilding failed drives. A rebuild rate of 100% means the system is totally dedicated to rebuilding the failed drive.

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The MegaRAID SCSI 320-1 rebuild rate can be configured between 0% and 100%. At 0%, the rebuild is only done if the system is not doing anything else. At 100%, the rebuild has a higher priority than any other system activity.

2.3.12 Logical Drive States

Table 2.2 describes the logical drive states.

Table 2.2 Logical Drive States

State	Description
Optimal	The drive operating condition is good. All configured drives are online.
Degraded	The drive operating condition is not optimal. One of the configured drives has failed or is offline.
Failed	The drive has failed.
Offline	The drive is not available to MegaRAID SCSI 320-1.

2.3.13 SCSI Drive States

A SCSI disk drive can be in one of the states described in Table 2.3.

Table 2.3 SCSI Drive States

State	Description
Online (ONLIN)	The drive is functioning normally and is a part of a configured logical drive.
Ready (READY)	The drive is functioning normally but is not part of a configured logical drive and is not designated as a hot spare.
Hot Spare (HOTSP)	The drive is powered up and ready for use as a spare in case an online drive fails.
Fail (FAIL)	A fault has occurred in the drive, placing it out of service.
Rebuild (REB)	The drive is being rebuilt with data from a failed drive.

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2.3.14 Disk Array Types

Table 2.4 describes the RAID disk array types.

Table 2.4 Disk Array Types

Type	Description
Software-Based	The array is managed by software running in a host computer using the host CPU bandwidth. The disadvantages associated with this method are the load on the host CPU and the need for different software for each operating system.
SCSI to SCSI	The array controller resides outside of the host computer and communicates with the host through a SCSI adapter in the host. The array management software runs in the controller. It is transparent to the host and independent of the host operating system. The disadvantage is the limited data transfer rate of the SCSI channel between the SCSI adapter and the array controller.
Bus-Based	The array controller resides on the bus (for example, a PCI or EISA bus) in the host computer and has its own CPU to generate the parity and handle other RAID functions. A bus-based controller can transfer data at the speed of the host bus (PCI, ISA, EISA, VL-Bus) but is limited to the bus it is designed for. MegaRAID SCSI 320-1 resides on a PCI bus, which can handle data transfer at up to 132 Mbytes/s. With MegaRAID SCSI 320-1, the channel can handle data transfer rates up to 320 Mbytes/s per SCSI channel.

2.3.15 Enclosure Management

Enclosure management is the intelligent monitoring of the disk subsystem by software and/or hardware.

The disk subsystem can be part of the host computer or can be separate from it. Enclosure management helps you stay informed of events in the disk subsystem, such as a drive or power supply failure. Enclosure management increases the fault tolerance of the disk subsystem.

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Chapter 3
RAID Levels

This chapter describes each supported RAID level and the factors to consider when choosing a RAID level. It contains the following sections:

- Section 3.1, “Selecting a RAID Level”
- Section 3.2, “RAID 0”
- Section 3.3, “RAID 1”
- Section 3.4, “RAID 5”
- Section 3.5, “RAID 10”
- Section 3.6, “RAID 50”

3.1 Selecting a RAID Level

To ensure the best performance, you should select the optimal RAID level when you create a system drive. The optimal RAID level for your disk array depends on a number of factors:

- The number of drives in the disk array
- The capacity of the drives in the array
- The need for data redundancy
- The disk performance requirements

Note: The SCSI 320-1 controller supports a maximum of 15 physical drives.

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3.2 RAID 0

RAID 0 provides disk striping across all drives in the RAID subsystem. RAID 0 does not provide any data redundancy, but does offer the best performance of any RAID level. RAID 0 breaks up data into smaller blocks and then writes a block to each drive in the array. The size of each block is determined by the stripe size parameter, set during the creation of the RAID set. RAID 0 offers high bandwidth. By breaking up a large file into smaller blocks, MegaRAID SCSI 320-1 can use several drives to read or write the file faster. RAID 0 involves no parity calculations to complicate the write operation. This makes RAID 0 ideal for applications that require high bandwidth but do not require fault tolerance.

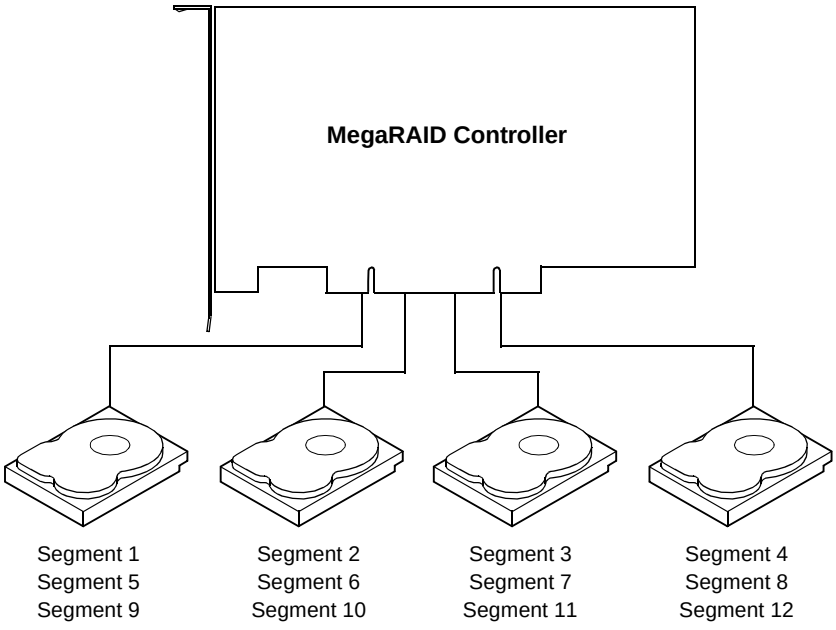
Uses	RAID 0 provides high data throughput, especially for large files. Suitable for any environment that does not require fault tolerance.
Strong Points	Provides increased data throughput for large files. No capacity loss penalty for parity.
Weak Points	Does not provide fault tolerance. All data lost if any drive fails.
Drives	1 to 15 The initiator takes one ID per channel. This leaves 15 IDs available for one channel.

Figure 3.1 shows a RAID 0 array with four disk drives.

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Figure 3.1 RAID 0 Array



3.3 RAID 1

In RAID 1, the MegaRAID SCSI 320-1 duplicates all data from one drive to a second drive. RAID 1 provides complete data redundancy, but at the cost of doubling the required data storage capacity.

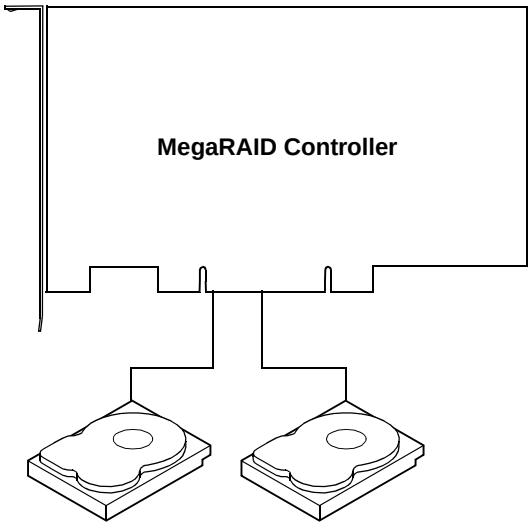
Uses	Use RAID 1 for small databases or any other environment that requires fault tolerance but small capacity.
Strong Points	Provides complete data redundancy. RAID 1 is ideal for any application that requires fault tolerance and minimal capacity.
Weak Points	Requires twice as many disk drives. Performance is impaired during drive rebuilds.
Drives	2

Figure 3.2 shows a RAID 1 array.

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Figure 3.2 RAID 1 Array



3.4 RAID 5

RAID 5 includes disk striping at the byte level and parity. In RAID 5, the parity information is written to several drives. RAID 5 is best suited for networks that perform many small I/O transactions simultaneously.

RAID 5 addresses the bottleneck issue for random I/O operations. Since each drive contains both data and parity, numerous writes can take place concurrently. In addition, robust caching algorithms and hardware based

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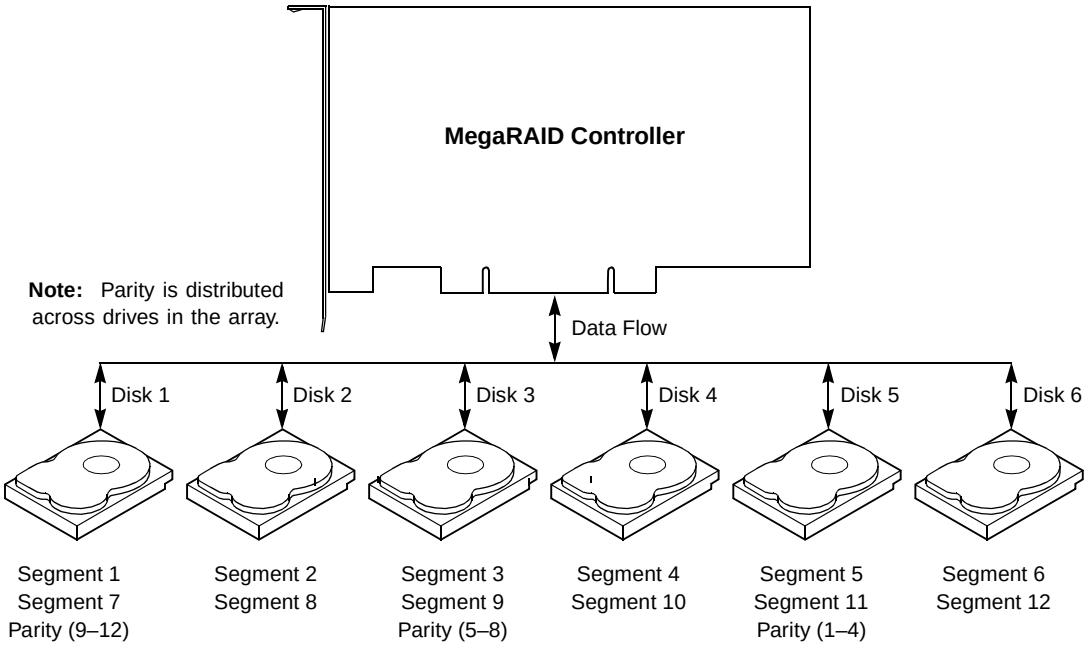
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exclusive-or assist make RAID 5 performance exceptional in many different environments.

Uses	Provides high data throughput, especially for large files. Use RAID 5 for transaction processing applications, because each drive can read and write independently. If a drive fails, the MegaRAID SCSI 320-1 uses the parity drive to recreate all missing information. Use also for office automation and online customer service that requires fault tolerance. Use for any application that has high read request rates but low write request rates.
Strong Points	Provides data redundancy and good performance in most environments
Weak Points	Disk drive performance is reduced if a drive is being rebuilt. Environments with few processes do not perform as well because the RAID overhead is not offset by the performance gains in handling simultaneous processes.
Drives	3 to 15

Figure 3.3 shows a RAID 5 array with six disk drives.

Figure 3.3 RAID 5 Array



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3.5 RAID 10

RAID 10 is a combination of RAID 0 and RAID 1. RAID 10 has mirrored drives. RAID 10 breaks up data into smaller blocks, and then stripes the blocks of data to each RAID 1 RAID set. Each RAID 1 RAID set then duplicates its data to its other drive. The size of each block is determined by the stripe size parameter, which is set during the creation of the RAID set. RAID 10 can sustain one to four drive failures while maintaining data integrity, if each failed disk is in a different RAID 1 array.

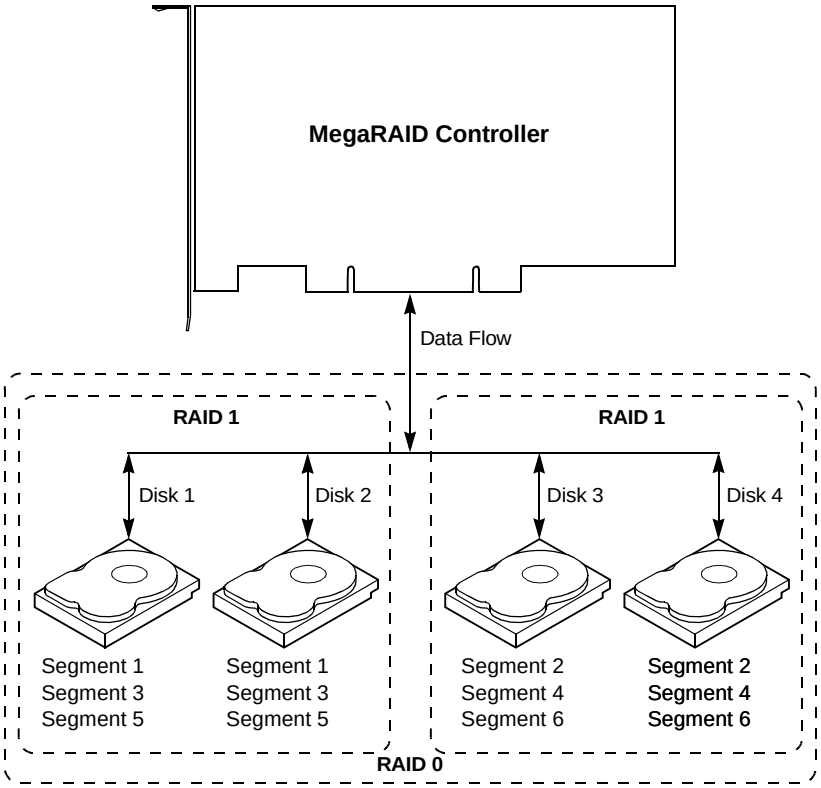
Uses	Works best for data storage that must have 100% redundancy of mirrored arrays and that also needs the enhanced I/O performance of RAID 0 (striped arrays). RAID 10 works well for medium-sized databases or any environment that requires a higher degree of fault tolerance and moderate to medium capacity.
Strong Points	Provides both high data transfer rates and complete data redundancy.
Weak Points	Requires twice as many drives as all other RAID levels except RAID 1.
Drives	4 to 16

Figure 3.4 shows a RAID 10 array with four disk drives.

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Figure 3.4 RAID 10 Array



3.6 RAID 50

RAID 50 provides the features of both RAID 0 and RAID 5, including both parity and disk striping across multiple drives. RAID 50 is best implemented on two RAID 5 disk arrays with data striped across both disk arrays. RAID 50 breaks up data into smaller blocks, and then stripes the blocks of data to each RAID 5 RAID set. RAID 5 breaks up data into smaller blocks, calculates parity by performing an exclusive-or on the blocks, and then writes the blocks of data and parity to each drive in the array. The size of each block is determined by the stripe size parameter, which is set during the creation of the RAID set.

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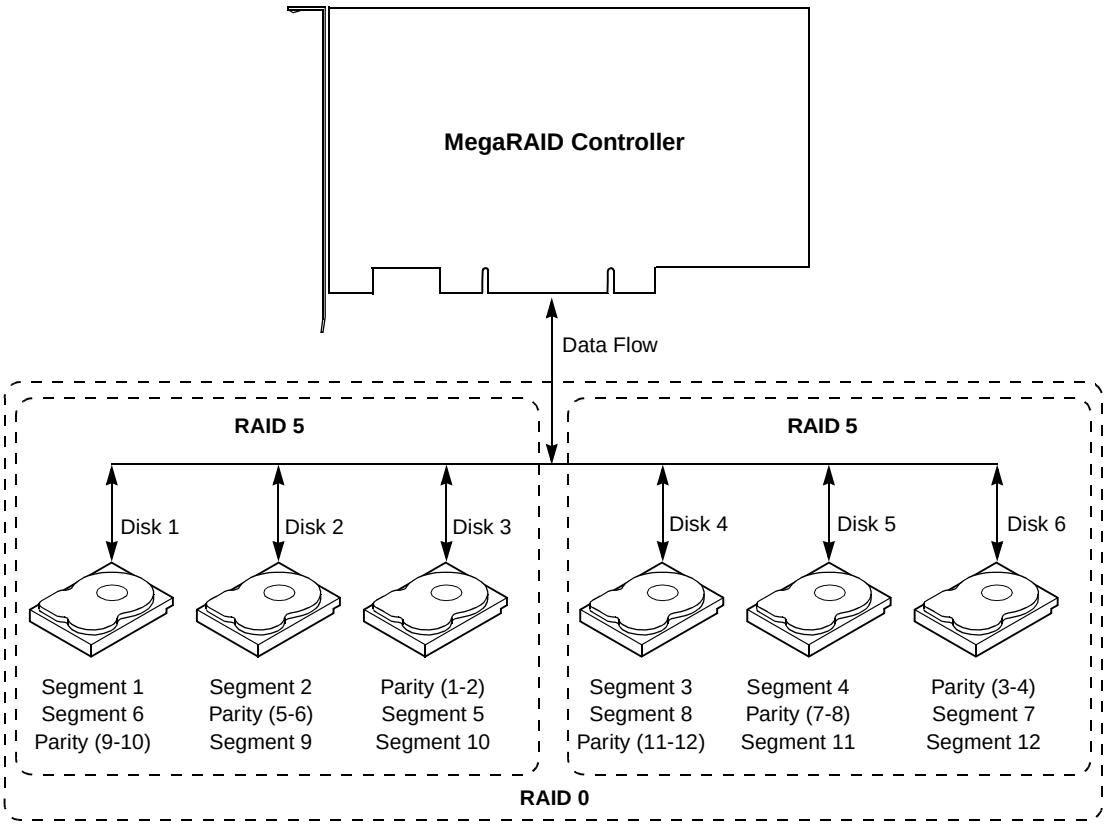
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RAID 50 can sustain one to four drive failures while maintaining data integrity, if each failed disk is in a different RAID 5 array.

Uses	Works best when used with data that requires high reliability, high request rates, high data transfer, and medium to large capacity.
Strong Points	Provides high data throughput, data redundancy, and very good performance.
Weak Points	Requires 2 to 4 times as many parity drives as RAID 5.
Drives	6 to 15 The initiator takes one ID per channel. This leaves 15 IDs available for one channel.

Figure 3.5 shows a RAID 50 array with six disk drives.

Figure 3.5 RAID 50 Array



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Chapter 4
Features

This chapter explains the features of the MegaRAID SCSI 320-1. It contains the following sections:

- Section 4.1, “SMART Technology”
- Section 4.2, “Configuration on Disk”
- Section 4.3, “Configuration Features”
- Section 4.4, “Array Performance Features”
- Section 4.5, “RAID Management Features”
- Section 4.6, “Fault Tolerance Features”
- Section 4.7, “Software Utilities”
- Section 4.8, “Operating System Software Drivers”
- Section 4.9, “MegaRAID SCSI 320-1 Specifications”
- Section 4.10, “RAID Management”
- Section 4.11, “Compatibility”

MegaRAID is a family of high performance intelligent PCI-to-SCSI host adapters with RAID control capabilities. The MegaRAID SCSI 320-1 has a SCSI channel that supports Ultra320 and Wide SCSI at data transfer rates up to 320 Mbytes/s. The SCSI channel supports up to 15 Wide devices and up to seven non-Wide devices.

4.1 SMART Technology

The MegaRAID SCSI 320-1 Self Monitoring Analysis and Reporting Technology (SMART) detects up to 70% of all predictable drive failures. SMART monitors the internal performance of all motors, heads, and drive electronics.

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4.2 Configuration on Disk

Configuration on Disk (drive roaming) saves configuration information both in nonvolatile random access memory (NVRAM) on the MegaRAID SCSI 320-1, and on the disk drives controlled by the MegaRAID SCSI 320-1. If the MegaRAID SCSI 320-1 is replaced, the new MegaRAID SCSI 320-1 controller can detect the actual RAID configuration, maintaining the integrity of the data on each drive, even if the drives have changed channel and/or target ID.

4.3 Configuration Features

Table 4.1 contains the configuration features for the MegaRAID 320-1.

Table 4.1 Configuration Features

Specification	Feature
RAID levels	0, 1, 5, 10, and 50
SCSI channels	1
Maximum number of drives per channel	15
Array interface to host	PCI 2.2
Drive interface	Fast and Wide, Ultra320 single-ended and low-voltage differential (LVD)
Upgradeable cache size	Cache memory onboard
Cache function	Write-through, write-back, adaptive read-ahead, no read-ahead, read-ahead
Multiple logical drives/arrays per controller	Up to 40 logical drives per controller
Maximum number of MegaRAID SCSI 320-1 controllers per system	12
Online capacity expansion	Yes
Hot spare support	Yes

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Table 4.1 Configuration Features (Cont.)

Specification	Feature
Flashable firmware	Yes
Hot swap devices supported	Yes
Non-disk devices supported	Yes
Mixed capacity hard disk drives	Yes
Number of 16-bit internal connectors	1
Number of 16-bit external connectors	1
Support for hard disk drives with capacities of more than 8 Gbytes.	Yes
Clustering support (Failover control)	No
Online RAID level migration	Yes
RAID remapping	Yes
No reboot necessary after expansion	Yes
More than 200 Qtags per physical drive	Yes
Hardware clustering support on the board	Yes
User-specified rebuild rate	Yes

4.4 Array Performance Features

Table 4.2 lists the array performance features.

Table 4.2 Array Performance Features

Specification	Feature
Host data transfer rate	533 Mbytes/s
Drive data transfer rate	320 Mbytes/s
Stripe sizes	2, 4, 8, 16, 32, 64, or 128 Kbytes

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4.5 RAID Management Features

Table 4.3 lists the RAID management features.

Table 4.3 RAID Management Features

Specification	Feature
Support for SNMP	Yes
Performance Monitor provided	Yes
Remote control and monitoring	Yes
Event broadcast and event alert	Yes
Hardware connector	RS232C
Drive roaming	Yes
Support for concurrent multiple stripe sizes	Yes
Windows NT, 2000, XP, and .NET server support using a GUI client utility	Yes

4.6 Fault Tolerance Features

Table 4.4 lists the fault tolerance features.

Table 4.4 Fault Tolerance Features

Specification	Feature
Support for SMART	Yes
Enclosure management	SCSI-accessed fault-tolerant enclosure (SAF-TE) compliant
Drive failure detection	Automatic
Drive rebuild using hot spares	Automatic
Parity generation for RAID	Hardware

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4.7 Software Utilities

Table 4.5 lists the software utility features.

Table 4.5 Software Utilities

Specification	Feature
Graphical user interface	Yes
Management utility	Yes
Bootup configuration using MegaRAID Manager	Yes
Online read, write, and cache policy switching	Yes

4.8 Operating System Software Drivers

MegaRAID SCSI 320-1 includes a DOS software configuration utility, and drivers for:

- Windows NT 4.0
- Windows 2000
- Windows .NET
- Windows XP
- Novell NetWare 5.1, 6.0
- Red Hat Linux 7.2, 7.3
- DOS version 6.xx or later

The DOS drivers for MegaRAID are contained in the firmware on the MegaRAID controller, except for the DOS ASPI and CD drivers. Call your LSI OEM support representative or access the web site at www.lsilogic.com for information about drivers for other operating systems.

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4.9 MegaRAID SCSI 320-1 Specifications

Table 4.6 lists the specifications for the SCSI 320-1.

Table 4.6 MegaRAID SCSI 320-1 Specifications

Parameter	Specification
Card size	Low profile PCI Adapter card size (6.875" X 2.5")
Processor	Intel GC80302 64-bit RISC processor at 100 MHz
Bus type	PCI 2.2
SCSI controller	LSI Logic 53C1020
PCI controller	Intel GC80302
Bus data transfer rate	Up to 532 Mbytes/s
BIOS	MegaRAID BIOS
Cache configuration	Predefined during manufacturing; ECC through a 66 MHz 72-bit unbuffered 3.3 V SDRAM
Firmware	1 MB × 8 flash ROM
Non-volatile random access memory (NVRAM)	32 KB × 8 for storing RAID configuration
Operating voltage	5.00 V ± 0.25 V
SCSI controller	One SCSI controller for Ultra320 and Wide support
SCSI data transfer rate	Up to 320 Mbytes/s
SCSI bus	LVD or single-ended
SCSI termination	Active, single-ended or LVD
Termination disable	Automatic through cable and device detection
Devices per SCSI channel	Up to 15 Wide or 7 non-Wide SCSI devices. Up to 6 non-disk SCSI drives per MegaRAID SCSI 320-1 controller.
SCSI device types supported	Synchronous or asynchronous. Disk and non-disk.
RAID levels supported	0, 1, 5, 10, and 50

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Table 4.6 MegaRAID SCSI 320-1 Specifications (Cont.)

Parameter	Specification
SCSI connectors	One 68-pin internal high-density connector for 16-bit SCSI devices. One very-high density 68-pin external connector for Ultra and Wide SCSI.
Serial port	3-pin RS232C-compatible berg

4.9.1 PCI Bridge/CPU

MegaRAID SCSI 320-1 uses the Intel GC80302 PCI bridge with an embedded 80960JT RISC processor running at 66 MHz. The GC80302 bridge handles data transfers between the primary (host) PCI bus, the secondary PCI bus, cache memory, and the SCSI bus. The DMA controller supports chaining and unaligned data transfers. The embedded 80960JT CPU directs all controller functions, including command processing, SCSI bus transfers, RAID processing, drive rebuilding, cache management, and error recovery.

4.9.2 Cache Memory

MegaRAID SCSI 320-1 cache memory resides in an onboard memory bank that uses 2 M x 72 (16 Mbyte), 4 M x 72 (32 Mbyte), 8 M x 72 (64 Mbyte) or 16 M x 72 (128 Mbyte) unbuffered 3.3 V SDRAM. Possible configurations are 8, 16, 32, 64, or 128 Mbytes. The maximum achievable memory bandwidth is 528 Mbytes/s.

MegaRAID supports write-through or write-back caching, which can be selected for each logical drive. To improve performance in sequential disk accesses, MegaRAID does not use read-ahead caching for the current logical drive. The default setting for the read policy is *Normal*, meaning no read-ahead caching. You can disable read-ahead caching.

Warning: Write caching is not recommended for the physical drives. When write cache is enabled, loss of data can occur when power is interrupted.

4.9.3 MegaRAID BIOS

The BIOS resides on a 1 MB × 8 flash ROM for easy upgrade. The MegaRAID BIOS supports INT 13h calls to boot DOS without special

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software or device drivers. The MegaRAID BIOS provides an extensive setup utility that can be accessed by pressing <Ctrl><M> at BIOS initialization. The MegaRAID BIOS Configuration Utility is described in the *MegaRAID Configuration Software Guide*.

4.9.4 Serial Port

MegaRAID SCSI 320-1 includes a 3-pin RS232C-compatible serial port berg connector, which can connect to communications devices.

4.9.5 SCSI Bus

MegaRAID SCSI 320-1 has a Fast and Wide Ultra320 SCSI channel that supports both LVD and single-ended devices with active termination. Synchronous and asynchronous devices are supported. MegaRAID SCSI 320-1 provides automatic termination disable using cable detection. The SCSI channel supports up to 15 Wide or seven non-Wide SCSI devices at speeds up to 320 Mbytes/s. MegaRAID SCSI 320-1 supports up to six non-disk devices per controller.

4.9.6 SCSI Connectors

The MegaRAID SCSI 320-1 has two types of SCSI connectors:

- 68-pin high density internal connector
- 68-pin very-high-density external connector

Both connector types can be used for the SCSI channel.

4.9.7 SCSI Termination

The MegaRAID SCSI 320-1 uses active termination on the SCSI bus, conforming to Alternative 2 of the SCSI-2 specifications. Termination enable/disable is automatic through cable detection.

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4.9.8 SCSI Firmware

The MegaRAID SCSI 320-1 firmware handles all RAID and SCSI command processing and also supports the features listed in Table 4.7.

Table 4.7 SCSI Firmware

Feature	Description
Disconnect/ reconnect	Optimizes SCSI bus seek
Tagged command queuing	Multiple tags to improve random access
Scatter/gather	Multiple address/count pairs
Multi-threading	Up to 255 simultaneous commands with elevator sorting and concatenation of requests per SCSI channel
Stripe size	Variable for all logical drives: 2, 4, 8, 16, 32, 64, or 128 Kbytes
Rebuild	Multiple rebuilds and consistency checks, with user-definable priority

4.10 RAID Management

RAID management is provided by software utilities that manage and configure the RAID system and MegaRAID SCSI 320-1, create and manage multiple disk arrays, control and monitor multiple RAID servers, provide error statistics logging, and provide online maintenance. They include:

- MegaRAID BIOS Configuration Utility
- WebBIOS Configuration Utility
- Power Console Plus
- MegaRAID Manager

4.10.1 MegaRAID BIOS Configuration Utility

The BIOS Configuration Utility (<Ctrl><M>) is used to configure and maintain RAID arrays, format hard drives, and manage the RAID system.

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It is independent of any operating system. See the *MegaRAID Configuration Software Guide* for additional information.

4.10.2 WebBIOS Configuration Utility

The WebBIOS Configuration Utility is an HTML-based utility used to configure and maintain RAID arrays, format hard drives, and manage the RAID system. See the *MegaRAID Configuration Software Guide* for additional information.

4.10.3 Power Console Plus

Power Console Plus runs in Windows NT, 2000, XP, and .NET. It configures, monitors, and maintains multiple RAID servers from any network node or a remote location. See the *MegaRAID Configuration Software Guide* for additional information.

4.10.4 MegaRAID Manager

This is a character-based utility that works in DOS, Novell NetWare, and Red Hat Linux. See the *MegaRAID Configuration Software Guide* for additional information.

4.11 Compatibility

MegaRAID SCSI 320-1 compatibility issues include:

- Server management
- SCSI device compatibility
- Software compatibility

4.11.1 Server Management

As a simple network management protocol (SNMP) agent, MegaRAID SCSI 320-1 supports all SNMP managers.

4.11.2 SCSI Device Compatibility

MegaRAID SCSI 320-1 supports SCSI hard drives, CD drives, and tape drives.

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4.11.3 Software

All SCSI backup and utility software should work with MegaRAID SCSI 320-1. This software is not provided with MegaRAID SCSI 320-1.

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Chapter 5
Configuring Physical Drives, Arrays, and Logical Drives

This chapter explains how to configure SCSI physical drives, arrays, and logical drives connected to the MegaRAID SCSI 320-1 controller. It contains the following sections:

- Section 5.1, “Configuring SCSI Physical Drives”
- Section 5.2, “Configuring Arrays”
- Section 5.3, “Creating Logical Drives”
- Section 5.4, “Configuring Logical Drives”
- Section 5.5, “Planning the Array Configuration”

5.1 Configuring SCSI Physical Drives

SCSI physical drives must be organized into logical drives. The arrays and logical drives that you construct must be able to support the RAID level that you select. The MegaRAID SCSI 320-1 controller has one SCSI channel.

5.1.1 Basic Configuration Rules

You should observe the following guidelines when connecting and configuring SCSI devices in a RAID array:

- You can place up to 15 physical drives in an array, depending on the RAID level.
- Include all drives that have the same capacity in the same array.
- Make sure any hot spare has a capacity that is at least as large as the largest drive that may be replaced by the hot spare.
- When replacing a failed drive, make sure that the replacement drive has a capacity that is at least as large as the drive being replaced.

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Note: Be sure to back up your data regularly, even when using RAID.

5.1.2 Current Physical Device Configuration

Use Table 5.1 to record the current configuration for your physical devices.

Table 5.1 Physical Device Configuration - SCSI Channel 1

SCSI ID	Device Description	Termination?
0		
1		
2		
3		
4		
5		
6		
8		
9		
10		
11		
12		
13		
14		
15		

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5.1.3 Logical Drive Configuration

Use Table 5.2 to record the configuration for your logical drives.

Table 5.2 Logical Drive Configuration

Logical Drive	RAID Level	Stripe Size	Logical Drive Size	Cache Policy	Read Policy	Write Policy	# of Physical Drives
LD0							
LD1							
LD2							
LD3							
LD4							
LD5							
LD6							
LD7							
LD8							
LD9							
LD10							
LD11							
LD12							
LD13							
LD14							
LD15							
LD16							
LD17							
LD18							
LD19							
LD20							
LD21							

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Table 5.2 Logical Drive Configuration (Cont.)

Logical Drive	RAID Level	Stripe Size	Logical Drive Size	Cache Policy	Read Policy	Write Policy	# of Physical Drives
LD22							
LD23							
LD24							
LD25							
LD26							
LD27							
LD28							
LD29							
LD30							
LD31							
LD32							
LD33							
LD34							
LD35							
LD36							
LD37							
LD38							
LD39							

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5.1.4 Physical Device Layout

Use Table 5.3 to record the physical device layout.

Table 5.3 Physical Device Layout

	Channel 1
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	

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Table 5.3 Physical Device Layout (Cont.)

	Channel 1
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	

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Table 5.3 Physical Device Layout (Cont.)

	Channel 1
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	

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Table 5.3 Physical Device Layout (Cont.)

	Channel 1
Target ID	
Device type	
Logical drive number/Drive number	
Manufacturer/Model number	
Firmware level	

5.2 Configuring Arrays

You organize the physical disk drives in arrays after they are connected to the MegaRAID SCSI 320-1, and after they are formatted and initialized. An array can consist of up to 15 physical disk drives, depending on the RAID level.

The MegaRAID SCSI 320-1 supports up to eight arrays. The number of drives in an array determines the RAID levels that can be supported.

5.2.1 Arranging Arrays

You must arrange the arrays to provide additional organization for the drive array. You must arrange arrays so that you can create system drives that can function as boot devices.

You can sequentially arrange arrays with an identical number of drives so that the drives in the group are spanned. Spanned drives can be treated as one large drive. Data can be striped across multiple arrays as one logical drive.

You can create spanned drives by using the MegaRAID BIOS Setup utility or the MegaRAID Manager.

5.2.2 Creating Hot Spares

Any drive that is present, formatted, and initialized, but is not included in a array or logical drive is automatically designated as a hot spare.

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You can also designate drives as hot spares using the MegaRAID BIOS Configuration Utility, the MegaRAID Manager, or Power Console Plus.

5.3 Creating Logical Drives

Logical drives are arrays or spanned arrays that are presented to the operating system. You must create one or more logical drives.

The logical drive capacity can include all or any portion of an array. The logical drive capacity can also be larger than an array by using spanning. The MegaRAID SCSI 320-1 supports up to 40 logical drives.

5.3.1 Configuration Strategies

The most important factors in RAID array configuration are: drive capacity, drive availability (fault tolerance), and drive performance. You cannot configure a logical drive that optimizes all three factors, but it is easy to choose a logical drive configuration that maximizes one factor at the expense of the other two factors, although needs are seldom that simple.

5.3.1.1 Maximize Capacity

RAID 0 achieves maximum drive capacity, but does not provide data redundancy. Maximum drive capacity for each RAID level is shown below. OEM-level firmware that can span up to 4 logical drives is assumed. Table 5.4 describes the RAID levels, including the number of drives required, and the capacity.

Table 5.4 Capacity for RAID Levels

RAID Level	Description	Drives Required	Capacity
0	Striping without parity	1 – 15	(Number of disks) X capacity of smallest disk
1	Mirroring	2	(Capacity of smallest disk) X (1)
5	Striping with floating parity drive	3 – 15	(Number of disks) X (capacity of smallest disk) - (capacity of 1 disk)

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Table 5.4 Capacity for RAID Levels (Cont.)

RAID Level	Description	Drives Required	Capacity
10	Mirroring and Striping	4 – 14 (Must be a multiple of 2.)	(Number of disks) X (capacity of smallest disk) / (2)
50	RAID 5 and Striping	6 – 15 (Must be a multiple of the number of arrays.)	(Number of disks) X (capacity of smallest disk) – (capacity of 1 disk X number of Arrays)

Note: The Megaraid SCSI 320-1 controller supports a maximum of 15 physical drives.

5.3.1.2 Maximizing Drive Availability

You can maximize the availability of data on the physical disk drive in the logical array by maximizing the level of fault tolerance. Table 5.5 describes the levels of fault tolerance for the RAID levels.

Table 5.5 Fault Tolerance for RAID Levels

RAID Level	Fault Tolerance Protection
0	No fault tolerance.
1	100% protection through data mirroring.
5	100% protection through striping and parity. The data is striped and parity data is written across a number of physical disk drives.
10	100% protection through data mirroring.
50	100% protection through data striping and parity. All data is striped and parity data is written across all drives in two or more arrays.

5.3.1.3 Maximizing Drive Performance

You can configure an array for optimal performance. But optimal drive configuration for one type of application will probably not be optimal for any other application. A basic guideline of the performance

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characteristics for RAID drive arrays at each RAID level is shown in Table 5.6.

Table 5.6 Performance Characteristics for RAID Levels

RAID Level	Performance Characteristics
0	Excellent for all types of I/O activity, but provides no data security.
1	Provides data redundancy and good performance.
5	Provides data redundancy and good performance in most environments.
10	Provides data redundancy and excellent performance.
50	Provides data redundancy and very good performance.

5.3.2 Assigning RAID Levels

Only one RAID level can be assigned to each logical drive. Table 5.7 shows the drives required per RAID level.

Table 5.7 Number of Physical Drives for RAID Levels

RAID Level	Minimum # of Physical Drives	Maximum # of Physical Drives
0	1	15
1	2	2
5	3	15
10	4	14
50	6	15

Note: The Megaraid SCSI 320-1 controller supports a maximum of 15 physical drives.

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5.4 Configuring Logical Drives

After you have installed the MegaRAID SCSI 320-1 controller in the server and have attached all physical disk drives, perform the following actions to prepare a RAID array:

1. Optimize the MegaRAID SCSI 320-1 controller options for your system. See Chapter 6 for additional information.
2. If necessary, perform a low-level format of the SCSI drives that will be included in the array and the drives to be used for hot spares.
3. Press <Ctrl><M> to run the MegaRAID Manager.
4. Customize the RAID array and define and configure one or more logical drives by selecting Easy Configuration or New Configuration.
5. Create and configure one or more system drives (logical drives) by selecting the RAID level, cache policy, read policy, and write policy.
6. Save the configuration.
7. Initialize the system drives.

   After initialization, you can install the operating system.

5.4.1 Optimizing Data Storage

5.4.1.1 Data Access Requirements

Each type of data stored in the disk subsystem has a different frequency of read and write activity. If you know the data access requirements, you can more successfully determine a strategy for optimizing the disk subsystem capacity, availability, and performance.

Servers that support Video on Demand typically read the data often, but write data infrequently. Both the read and write operations tend to be long. Data stored on a general-purpose file server involves relatively short read and write operations with relatively small files.

5.4.1.2 Array Functions

You must first define the major purpose of the disk array. Will this disk array increase the system storage capacity for general-purpose file and print servers? Does this disk array support any software system that

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must be available 24 hours per day? Will the information stored in this disk array contain large audio or video files that must be available on demand? Will this disk array contain data from an imaging system? You must identify the purpose of the data to be stored in the disk subsystem before you can confidently choose a RAID level and a RAID configuration.

5.5 Planning the Array Configuration

Fill out Table 5.8 to help plan this array.

Table 5.8 Factors for Planning the Array Configuration

Question	Answer
Number of physical disk drives in the array	
Purpose of this array. Rank the following factors:	
Maximize drive capacity	
Maximize the safety of the data (fault tolerance)	
Maximize hard drive performance and throughput	
Number of hot spares	
Amount of cache memory installed on MegaRAID SCSI 320-1	
Are all of the disk drives and the server protected by an uninterruptible power supply?	

5.5.1 Using the Array Configuration Planner

The following table lists the possible RAID levels, fault tolerance, and effective capacity for all possible drive configurations for an array consisting of one to eight drives. This table does not take into account any hot spare (standby) drives. You should always have a hot spare drive in case of drive failure. RAID 1 requires two drives, RAID 10 at least four, and RAID 50 at least six.

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Use Table 5.9 to plan the array configuration.

Table 5.9 Array Configuration Planner

# of Drives	Possible RAID Levels	Relative Performance	Fault Tolerance	Effective Capacity
1	None	Excellent	No	100%
1	RAID 0	Excellent	No	100%
2	None	Excellent	No	100%
2	RAID 0	Excellent	No	100%
2	RAID 1	Good	Yes	50%
3	None	Excellent	No	100%
3	RAID 0	Excellent	No	100%
3	RAID 5	Good	Yes	67%
4	None	Excellent	No	100%
4	RAID 0	Excellent	No	100%
4	RAID 5	Good	Yes	75%
4	RAID 10	Good	Yes	50%
5	None	Excellent	No	100%
5	RAID 0	Excellent	No	100%
5	RAID 5	Good	Yes	80%
6	None	Excellent	No	100%
6	RAID 0	Excellent	No	100%
6	RAID 5	Good	Yes	83%
6	RAID 10	Good	Yes	50%
6	RAID 50	Good	Yes	67%
7	None	Excellent	No	100%
7	RAID 0	Excellent	No	100%
7	RAID 5	Good	Yes	86%
8	None	Excellent	No	100%

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Table 5.9 Array Configuration Planner (Cont.)

# of Drives	Possible RAID Levels	Relative Performance	Fault Tolerance	Effective Capacity
8	RAID 0	Excellent	No	100%
8	RAID 5	Good	Yes	87%
8	RAID 10	Good	Yes	50%
8	RAID 50	Good	Yes	75%

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Chapter 6
Hardware Installation

This chapter explains how to install the MegaRAID SCSI 320-1 controller. It contains the following sections:

- Section 6.1, “Hardware Requirements”
- Section 6.2, “Installation Steps”
- Section 6.3, “Summary”

6.1 Hardware Requirements

You must have the following in order to install the MegaRAID SCSI 320-1 controller and create arrays:

- A host computer with the following:
  - A motherboard with 5 V/3.3 V PCI expansion slots that has an available expansion slot
  - Support for PCI version 2.2 or later
  - Intel Pentium, Pentium Pro, or more powerful CPU
  - Floppy drive, color monitor, VGA adapter card, mouse, and keyboard
- The MegaRAID SCSI 320-1 Installation CD
- The necessary internal and/or external SCSI cables and terminators (this depends on the number and type of SCSI devices to be attached)
- An Uninterruptible Power Supply (UPS) for the entire system
- Ultra320, Ultra, Fast SCSI 2 or Wide SCSI hard disk drives

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6.2 Installation Steps

The MegaRAID SCSI 320-1 provides extensive customization options. If you need only basic MegaRAID SCSI 320-1 features and your computer does not use other adapter cards with resource settings that may conflict with MegaRAID SCSI 320-1 settings, even custom installation can be quick and easy.

Table 6.1 lists the hardware installation steps. Each step is described in detail in the following pages.

Table 6.1 Hardware Installation Steps

Step	Action	Additional Information
1	Unpack the MegaRAID controller and inspect for damage. Make sure all items are in the package.	If damaged, call your LSI Logic OEM support representative.
2	Turn the computer off and remove the power cord, and remove the cover.	
3	Check the jumper settings on the MegaRAID SCSI 320-1 controller.	See page 6-3 for the MegaRAID SCSI 320-1 jumper settings.
4	Set SCSI termination.	
5	Install the MegaRAID SCSI 320-1 card.	
6	Connect the SCSI cables to SCSI devices.	
7	Set the target IDs for the SCSI devices.	
8	Replace the computer cover and turn the power on.	Be sure the SCSI devices are powered up before, or at the same time as, the host computer.
9	Run the MegaRAID BIOS Configuration Utility.	Optional.
10	Install software drivers for the desired operating systems.	

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6.2.1 Step 1: Unpack

Unpack and install the hardware in a static-free environment. Remove the MegaRAID SCSI 320-1 controller card from the anti-static bag and inspect it for damage. If the card appears damaged, or if any item listed below is missing, contact LSI Logic or your MegaRAID OEM support representative. The MegaRAID SCSI 320-1 controller is shipped with the following:

- The Driver and Documentation CD, which contains these items:
  - The *MegaRAID Configuration Software Guide*
  - The *MegaRAID Operating System Driver Installation Guide*
  - The *MegaRAID SCSI 320-1 Hardware Guide*
  - The software license agreement
  - The MegaRAID SCSI 320-1 configuration utilities for DOS
- The warranty registration card

6.2.2 Step 2: Power Down

Turn off the computer, remove the power cord, then remove the cover. Make sure the computer is turned off and disconnected from any networks before installing the controller card.

6.2.3 Step 3: Check Jumper Settings

Make sure the jumper settings on the MegaRAID SCSI 320-1 card are correct. The jumpers are set at the factory and you probably do not need to change them. Table 6.2 lists the jumpers (and a connector).

Table 6.2 Jumpers for the MegaRAID SCSI 320-1

Item	Description	Type
J2	Dirty cache LED	2-pin header
J3	Clear EPROM	2-pin header
J4	BIOS enable	2-pin header
J5	SCSI activity LED	2-pin connector
J6	Serial port	3-pin header

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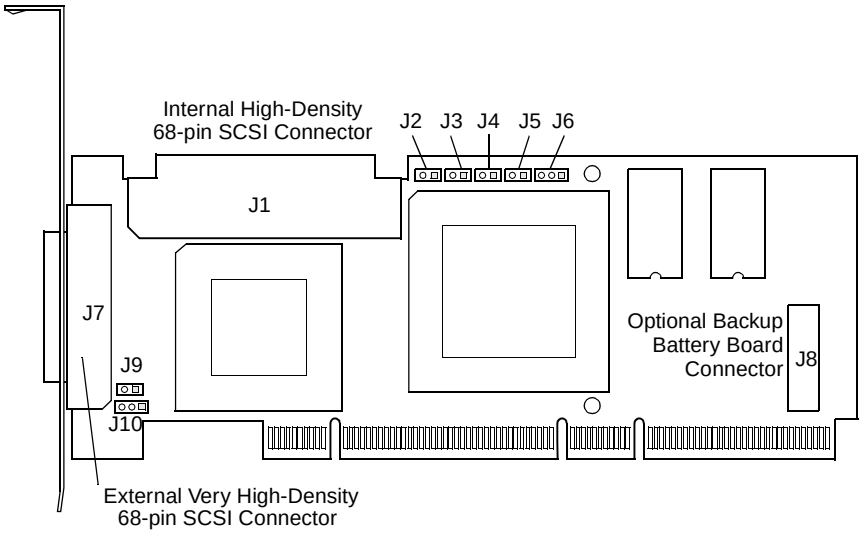
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Table 6.2 Jumpers for the MegaRAID SCSI 320-1

Item	Description	Type
J8	Battery backup unit (BBU) daughter card connector	40-pin header
J9	SCSI bus termination power	2-pin header
J10	SCSI bus termination enable control	3-pin header

Figure 6.1 shows the location of these items on the MegaRAID SCSI 320-1 controller.

Figure 6.1 MegaRAID SCSI 320-1 Controller Layout



6.2.3.1 J2 Dirty Cache LED

J2 is a two-pin header for the dirty cache LED. This can be connected to an LED on the computer enclosure. The LED will be lit when data in the cache has not yet been written to the storage device.

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6.2.3.2 J3 Clear EPROM

J3 is a two-pin header that clears the erasable progammable read-only memory (EPROM) configuration data.

6.2.3.3 J4 BIOS Enable

J4 is a 2-pin header that enables or disables the MegaRAID onboard BIOS. The onboard BIOS should be enabled (J4 unjumpered) for normal board position. Table 6.3 shows the jumper settings.

Table 6.3 Pinout for J4 BIOS Enable

J4 Setting	Onboard BIOS Status
Unjumpered	Enabled
Jumpered	Disabled

6.2.3.4 J5 SCSI Activity LED

J5 is a two-pin connector that attaches to a cable that connects to the hard disk LED mounted on the computer enclosure. The LED indicates data transfers (SCSI bus activity.)

6.2.3.5 J6 Serial Port

J6 is a 3-pin header that attaches to a serial cable. This is used for test purposes only.

6.2.3.6 J8 Connector for Optional BBU Daughter Card

J8 is 40-pin connector that is used to mount an optional battery backup unit that is on a daughtercard.

6.2.3.7 J9 SCSI Bus Termination Power

J9 is a 2-pin jumper. The factory setting is pins 1-2 shorted. Leave at the default setting (jumper installed) for J9 to allow the PCI bus to provide termination power.

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6.2.3.8 J10 Termination Enable

J10 is a three-pin header that specifies hardware or software control of SCSI termination, as shown in Table 6.4. Leave at the default setting (jumper on pins 1 and 2) to allow the MegaRAID controller to automatically set its own SCSI termination.

Table 6.4 Pinout for J10 Termination Enable

Type of SCSI Termination	J10 Setting
Software control of SCSI termination using drive detection (default).	Short pins 1-2
Permanently disable all onboard SCSI termination.	Short pins 2-3
Permanently enable all onboard SCSI termination.	OPEN

6.2.4 Step 4: Set Termination

You must terminate the SCSI bus properly. Set termination at both ends of the SCSI cable. The SCSI bus is an electrical transmission line and must be terminated properly to minimize reflections and losses.

For a disk array, set SCSI bus termination so that removing or adding a SCSI device does not disturb termination. An easy way to do this is to connect the card to one end of the SCSI cable and to connect a terminator module at the other end of the cable. The connectors between the two ends can connect SCSI devices. Disable termination on the SCSI devices. See the manual for each SCSI device to disable termination.

6.2.4.1 SCSI Termination

The SCSI bus is an electrical transmission line and it must be terminated properly to minimize reflections and losses. You complete the SCSI bus by setting termination at both ends.

You can let the card automatically provide SCSI termination at one end of the SCSI bus. You can terminate the other end of the SCSI bus by attaching an external SCSI terminator module to the end of the cable or by attaching a SCSI device that internally terminates the SCSI bus at the end of the SCSI channel.

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6.2.4.2 Selecting a Terminator

Use standard external SCSI terminators on a SCSI channel operating at 10 Mbytes/s or higher synchronous data transfer.

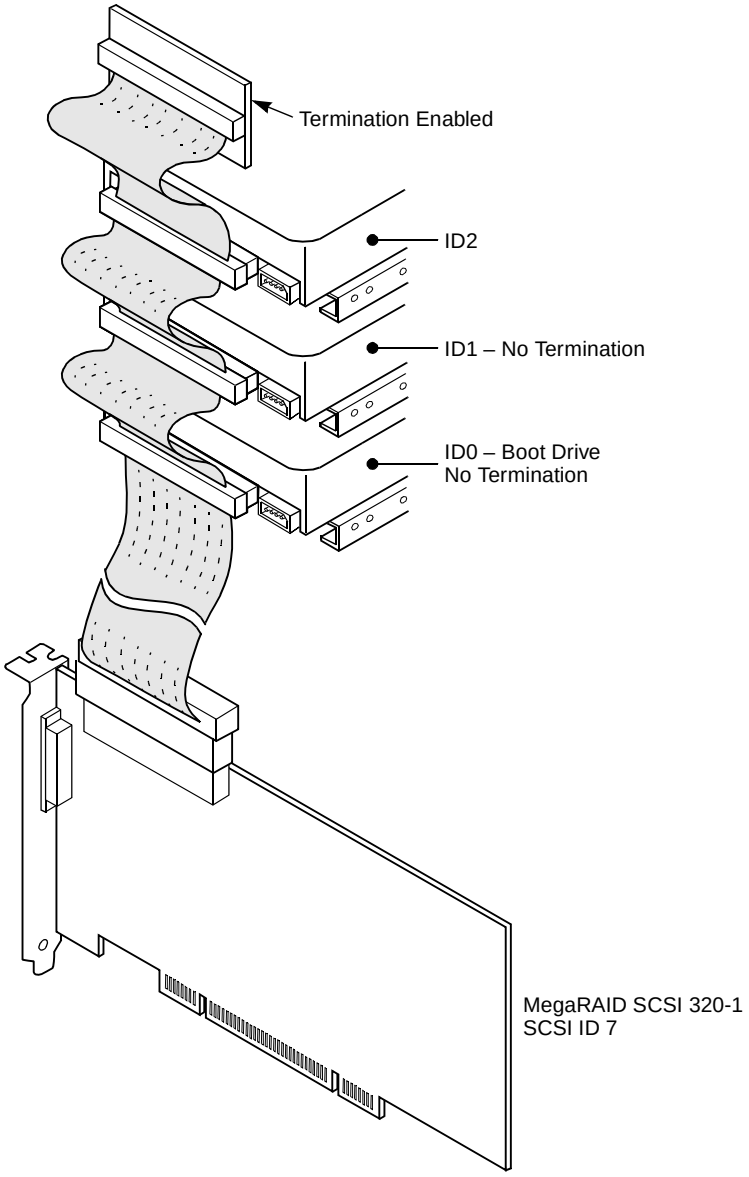
6.2.4.3 Terminating Internal SCSI Disk Arrays

Set the termination so that SCSI termination and termination power are intact when any hard drive is removed from a SCSI channel, as shown in Figure 6.2.

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Figure 6.2 Termination of Internal SCSI Disk Arrays



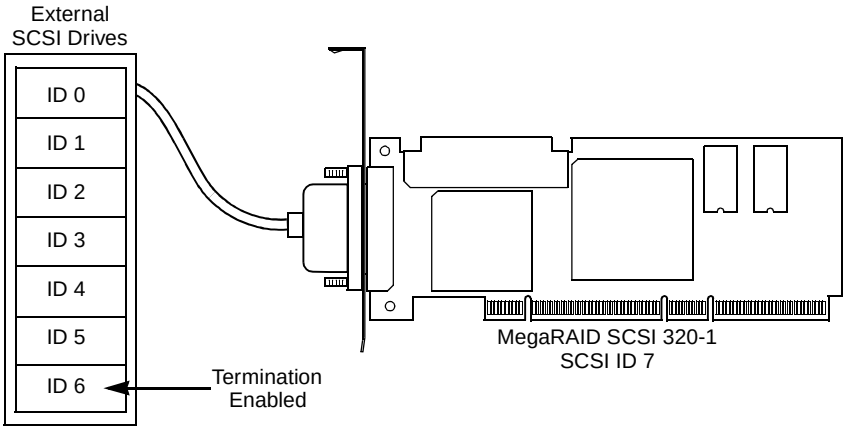
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6.2.4.4 Terminating External Disk Arrays

In most array enclosures, the end of the SCSI cable has an independent SCSI terminator module that is not part of any SCSI drive. In this way, SCSI termination is not disturbed when any drive is removed, as shown in Figure 6.3:

Figure 6.3 Terminating External Disk Arrays



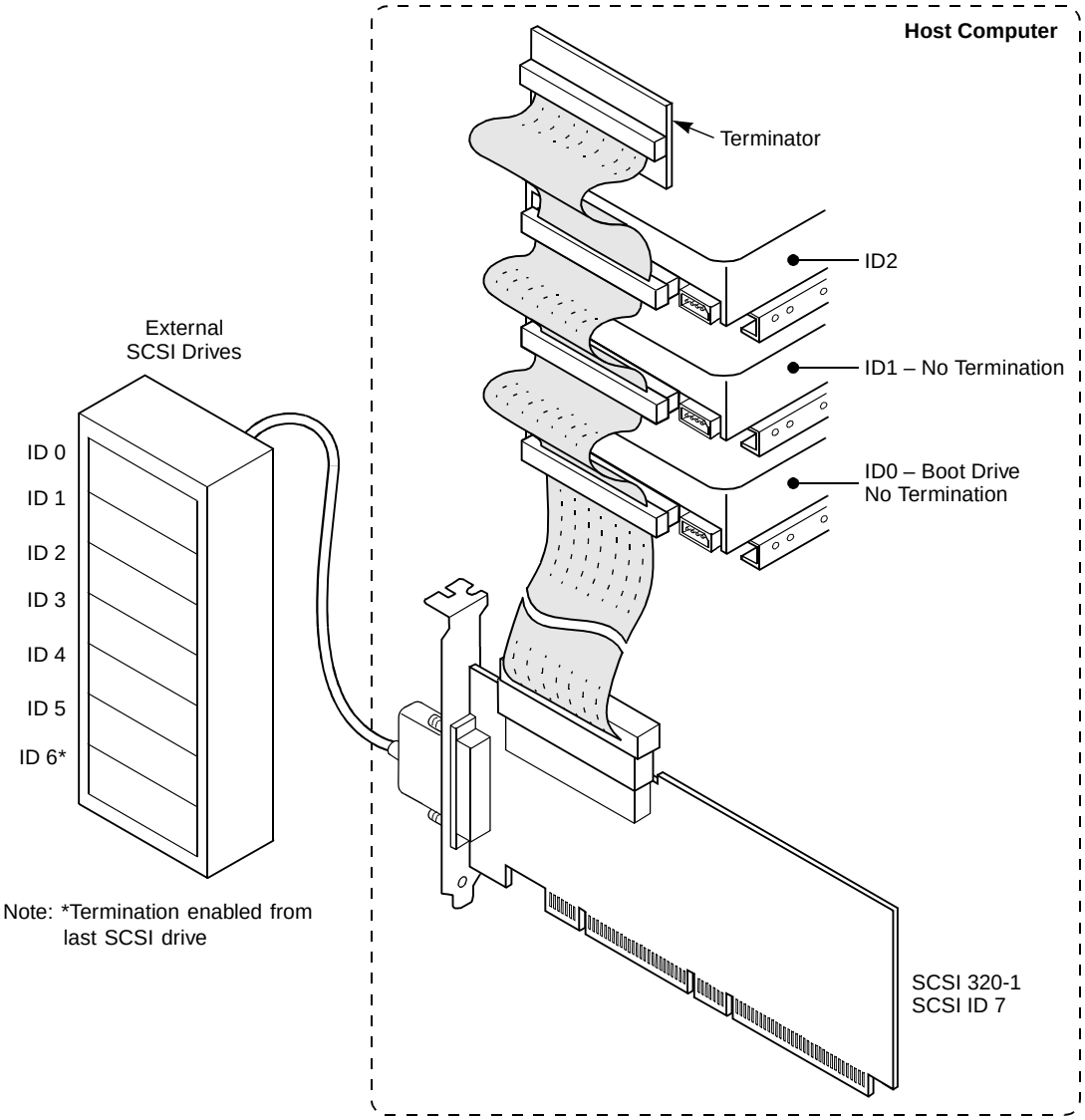
6.2.4.5 Terminating Internal and External Disk Arrays

You can use both internal and external drives with the MegaRAID SCSI 320-1. You still must make sure that the proper SCSI termination and termination power is preserved, as shown in Figure 6.4:

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Figure 6.4 Terminating Internal and External Disk Arrays



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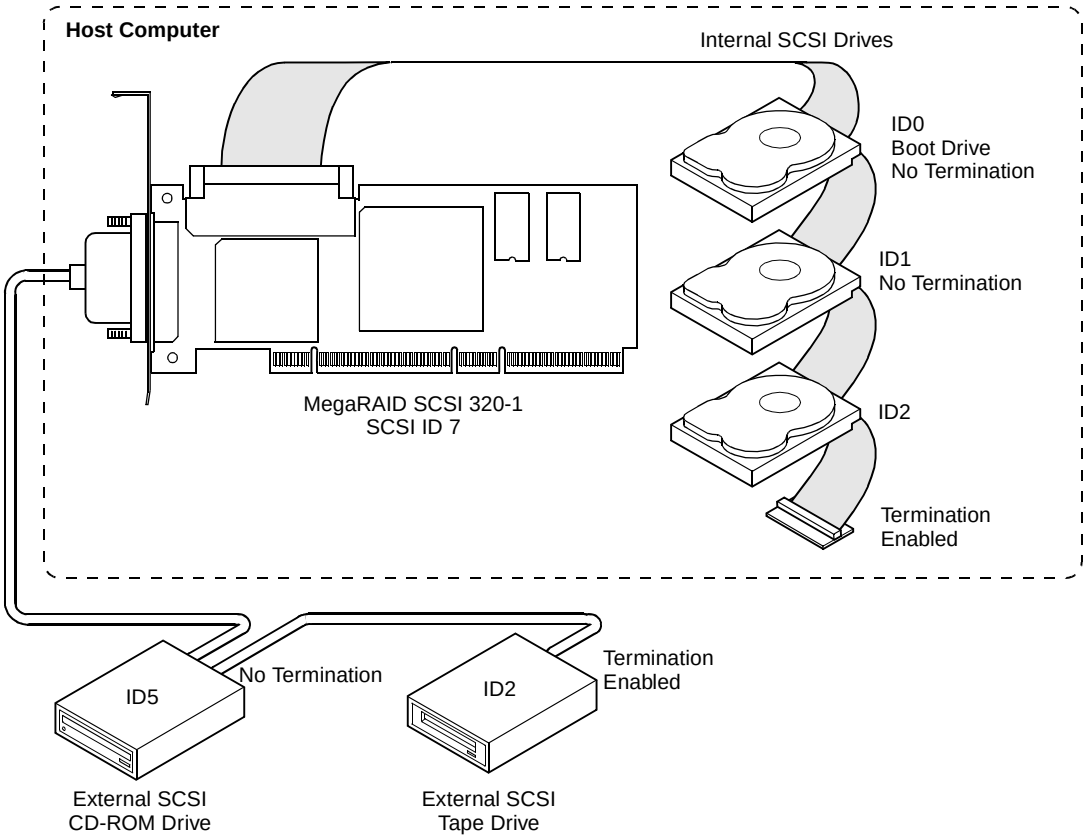
6.2.4.6 Connecting Non-Disk SCSI Devices

SCSI tape drives and SCSI CD-ROM drives must each have a unique SCSI ID regardless of the SCSI channel they are attached to. The general rule for Unix systems is:

- Tape drive set to SCSI ID 2
- CD-ROM drive set to SCSI ID 5

Caution: Since all non-disk SCSI devices are single ended, it is not advisable to attach a non-disk device to a MegaRAID SCSI 320-1 RAID controller if LVD disk drives are also attached. This is because the SCSI bus will then operate in single-ended mode.

Figure 6.5 Connecting Non-Disk SCSI Devices



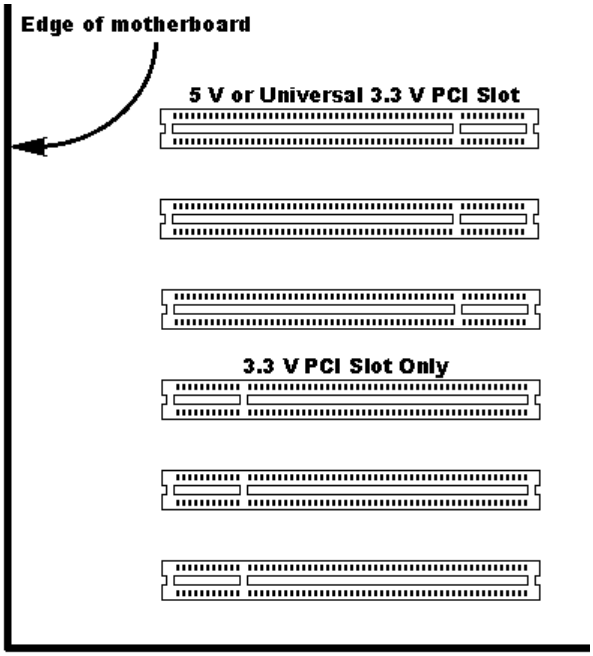
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6.2.5 Step 5: Install MegaRAID SCSI 320-1

Select a 3.3 V or 5 V PCI slot and align the MegaRAID SCSI 320-1 controller bus connector with the slot. Figure 6.6 shows the differences between the 3.3 V and 5 V slots.

Figure 6.6 3.3 V and 5 V PCI Slots

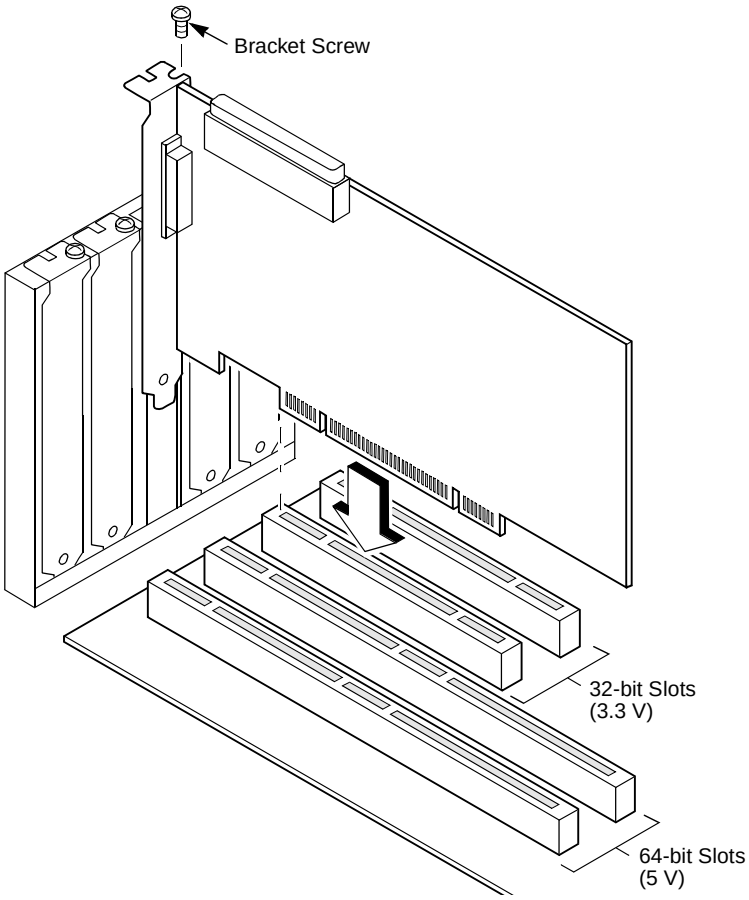


Insert the MegaRAID SCSI 320-1 card in the PCI slot, as shown in Figure 6.7. Press down gently but firmly to make sure that the card is properly seated in the slot. The bottom edge of the controller card should be flush with the slot. Attach the bracket to the computer frame with the bracket screw.

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Figure 6.7 Installing the MegaRAID SCSI 320-1 Controller



6.2.6 Step 6: Connect SCSI Devices

Use SCSI cables to connectSCSI devices to the MegaRAID SCSI 320-1. The MegaRAID SCSI 320-1 provides two SCSI connectors:

- J1, the internal high-density 68-pin SCSI connector for Wide (16-bit) SCSI
- J7, the external very high-density 68-pin SCSI connector

Use this procedure to connect SCSI devices:

1. Disable termination on any SCSI device that does *not* sit at the end of the SCSI bus.

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2. Configure all SCSI devices to supply TermPWR.
3. Set proper target IDs (TIDs) for each SCSI device.

   The cable length can be up to 20 m.

6.2.6.1 Cable Suggestions

System throughput problems can occur if SCSI cable use is not maximized. Here are some cabling guidelines:

- You can use cables up to 12 meters for LVD devices.
- For single-ended SCSI devices, use the shortest SCSI cables.
- Use active termination.
- Avoid clustering the cable nodes.
- Cable stub length should be no more than 0.1 meter (4 inches).
- Route SCSI cables carefully.
- Use high impedance cables.
- Use flat cables for inside the enclosure, and round, shielded cables for outside of the enclosure.
- Ribbon cables have fairly good cross-talk rejection characteristics.

6.2.7 Step 7: Set Target IDs

Set target identifiers (TIDs) on the SCSI devices. Each device in a specific SCSI channel must have a unique TID in that channel. Non-disk devices (CD-ROM or tapes) should have unique SCSI IDs *regardless of the channel where they are connected*. See the documentation for each SCSI device to set the TIDs. The MegaRAID SCSI 320-1 controller automatically occupies TID 7 in the SCSI channel. Eight-bit SCSI devices can only use the TIDs from 0 to 6. 16-bit devices can use the TIDs from 0 to 15. The arbitration priority for a SCSI device depends on its TID.

Table 6.5 shows the relative priority of each Target ID:

Table 6.5 Priority of Target IDs

Priority	**Highest**							**Lowest**				
TID	7	6	5	...	2	1	0	15	14	...	9	8

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Important: Non-disk devices (CD-ROM or tape drive) should have unique SCSI IDs regardless of the channel they are connected to.

6.2.7.1 Example of MegaRAID SCSI 320-1 ID Mapping

Table 6.6 provides an example of ID mapping for the SCSI 320-1.

Table 6.6 Example of Mapping for SCSI 320-1

ID	Channel 1
0	A1-1
1	A2-1
2	CD
3	A2-5
4	CD
5	A4-1
6	Optical
7	Reserved
8	A5-2
9	A5-6
10	A6-1
11	A6-4
12	A6-7
13	A7-2
14	A7-5
15	A7-8

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6.2.7.2 Target IDs as Presented to the Operating System

Table 6.7 shows the target IDs as presented to the operating system.

Table 6.7 Target IDs as Presented to the Operating System

ID	LUN	Device	ID	LUN	Device
0	0	Disk (A1-X)	1	0	
0	1	Disk (A2-X)	2	0	CD
0	2	Disk (A3-X)	3	0	Tape
0	3	Disk (A4-X)	4	0	CD
0	4	Disk (A5-X)	5	0	Tape
0	5	Disk (A6-X)	6	0	
0	6	Disk (A7-X)			
0	7	Disk (A8-X)			

6.2.8 Step 8: Power Up

Replace the computer cover and reconnect the AC power cords. Turn power on to the host computer. Set up the power supplies so that the SCSI devices are powered up at the same time as or before the host computer. If the computer is powered up before a SCSI device, the device might not be recognized.

During boot, the MegaRAID SCSI 320-1 BIOS message appears:

```
MegaRAID SCSI 320-1 Disk Array Adapter BIOS Version x.xx
date
Copyright (c) LSI Logic Corporation
Firmware Initializing... [ Scanning SCSI Device ..(etc.).. ]
```

The firmware takes several seconds to initialize. During this time the adapter will scan the SCSI channel(s). When ready, the following appears:

```
Host Adapter-1 Firmware Version x.xx DRAM Size 16 MB
0 Logical Drives found on the Host Adapter
0 Logical Drives handled by BIOS
Press <Ctrl><M> to run MegaRAID SCSI 320-1 BIOS
Configuration Utility
```


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The <Ctrl><M> utility prompt times out after several seconds. The MegaRAID SCSI 320-1 host adapter (controller) number, firmware version, and cache DRAM size are displayed in the second portion of the BIOS message. The numbering of the controllers follows the PCI slot scanning order used by the host motherboard.

6.2.9 Step 9: Run the MegaRAID BIOS Configuration Utility

Press <Ctrl><M> to run the MegaRAID BIOS Configuration Utility. See the *MegaRAID Configuration Software Guide* for information about running this utility.

6.2.10 Step 10: Install the Operating System Driver

MegaRAID can operate under MS-DOS or any DOS-compatible operating system using the standard AT BIOS INT 13h Hard Disk Drive interface. To operate with other operating systems, you must install software drivers. MegaRAID provides software drivers on the Driver and Documentation CD for the following operating systems:

- MS-DOS version 6.xx or later
- Microsoft Windows NT 4.0, Windows 2000, Windows XP, Windows .NET
- Novell NetWare 5.1, 6.0
- Red Hat Linux 7.2, 7.3

Note: Refer to the *MegaRAID Driver Installation Guide* for the procedures used to install operating system drivers.

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6.3 Summary

This chapter discussed hardware installation. Configure the RAID system using software configuration utilities. See the *MegaRAID Configuration Software Guide* for all information about MegaRAID SCSI 320-1 software utilities. Table 6.8 lists the utility programs for configuring MegaRAID SCSI 320-1.

Table 6.8 Configuration Utilities and Operating Systems

Configuration Utility	Operating System
MegaRAID BIOS Configuration Utility	Independent of the operating system
WebBIOS Configuration Utility	Independent of the operating system
MegaRAID Manager	DOS Red Hat Linux 7.2, 7.3 Novell NetWare 5.1, 6.0
Power Console Plus	Microsoft Windows NT Windows 2000 Windows XP Windows .NET

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Chapter 7
Troubleshooting

This chapter provides troubleshooting information for the MegaRAID SCSI 320-1 controller. It contains the following sections:

- Section 7.1, “General Troubleshooting”
- Section 7.2, “BIOS Boot Error Messages”
- Section 7.3, “Other BIOS Error Messages”
- Section 7.4, “Other Potential Problems”

7.1 General Troubleshooting

Table 7.1 lists the general problems that can occur, along with suggested solutions.

Table 7.1 General Problems and Suggested Solutions

Problem	Suggested Solution
Some operating systems do not load in a computer with a MegaRAID SCSI 320-1 controller.	Check the system BIOS configuration for PCI interrupt assignments. Make sure some Interrupts are assigned for PCI. Initialize the logical drive before installing the operating system.
One of the hard drives in the array fails often.	Check the drive error counts using Power Console Plus. (See the *MegaRAID Configuration Software Guide* for more information.) Format the drive. Rebuild the drive If the drive continues to fail, replace it with another drive with the same capacity.

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Table 7.1 General Problems and Suggested Solutions (Cont.)

Problem	Suggested Solution
Pressed <Ctrl><M>. Ran Megaconf.exe and tried to make a new configuration. The system hangs when scanning devices.	Check the drives IDs on each channel to make sure each device has a different ID. Check the termination. The device at the end of the channel must be terminated. Replace the drive cable.
Multiple drives connected to the MegaRAID SCSI 320-1 use the same power supply. There is a problem spinning the drives all at once.	Set the drives to spin on command. This will allow MegaRAID SCSI 320-1 to spin two devices simultaneously.
Pressing <Ctrl><M> or running megaconf.exe does not display the Management Menu.	These utilities require a color monitor.
Cannot flash or update the EEPROM.	You may need a new EEPROM.
`Firmware Initializing...` appears and remains on the screen.	Make sure that TERMPWR is being properly provided to each peripheral device populated channel. Make sure that each end of the channel chain is properly terminated using the recommended terminator type for the peripheral device. The channel is automatically terminated at the MegaRAID SCSI 320-1 card if only one cable is connected to a channel. Make sure (on a channel basis) only two types of cables are connected at any one time. Make sure that the MegaRAID SCSI 320-1 controller is properly seated in the PCI slot.
What SCSI IDs can a non-hard disk device have and what is maximum number allowed per adapter?	Non-hard disk devices can accommodate only SCSI IDs 1, 2, 3, 4, 5, or 6, regardless of the channel used. A maximum of six non-hard disk devices are supported per MegaRAID SCSI 320-1 adapter.

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7.2 BIOS Boot Error Messages

Table 7.2 describes BIOS error messages that can display when you boot the system, and suggested solutions.

Table 7.2 BIOS Boot Error Messages

Message	Problem	Suggested Solution
Adapter BIOS Disabled. No Logical Drives Handled by BIOS	The MegaRAID BIOS is disabled. Sometimes the BIOS is disabled to prevent booting from the BIOS.	Enable the BIOS using the MegaRAID BIOS Configuration Utility.
Host Adapter at Baseport xxxx Not Responding	The BIOS cannot communicate with the adapter firmware.	Make sure the MegaRAID SCSI 320-1 is properly installed.
No MegaRAID SCSI 320-1 Adapter	The BIOS cannot communicate with the adapter firmware.	Make sure the MegaRAID SCSI 320-1 is properly installed.
Configuration of nonvolatile RAM (NVRAM) and drives mismatch. Run View/Add Configuration option of Configuration Utility. Press any key to run the Configuration Utility.	The configuration stored in the MegaRAID SCSI 320-1 adapter does not match the configuration stored in the drives.	1. Press a key to run MegaRAID Manager. 2. Select View/Add Configuration from the Configure menu. 3. Use View/Add Configuration to examine both the configuration in NVRAM and the configuration stored on the disk drives. 4. Resolve the problem by selecting one of the configurations.
1 Logical Drive Failed	A logical drive failed to sign on.	Make sure all physical drives are properly connected and are powered on. Run MegaRAID Manager to find out if any physical drives are not responding. Reconnect, replace, or rebuild any drive that is not responding.
X Logical Drives Degraded	x number of logical drives signed on in a degraded state.	Make sure all physical drives are properly connected and are powered on. Run MegaRAID Manager to find if any physical drives are not responding. Reconnect, replace, or rebuild any drive that is not responding.

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Table 7.2 BIOS Boot Error Messages (Cont.)

Message	Problem	Suggested Solution
1 Logical Drive Degraded	A logical drive signed on in a degraded state.	Make sure all physical drives are properly connected and are powered on. Run MegaRAID Manager to find out if any physical drives are not responding. Reconnect, replace, or rebuild any drive that is not responding.
The following SCSI IDs are not responding: Channel x:a.b.c	The physical drives with SCSI IDs a, b, and c are not responding on SCSI channel x.	Make sure the physical drives are properly connected and are powered on.

7.3 Other BIOS Error Messages

Table 7.3 describes other BIOS error messages, their meaning, and suggested solutions.

Table 7.3 Other BIOS Error Messages

Message	Problem	Suggested Solution
Following SCSI disk not found and no empty slot available for mapping it	The physical disk roaming feature did not find the physical disk with the displayed SCSI ID. No slot is available to map the physical drive. MegaRAID cannot resolve the physical drives into the current configuration.	Reconfigure the array.
Following SCSI IDs have the same data y, z Channel x: a, b, c	The physical drive roaming feature found the same data on two or more physical drive on channel x with SCSI IDs a, b, and c. MegaRAID cannot determine the drive that has the duplicate information.	Remove the drive or drives that should not be used.

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Table 7.3 Other BIOS Error Messages (Cont.)

Message	Problem	Suggested Solution
Unresolved configuration mismatch between disks and NVRAM on the adapter	The configuration stored in the MegaRAID NVRAM does not match the configuration stored on the drives.	1. Press a key to run MegaRAID Manager. 2. Select View/Add Configuration from the Configure menu. 3. Use View/Add Configuration to examine both the configuration in NVRAM and the configuration stored on the disk drives. 4. Resolve the problem by selecting one of the configurations.

7.4 Other Potential Problems

Table 7.4 describes other potential problems.

Table 7.4 Other Potential Problems

Topic	Information
DOS ASPI	MEGASPI.SYS, the MegaRAID DOS ASPI manager, uses 6 Kbytes of system memory once it is loaded.
CD drives under DOS	At this time, copied CDs are not accessible from DOS even after loading MEGASPI.SYS and MEGACDR.SYS.
Physical drive errors	To display the MegaRAID Manager Media Error and Other Error options, select the Objects menu, then Physical Drive. Select a physical drive and press <F2>. The windows displays the number of errors. A Media Error is an error that occurred while actually transferring data. An Other Error is an error that occurs at the hardware level because of a device failure, poor cabling, bad termination, signal loss, etc.
Virtual sizing	The virtual sizing option enables RAID expansion. Virtual sizing must be enabled to increase the size of a logical drive or add a physical drive to an existing logical drive. Run the BIOS Configuration Utility by pressing <Ctrl><M> to enable virtual sizing. Select Objects, then Logical Drive. Next, select View/Update Parameters, then set Virtual Sizing to Enabled.
BSD Unix	We do not provide a driver for BSDI Unix. MegaRAID SCSI 320-1 does not support BSDI Unix.
Multiple LUNs	MegaRAID SCSI 320-1 supports one logical unit number (LUN) per each target ID. No multiple LUN devices are supported.

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Table 7.4 Other Potential Problems (Cont.)

Topic	Information
MegaRAID power requirements	The maximum MegaRAID SCSI 320-1 power requirements are 15 W at 5 V and 3 A.
SCSI bus requirements	The ANSI specification dictates the following: • The maximum signal path length between terminators is 3 meters when using up to 4 maximum capacitance (25 pF) devices and 1.5 meters when using more than 4 devices. • SCSI devices should be uniformly spaced between terminators, with the end devices located as close as possible to the terminators. • The characteristic impedance of the cable should be 90 +/- 6 ohms for the /REQ and /ACK signals and 90 +/- 10 ohms for all other signals. • The stub length (the distance from the controller's external connector to the mainline SCSI bus) shall not exceed 0.1m (approximately 4 inches). • The spacing of devices on the mainline SCSI bus should be at least three times the stub length. • All signal lines shall be terminated once at both ends of the bus powered by the TERMPWR line.

Windows NT Installation	When Windows NT is installed using a bootable CD, the devices on the MegaRAID SCSI 320-1 will not be recognized until after the initial reboot. The Microsoft documented workaround is in SETUP.TXT. SETUP.TXT is on the CD. Perform the following steps to install drivers when Setup recognizes one of the supported SCSI host adapters without making the devices attached to it available for use:
	1. Restart Windows NT Setup.
	2. Press <F6> to prevent Windows NT Setup from performing disk controller detection when Windows NT Setup displays the following:
	`Setup is inspecting your computer's hardware configuration...,`
	This allows you to install the driver from the drivers disk you created. All SCSI adapters must be installed manually.
	3. Press <S> to display a list of supported SCSI host adapters when Windows NT Setup displays the following:
	`Setup could not determine the type of one or more mass storage devices installed in your system, or you have chosen to manually specify an adapter,`
	4. Select Other from the bottom of the list.
	5. Insert the drivers disk you made when prompted to do so and select Mega-RAID SCSI 320-1 from this list.
	In some cases, Windows NT Setup repeatedly prompts to swap disks. Windows NT will recognize any devices attached to this adapter.
	6. Repeat this step for each host adapter not already recognized by Windows NT Setup.

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Appendix A
SCSI Cables and Connectors

MegaRAID SCSI 320-1 provides several different types of SCSI connectors. The connectors are:

- One 68-pin high density internal connector
- One 68-pin very high density external connector

A.1 68-Pin High-Density SCSI Internal Connector

The SCSI channel on the MegaRAID SCSI 320-1 controller has a 68-pin high density 0.050 inch pitch unshielded connector.

This connector provides all signals needed to connect MegaRAID SCSI 320-1 to Wide SCSI devices. The following connector pinouts are provided for both single-ended and differential primary bus (P-CABLE) as specified in the SPI (SCSI Parallel Interface) documentation.

The cable assemblies that interface with the 68-pin connector are:

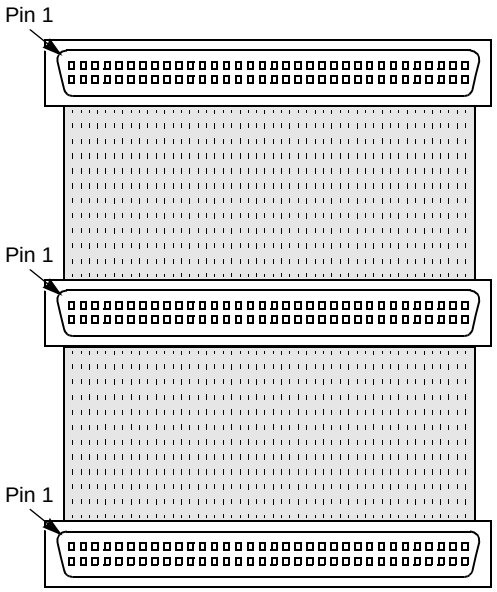
- Flat ribbon or twisted pair cable for connecting internal Wide SCSI devices
- Round shielded cable for connecting external Wide SCSI devices

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A.1.1 Cable Assembly for Internal Wide SCSI Devices

The cable assembly for connecting internal Wide SCSI devices is shown below.



Connectors: 68 Position Plug (Male)
AMP – 786090-7

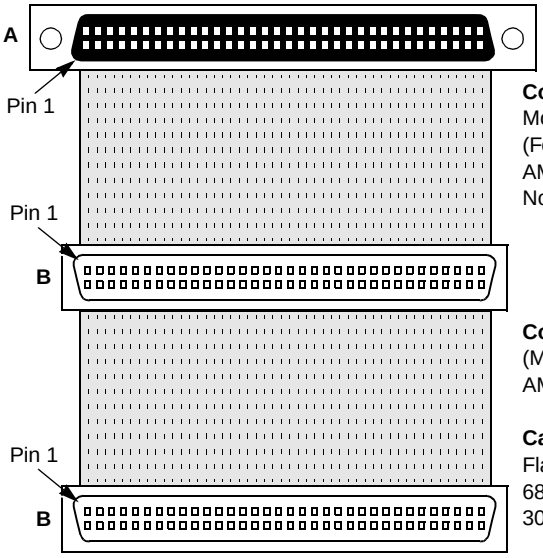
Cable: Flat Ribbon or Twisted-Pair Flat Cable
68 Conductor 0.025 Centerline
30 AWG

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A.1.2 Connecting Internal and External Wide Devices

The cable assembly for connecting internal Wide and external Wide SCSI devices is shown below.



Connector A: 68 Position Panel Mount Receptacle with 4-40 Holes (Female)
AMP – 786096-7
Note: To convert to 2-56 holes, use screwlock kit 749087-1, 749087-2, or 750644-1 from AMP

Connectors B: 68 Position Plug (Male)
AMP – 786090-7

Cable: Flat Ribbon or Twisted-Pair Flat Cable
68 Conductor 0.025 Centerline
30 AWG

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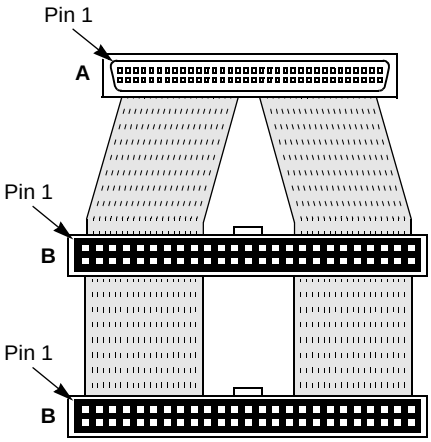
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A.1.3 Converting Internal Wide to Internal Non-Wide (Type 2)

The cable assembly for converting internal Wide SCSI connectors to internal non-Wide (Type 2) SCSI connectors is shown below.

68 Position Connector Contact Number		50 Position Connector Contact Number
6	● — ●	1
40	● — ●	2
7	● — ●	3
41	● — ●	4
⋮		⋮
49	● — ●	20
16	● — ●	21
50	● — ●	22
17	Open	23
51	Open	24
18	Open	25
52	● — ●	26
19	● — ●	27
⋮		⋮
29	● — ●	47
63	● — ●	48
30	● — ●	49
64	● — ●	50

Table 1: Connector Contact Connection for Wide to Non-Wide Conversion



Connector A: 68 Position Plug (Male)
AMP– 749925-5

Connector B: 50 Position IDC Receptacle (Female)
AMP – 499252-4, 1-746285-0, 1-746288-0

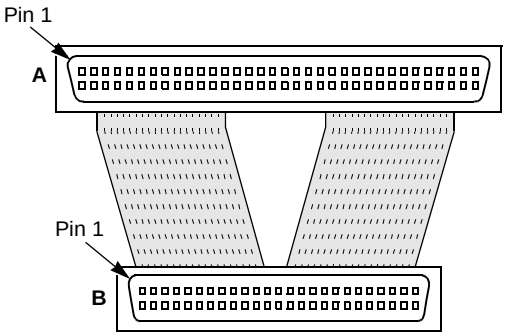
Wire: Twisted-Pair Flat Cable or Laminated Discrete Wire Cable
25 Pair 0.050 Centerline
28 AWG

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A.1.4 Converting Internal Wide to Internal Non-Wide (Type 30)

The cable assembly for converting internal Wide SCSI connectors to internal non-Wide (Type 30) SCSI connectors is shown below.



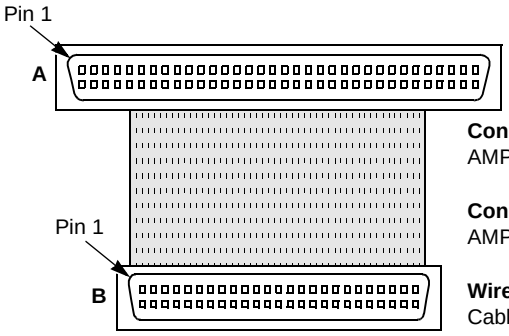
Connector A: 68 Position Plug (Male)
AMP– 749925-5

Connector B: 50 Position Plug (Male)
AMP – 749925-3

Wire: Twisted-Pair Flat Cable or Laminated Discrete Wire Cable
25 Pair 0.050 Centerline
28 AWG

A.1.5 Converting from Internal Wide to Internal Non-Wide (Type 3)

The cable assembly for converting internal Wide SCSI connectors to internal non-Wide (Type 3) SCSI connectors is shown below.



Connector A: 68 Position Plug (Male)
AMP– 786090-7

Connector B: 50 Position Plug (Male)
AMP – 786090-7

Wire: Flat Ribbon or Twisted-Pair Flat Cable 50 Conductor 0.025 Centerline
30 AWG

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A.2 SCSI Cable and Connector Vendors

Table A.1 lists SCSI cable vendors, and contact information.

Table A.1 SCSI Cable Vendors

Manufacturer	Telephone Number
Cables To Go	Voice: 800-826-7904 Fax: 800-331-2841
System Connection	Voice: 800-877-1985
Technical Cable Concepts	Voice: 714-835-1081
GWC	Voice: 800-659-1599

Table A.2 table lists SCSI connector vendors.

Table A.2 SCSI Connector Vendors

Manufacturer	Connector Part Number	Back Shell Part Number
AMP	749111-4	749193-1
Fujitsu	FCN-237R050-G/F	FCN-230C050-D/E
Honda	PCS-XE50MA	PCS-E50LA

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A.3 High-Density 68-Pin Connector Pinout for SE SCSI

Table A.3 lists the pinout for the high-density 68-pin connector for single-ended SCSI.

Table A.3 High-Density 68-Pin Connector Pinout (SE SCSI)

Signal	Connector Pin	Cable Pin	Cable Pin	Connector Pin	Signal
Ground	1	1	2	35	-DB(12)
Ground	2	3	4	36	-DB(13)
Ground	3	5	6	37	-DB(14)
Ground	4	7	8	38	-DB(15)
Ground	5	9	10	39	-DB(P1)
Ground	6	11	12	40	-DB(0)
Ground	7	13	14	41	-DB(1)
Ground	8	15	16	42	-DB(2)
Ground	9	17	18	43	-DB(3)
Ground	10	19	20	44	-DB(4)
Ground	11	21	22	45	-DB(5)
Ground	12	23	24	46	-DB(6)
Ground	13	25	26	47	-DB(7)
Ground	14	27	28	48	-DB(P)
Ground	15	29	30	49	SWAP L
Ground	16	31	32	50	SHELF_OK
TERMPWR	17	33	34	51	TERMPWR
TERMPWR	18	35	36	52	TERMPWR
Reserved	19	37	38	53	Reserved
Ground	20	39	40	54	FAULT_CLK H
Ground	21	41	42	55	-ATN

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Table A.3 High-Density 68-Pin Connector Pinout (SE SCSI)

Signal	Connector Pin	Cable Pin	Cable Pin	Connector Pin	Signal
Ground	22	43	44	56	FAULT_DATA H
Ground	23	45	46	57	-BSY
Ground	24	47	48	58	-ACK
Ground	25	49	50	59	-RST
Ground	26	51	52	60	-MSG
Ground	27	53	54	61	-SEL
Ground	28	55	56	62	-C/D
Ground	29	57	58	63	-REQ
Ground	30	59	60	64	-I/O
Ground	31	61	62	65	-DB(8)
Ground	32	63	64	66	-DB(9)
Ground	33	65	66	67	-DB(10)
Ground	34	67	68	68	-DB(11)

The following applies to the high-density SCSI connector described in Table A.3:

- A hyphen before a signal name indicates that signal is active low.
- The connector pin refers to the conductor position when using 0.025 inch centerline flat ribbon cable with a high-density connector (AMPLIMITE.050 Series connectors).
- Eight-bit devices connected to the P-Cable must leave the following signals open: -DB (8), -DB (9), -DB (10), -DB (11), -DB(12), -DB (13), -DB (14), -DB 15), and -DB (P1).
- All other signals should be connected as defined.

Caution: Lines labeled RESERVED should be connected to Ground in the bus terminator assemblies or in the end devices on the SCSI cable. RESERVED lines should be open in the other SCSI devices, but can be connected to Ground.

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A.4 68-Pin Connector Pinout for LVD SCSI

Table A.4 lists the pinout for the 68-pin connector for LVD SCSI.

Table A.4 68-Pin Connector Pinout for LVD SCSI

Signal	Connector Pin	Cable Pin	Cable Pin	Connector Pin	Signal
+DB(12)	1	1	2	35	-DB(12)
+DB(13)	2	3	4	36	-DB(13)
+DB(14)	3	5	6	37	-DB(14)
+DB(15)	4	7	8	38	-DB(15)
+DB(P1)	5	9	10	39	-DB(P1)
+DB(0)	6	11	12	40	-DB(0)
+DB(1)	7	13	14	41	-DB(1)
+DB(2)	8	15	16	42	-DB(2)
+DB(3)	9	17	18	43	-DB(3)
+DB(4)	10	19	20	44	-DB(4)
+DB(5)	11	21	22	45	-DB(5)
+DB(6)	12	23	24	46	-DB(6)
+DB(7)	13	25	26	47	-DB(7)
+DB(P)	14	27	28	48	-DB(P)
Ground	15	29	30	49	Ground
DIFFSENS	16	31	32	50	Ground
TERMPWR	17	33	34	51	TERMPWR
TERMPWR	18	35	36	52	TERMPWR
Reserved	19	37	38	53	Reserved
Ground	20	39	40	54	Ground
+ATN	21	41	42	55	-ATN
Ground	22	43	44	56	Ground

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Table A.4 68-Pin Connector Pinout for LVD SCSI (Cont.)

Signal	Connector Pin	Cable Pin	Cable Pin	Connector Pin	Signal
+BSY	23	45	46	57	-BSY
+ACK	24	47	48	58	-ACK
+RST	25	49	50	59	-RST
+MSG	26	51	52	60	-MSG
+SEL	27	53	54	61	-SEL
+C/D	28	55	56	62	-C/D
+REQ	29	57	58	63	-REQ
+I/O	30	59	60	64	-I/O
+DB(8)	31	61	62	65	-DB(8)
+DB(9)	32	63	64	66	-DB(9)
+DB(10)	33	65	66	67	-DB(10)
+DB(11)	34	67	68	68	-DB(11)

Note: The conductor number refers to the conductor position when using flat-ribbon cable.

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Appendix B
Audible Warnings

The MegaRAID SCSI 320-1 RAID controller has an onboard tone generator that indicates events and errors.

Note: This is available only if the optional series 502 Battery Backup Unit (BBU) is installed.

Table B.1 Audible Warnings and Descriptions

Tone Pattern	Meaning	Examples
Three seconds on and one second off	A logical drive is offline.	One or more drives in a RAID 0 configuration failed. Two or more drives in a RAID 1, or 5 configuration failed.
One second on and one second off	A logical drive is running in degraded mode.	One drive in a RAID 5 configuration failed.
One second on and three seconds off	An automatically initiated rebuild has been completed.	While you were away from the system, a disk drive in a RAID 1, or 5 configuration failed and was rebuilt.

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Appendix C
Glossary

Array	A grouping of individual disk drives that combines the storage space on the disk drives into a single segment of contiguous storage space. MegaRAID can group disk drives on one or more SCSI channels into an array.
Array Management Software	Software that provides common control and management for a disk array. Array management software most often executes in a disk controller or intelligent host bus adapter, but it can also execute in a host computer. When array management software executes in a disk controller or adapter, it is often called *firmware*.
Array Spanning	Array spanning by a logical drive combines storage space in two arrays of disk drives into a single, contiguous storage space in a logical drive. MegaRAID logical drives can span consecutively numbered arrays that have the same number of disk drives. Array spanning promotes RAID levels 1 and 5 to RAID levels 10 and 50, respectively. See also *Disk Spanning*.
Asynchronous Operations	Operations that bear no relationship to each other in time and can overlap. The concept of asynchronous I/O operations is central to independent access arrays in throughput-intensive applications.
Cache I/O	A small amount of fast memory that holds recently accessed data. Caching speeds subsequent access to the same data. It is most often applied to processor-memory access, but it can also be used to store a copy of data accessible over a network. When data is read from or written to main memory, a copy is also saved in cache memory with the associated main memory address. The cache memory software monitors the addresses of subsequent reads to see if the required data is already stored in cache memory. If it is already in cache memory (a cache hit), the data is read from cache memory immediately and the main memory read is aborted (or not started.) If the data is not cached (a cache miss), it is fetched from main memory and saved in cache memory.

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Channel	An electrical path for the transfer of data and control information between a disk and a disk controller.
Consistency Check	An examination of the disk system to determine whether all conditions are valid for the specified configuration (such as parity.)
Cold Swap	A cold swap requires that you turn the power off before replacing a defective disk drive in a disk subsystem.
Data Transfer Capacity	The amount of data per unit time moved through a channel. For disk I/O, data transfer capacity (bandwidth) is expressed in megabytes per second (Mbytes/s).
Degraded	Used to describe a disk drive that has become non-functional or has decreased in performance.
Disk	A nonvolatile, randomly addressable, rewritable mass storage device, including both rotating magnetic and optical disks and solid-state disks, or nonvolatile electronic storage elements. It does not include specialized devices such as write-once-read-many (WORM) optical disks, nor does it include so-called RAM disks implemented using software to control a dedicated portion of a host computer volatile random access memory.
Disk Array	A collection of disks from one or more disk subsystems combined with array management software. The software controls the disks and presents them to the array operating environment as one or more virtual disks.
Disk Duplexing	A variation on disk mirroring in which a second disk adapter or host adapter and redundant disk drives are present.
Disk Mirroring	Writing duplicate data to more than one (usually two) disk drives to protect against data loss in the event of device failure. Disk mirroring is a common feature of RAID systems.
Disk Spanning	Disk spanning allows multiple disk drives to function like one big drive. Spanning overcomes lack of disk space and simplifies storage management by combining existing resources or adding relatively inexpensive resources. For example, four 36 Gbyte disk drives can be combined to appear to the operating system as one single 144 Gbyte drive. See also *Array Spanning* and *Spanning*.
Disk Striping	A type of disk array mapping. Consecutive stripes of data are mapped round-robin to consecutive array members. A striped array (RAID 0)

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	provides high I/O performance at low cost, but provides lowers data reliability than any of its member disks.
Disk Subsystem	A collection of disks and the hardware that connects them to one or more host computers. The hardware can include an intelligent controller, or the disks can attach directly to a host computer I/O bus adapter.
Double Buffering	A technique that achieves maximum data transfer bandwidth by constantly keeping two I/O requests for adjacent data outstanding. A software component begins a double-buffered I/O stream by issuing two requests in rapid sequence. Thereafter, each time an I/O request completes, another is immediately issued. If the disk subsystem is capable of processing requests fast enough, double buffering allows data to be transferred at the full-volume transfer rate.
Failed Drive	A drive that has ceased to function or consistently functions improperly.
Fast SCSI	A variant on the SCSI-2 standard. It uses the same 8-bit bus as the original SCSI-1, but runs at up to 10 Mbytes (double the speed of SCSI-1.)
Firmware	Software stored in read-only memory (ROM) or Programmable ROM (PROM). Firmware often controls the behavior of a system when it is first turned on. A typical example would be a monitor program in a computer that loads the full operating system from disk or from a network and then passes control to the operating system.
FlexRAID Power Fail Option	The FlexRAID Power Fail option allows a reconstruction to restart if a power failure occurs. This is the advantage of this option. The disadvantage is, once the reconstruction is active, the performance is slower because an additional activity is added.
Format	The process of writing zeros to all data fields in a physical drive (disk drive) to map out unreadable or bad sectors. Because most disk drives are factory formatted, formatting is usually only done if a hard disk generates many media errors.
GByte	Gigabyte. Shorthand for 1,000,000,000 (10 to the ninth power) bytes. One Gbyte is equivalent to 1,000 Mbytes.
Host-based Array	A disk array with an array management software in its host computer rather than in a disk subsystem.

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Host Computer Any computer to which disks are directly attached. Mainframes, servers, workstations, and personal computers can all be considered host computers.

Hot Spare A stand-by disk drive ready for use if a drive in an array fails. A hot spare does not contain any user data. Up to eight disk drives can be assigned as hot spares for an adapter. 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 controlled by the adapter.

Hot Swapping The substitution of a replacement unit in a disk subsystem for a defective one, where the substitution can be performed while the subsystem is running. Hot swaps are done manually.

I/O Driver A host computer software component (usually part of the operating system) that controls the operation of peripheral controllers or adapters attached to the host computer. I/O drivers communicate between applications and I/O devices, and in some cases they participate in data transfer.

Initialization The process of writing zeros to the data fields of a logical drive and generating the corresponding parity to put the logical drive in a Ready state. Initializing erases previous data and generates parity so that the logical drive will pass a consistency check. Arrays can work without initialization, but they can fail a consistency check because the parity fields have not been generated.

Logical Disk A set of contiguous chunks on a physical disk. Logical disks are used in array implementations as constituents of logical volumes or partitions. Logical disks are normally transparent to the host environment, except when the array containing them is being configured.

Logical Drive A virtual drive within an array that can consist of more than one physical drive. Logical drives divide the contiguous storage space of an array of disk drives or a spanned group of arrays of drives. The storage space in a logical drive is spread across all the physical drives in the array or spanned arrays. Configure at least one logical drive for each array.

Mapping The conversion between multiple data addressing schemes, especially conversions between member disk block addresses and block addresses of the virtual disks presented to the operating environment by array management software.

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Mbyte	(Megabyte) An abbreviation for 1,000,000 (10 to the sixth power) bytes. One Mbyte equals 1,000 Kbytes (kilobytes).
Multi-threaded	Having multiple concurrent or pseudo-concurrent execution sequences. Used to describe processes in computer systems. Multi-threaded processes allow throughput-intensive applications to efficiently use a disk array to increase I/O performance.
Operating Environment	The operating environment includes the host computer where the array is attached, any I/O buses and adapters, the host operating system, and any additional software required to operate the array. For host-based arrays, the operating environment includes I/O driver software for the member disks, but does not include array management software, which is regarded as part of the array itself.
Parity	Parity is an extra bit added to a byte or word to reveal errors in storage (in RAM or disk) or transmission. Parity is used to generate a set of redundancy data from two or more parent data sets. The redundancy data can be used to reconstruct one of the parent data sets, although it does not fully duplicate the parent data sets. In RAID, this method is applied to entire drives or stripes across all disk drives in an array. Parity data is distributed among all the drives in the system. If a single disk drive fails, the drive can be rebuilt from the parity of the respective data on the remaining drives.
Partition	An array virtual disk made up of logical disks rather than physical ones. Also known as logical volume.
Physical Disk	A hard disk drive that stores data. A hard disk drive consists of one or more rigid magnetic discs rotating about a central axle with associated read/write heads and electronics.
Physical Disk Roaming	The ability of some adapters to detect when disk drives have been moved to a different slot in the computer—for example, after a hot swap.
Protocol	A set of formal rules describing how to transmit data, especially across a network. Low level protocols define the electrical and physical standards to be observed, bit- and byte- ordering, and the transmission and error detection and correction of the bit stream. High level protocols deal with the data formatting, including the message syntax, the terminal-to-computer dialogue, character sets, and sequencing of messages.

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RAID Redundant Array of Independent Disks. A data storage method in which data, along with parity information, is distributed among two or more hard disks (called an *array*) to improve performance and reliability. A RAID disk subsystem improves I/O performance on a server using only a single drive. The RAID array appears to the host server as a single storage unit. I/O is expedited because several disks can be accessed simultaneously.

RAID Levels A style of redundancy applied to a logical drive. It can increase the performance of the logical drive and can decrease usable capacity. Each logical drive must have a RAID level assigned to it. The RAID level drive requirements are: RAID 0 requires one or more physical drives, RAID 1 requires exactly two physical drives, RAID 5 requires at least three physical drives. RAID levels 10 and 50 result when logical drives span arrays. RAID 10 results when a RAID 1 logical drive spans arrays. RAID 50 results when a RAID 5 logical drive spans arrays.

RAID Migration RAID migration is used to move between optimal RAID levels or to change from a degraded redundant logical drive to an optimal RAID 0. In Novell, the utility used for RAID migration is MEGAMGR; in Windows NT, it is Power Console Plus. If a RAID 1 array is being converted to a RAID 0 array, instead of performing RAID migration, one drive can be removed and the other reconfigured on the controller as a RAID 0. This is due to the same data being written to each drive.

Read-Ahead A memory caching capability in some adapters that allows them to read sequentially ahead of requested data and store the additional data in cache memory, anticipating that the additional data will be needed soon. Read-Ahead supplies sequential data faster, but it is not as effective when accessing random data.

Ready State A condition in which a workable disk drive is neither online nor a hot spare and is available to add to an array or to designate as a hot spare.

Rebuild The regeneration of all data from a failed disk in a RAID level 1, or 5 array to a replacement disk. A disk rebuild normally occurs without interruption of application access to data stored on the array virtual disk.

Rebuild Rate The percentage of CPU resources devoted to rebuilding.

Reconstruct The act of remaking a logical drive after changing RAID levels or adding a physical drive to an existing array.

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Redundancy The provision of multiple interchangeable components to perform a single function to cope with failures or errors. Redundancy normally applies to hardware; disk mirroring is a common form of hardware redundancy.

Replacement Disk A disk available to replace a failed member disk in a RAID array.

Replacement Unit A component or collection of components in a disk subsystem that is always replaced as a unit when any part of the collection fails. Typical replacement units in a disk subsystem includes disks, controller logic boards, power supplies, and cables. Also called a hot spare.

SAF-TE SCSI-accessed fault-tolerant enclosure. An industry protocol for managing RAID enclosures and reporting enclosure environmental information.

SCSI (Small computer system interface) A processor-independent standard for system-level interfacing between a computer and intelligent devices, including hard disks, floppy disks, CD-ROM, printers, scanners, etc. Multiple SCSI devices can be connected to a single host adapter on the computer's bus. SCSI transfers eight or 16 bits in parallel and can operate in either asynchronous or synchronous modes. The synchronous transfer rate is up to 320 Mbytes/s (for Ultra320 SCSI). SCSI connections normally use single-ended drivers, as opposed to differential drivers.

SCSI Channel MegaRAID controls the disk drives through SCSI-2 buses (channels) over which the system transfers data in either Fast and Wide or Ultra SCSI mode. Each adapter can control up to three SCSI channels. Internal and external disk drives can be mixed on channels 0 and 1, but not on channel 2.

SCSI Drive State A SCSI physical drive can be in one of these states:

- **Online:** Powered-on and operational.
- **Ready:** Functioning normally, but not part of a configured logical drive and not designated as a hot spare.
- **Hot Spare:** Powered-on stand-by disk drive, ready for use if an online disk fails.
- **Fail:** Out of service, due to a fault occurring on the drive.
- **Rebuild:** Currently being rebuilt with data from a failed drive.

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Service Provider	The Service Provider (SP) is a program that resides in the desktop system or server and is responsible for all DMI activities. This layer collects management information from products (whether system hardware, peripherals, or software), stores that information in the DMI database, and passes it to management applications as requested.
SNMP	Simple Network Management Protocol. The most widely used protocol for communicating management information between the managed elements of a network and a network manager. SNMP focuses primarily on the network backbone. The Internet standard protocol that manages nodes on an Internet Protocol (IP) network.
Spanning	Array spanning by a logical drive combines storage space in two arrays of disk drives into a single, contiguous storage space in a logical drive. MegaRAID logical drives can span consecutively numbered arrays that each consist of the same number of disk drives. Array spanning promotes RAID levels 1 and 5 to RAID levels 10 and 50, respectively. See also *Disk Spanning*.
Spare	A disk drive available to back up the data of other drives.
Stripe Size	The amount of data contiguously written to each disk. You can specify stripe sizes of 4, 8, 16, 32, 64, and 128 Kbytes for each logical drive. For best performance, choose a stripe size equal to or smaller than the block size used by the host computer.
Stripe Width	The number of disk drives across which the data is striped.
Striping	Segmentation of logically sequential data, such as a single file, so that segments can be written to multiple physical devices in a round-robin fashion. This technique is useful if the processor can read or write data faster than a single disk can supply or accept it. While data is being transferred from the first disk, the second disk can locate the next segment. Data striping is used in some modern databases and in certain RAID devices.
Terminator	A resistor connected to a signal wire in a bus or network for impedance matching to prevent reflections—for example, a 50 ohm resistor connected across the end of an Ethernet cable. SCSI buses and some LocalTalk wiring schemes also require terminators.

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Ultra320 A subset of Ultra3 SCSI that allows a maximum throughput of 320 Mbytes/s, which is twice as fast as Wide Ultra2 SCSI. Ultra320 SCSI provides 320 Mbytes/s on a 16-bit connection.

Virtual Sizing FlexRAID virtual sizing is used to create a logical drive up to 80 Gbytes. A maximum of 40 logical drives can be configured on a RAID controller, and RAID migration is possible for all logical drives except the fortieth. Because it is not possible to do migration on the last logical drive, the maximum space available for RAID migration is 560 Gbytes.

Wide SCSI A variant on the SCSI-2 interface. Wide SCSI uses a 16-bit bus, double the width of the original SCSI-1. Wide SCSI devices cannot be connected to a SCSI-1 bus. Like Fast SCSI, Wide SCSI supports transfer rates up to 20 Mbytes/s.

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