

## **Sun Storage 6 Gb SAS REM HBA**

Installation Guide For HBA Models SGX-SAS6-REM-Z and SG-SAS6-REM-Z

**ORACLE**

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# Using This Documentation

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This installation guide describes how to install and remove Oracle's Sun Storage 6 Gigabit per second (Gb) Serial Attached SCSI/SATA (SAS) RAID Expansion Module (REM) host bus adapter (HBA). It also explains how to install any drivers, patches, and firmware required by the HBA, and provides any known issues with the product.

The document is written for technicians, system administrators, application service providers (ASPs), and users who have advanced experience troubleshooting and replacing hardware.

This preface contains the following topics:

- “Related Oracle Documentation” on page 7
- “Related Third Party Documentation” on page 8
- “Documentation Feedback” on page 8
- “Support and Accessibility” on page 8

## Related Oracle Documentation

To view, print, or purchase a broad selection of Oracle documentation, including localized versions, go to: <http://www.oracle.com/documentation>

The Oracle Sun Blade 6000 modular system document listed as online is available at: <http://www.oracle.com/pls/topic/lookup?ctx=sb6000&id=homepage>

Application/Hardware	Title	Part Number	Format	Location
Sun Blade 6000 modular system	<i>SAS-1/SAS-2 Compatibility Upgrade Guide For the Sun Blade 6000 Modular System</i>	821-1800-nn	PDF	Online

To access HBA and Converged Network Adapter documentation, go to: <http://www.oracle.com/technetwork/documentation/oracle-storage-networking-190061.html>

## Related Third Party Documentation

The documents listed as online are available at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

Application/Hardware	Title	Format	Location
MegaRAID graphical user interface (GUI)	<i>MegaRAID SAS Software User's Guide</i>	PDF	Online
	<i>MegaRAID SAS Software Release Notes</i>	PDF	Online
SAS2 Integrated RAID Solution (SAS2IRCU utility)	<i>SAS2 Integrated RAID Solution User's Guide</i>	PDF	Online

## Documentation Feedback

Provide feedback on this documentation at:

<http://www.oracle.com/goto/docfeedback>

## Support and Accessibility

Description	Links
Access electronic support through My Oracle Support.	<a href="http://support.oracle.com">http://support.oracle.com</a>
	For hearing impaired: <a href="http://www.oracle.com/accessibility/support.html">http://www.oracle.com/accessibility/support.html</a>
Learn about Oracle's commitment to accessibility.	<a href="http://www.oracle.com/us/corporate/accessibility/index.html">http://www.oracle.com/us/corporate/accessibility/index.html</a>

# ◆◆◆ CHAPTER 1

## HBA Overview

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This chapter provides a basic overview of Oracle's Sun Storage 6 Gigabit per second (Gb) Serial Attached SCSI/SATA (SAS) RAID Expansion Module (REM) host bus adapter (HBA), which uses LSI technology. The chapter also describes the various operating systems, host platforms, storage, and infrastructure configurations that support the HBA.

This chapter contains the following topics:

- [“Kit Contents” on page 9](#)
- [“HBA Features” on page 9](#)
- [“Valid Drive Mix Configurations With HDDs and SSDs” on page 11](#)
- [“Operating System and Technology Requirements” on page 11](#)
- [“System Interoperability” on page 12](#)
- [“Boot Support” on page 13](#)

## Kit Contents

- Sun Storage 6 Gb SAS REM HBA
- *Accessing Documentation* document

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**Note** - The *Accessing Documentation* document in the HBA ship kit provides instructions on how to access Oracle HBA installation documentation. For information about accessing non-Oracle documents that are related to this HBA, see [“Related Third Party Documentation” on page 8](#).

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## HBA Features

The Sun Storage 6 Gb SAS REM HBA (SGX-SAS6-REM-Z, SG-SAS6-REM-Z) provides eight serial PHYs for connection to SAS/SATA (Serial ATA) devices. Each PHY is capable of

1.5 Gb, 3 Gb, or 6 Gb SAS and SATA link rates. The PCIe transmission and reception data rate is 5 Gb in each direction, yielding a total bandwidth of 10 Gb for each full-duplex lane.

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**Note** - While each PHY is capable of 6 Gb SAS and SATA link rates, only four of the eight PHYs can operate at 6 Gb link rates at one time. This is to accommodate platforms that are not designed for 6 Gb per second operation.

---

The HBA contains on-board Flash ROM for storing BIOS and firmware, and NVSRAM for embedded mirroring. The LEDs on the HBA report a heartbeat, activity, and fault conditions when detected by the firmware. Fusion-MPT firmware operates the HBA.

The functionality of the HBA comes from the LSISAS2008 controller chip. The HBA controller connects up to eight SAS/SATA devices to a computer system through the PCIe signals routed through the mezzanine connector. The HBA controller uses eight PCIe PHYs.

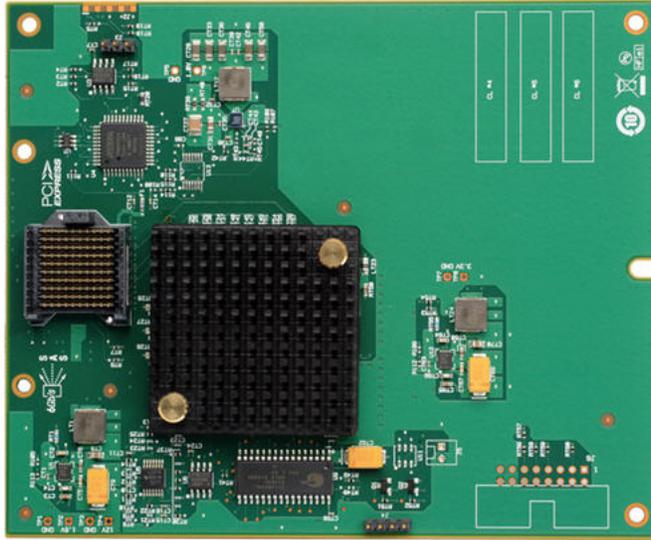
The HBA has the following features:

- Serial SCSI protocol (SSP), serial ATA tunneling protocol (STP), and serial management protocol (SMP), as defined, in the *Serial Attached SCSI (SAS) Specification*, version 2.0
- Support for RAID levels 0, 1, and 10
- Support for a maximum of two logical RAID volumes that can be provided by the HBA
- Support for a maximum of 10 physical devices within any single RAID volume and a maximum of fourteen physical devices within all RAID volumes combined
- Configurable drive spin-up sequencing on a per-PHY basis
- A serial, point-to-point, enterprise-level storage interface
- Ability to transfer data using SCSI information units
- Compatibility with SATA target devices
- Narrow and wide ports (see [Table 1-1](#))

**TABLE 1-1** 6 Gb SAS Bandwidths

Half Duplex	Full Duplex
Narrow Port (1 Lane), 600 MB/s	Narrow Port (1 Lane), 1200 MB/s
Wide Port (2 Lanes), 1200 MB/s	Wide Port (2 Lanes), 2400 MB/s
Wide Port (4 Lanes), 2400 MB/s	Wide Port (4 Lanes), 4800 MB/s

[Figure 1-1](#) shows the physical features of the HBA.

**FIGURE 1-1** Oracle's Sun Storage 6 Gb SAS REM HBA

## Valid Drive Mix Configurations With HDDs and SSDs

This HBA supports connectivity using SATA II drives, SAS drives, or both. The following are some basic rules about the types of drives you can use:

- **Within a logical volume:**
  - You cannot mix SAS and SATA drives.
  - You cannot mix HDDs and SSDs of any type.
- **Within an enclosure (SAS expander or direct-connect SAS cable),** you can mix any drive types, subject to any restrictions imposed by the enclosure.

## Operating System and Technology Requirements

The HBA requires the operating system (OS) and technology levels, at minimum, listed in [Table 1-2](#).

**TABLE 1-2** Supported Operating System/Technology Versions

Operating System/Technology	Recommended Versions (minimum) <sup>†</sup>
Oracle Solaris OS for the x86 (32-bit and 64-bit) platforms	<ul style="list-style-type: none"> <li>■ Oracle Solaris 11.1 with SRU7</li> <li>■ Oracle Solaris 10 01/13 with patches 149176-02 and 145649-04, at minimum</li> </ul> <p>To obtain the latest patches and SRUs, go to <a href="http://support.oracle.com">http://support.oracle.com</a></p>
Oracle Solaris OS for the SPARC (32-bit and 64-bit) platform	<ul style="list-style-type: none"> <li>■ Oracle Solaris 11.1 with SRU7</li> <li>■ Oracle Solaris 10 01/13 with patches 149175-02 and 145648-04, at minimum</li> </ul> <p>To obtain the latest patches and SRUs, go to <a href="http://support.oracle.com">http://support.oracle.com</a></p>
Linux OS (64-bit)	<ul style="list-style-type: none"> <li>■ Red Hat Enterprise Linux (RHEL) 5.9 and 6.4</li> <li>■ SUSE Linux Enterprise Server (SLES) 11SP2</li> <li>■ Oracle Enterprise Linux 5.9 and 6.4 (Red Hat Compatible Kernel (RHCK) and Unbreakable Enterprise Kernel (UEK) 2, at minimum)</li> </ul>
Virtual Machine OS	Oracle VM 3.2.1
Microsoft Windows OS (64-bit)	<ul style="list-style-type: none"> <li>■ Window Server 2008 R2 including SP1 (64-bit)</li> <li>■ Windows Server 2012</li> </ul>
VMware Technology	<ul style="list-style-type: none"> <li>■ VMware ESX/ESXi 5.0</li> <li>■ VMware ESX/ESXi 5.1</li> </ul>

<sup>†</sup>Oracle supports the Oracle Solaris 10 10/09 OS with patches 142676-02 (x86) and 143523-02 (SPARC) as the minimum Oracle Solaris OS level. However, if issues occur with the HBA, Oracle Support requires that you update to the recommended OS levels listed in [Table 1-2](#).

## System Interoperability

This section provides host platform, storage, and software support information. This section contains the following topics:

- [“Host Platform Support” on page 12](#)
- [“Storage System Support” on page 13](#)
- [“Software Support” on page 13](#)

## Host Platform Support

The HBA is supported by the platforms listed in [Table 1-3](#). For up-to-date information, see your Oracle system's Product Notes and web pages.

For supported operating system and technology versions, see [Table 1-2](#).

**TABLE 1-3** Host Platform Support

Platform	Supported OS/Technology
<b>Oracle SPARC Servers</b>	
Sun Blade T6320	Oracle Solaris
Sun Blade T6340	Oracle Solaris
<b>Oracle x86 Servers</b>	
Sun Blade X6270 M2	Oracle Solaris, Linux, Virtual Machine, VMware, and Windows
Sun Blade X3-2B	Oracle Solaris, Linux, Virtual Machine, VMware, and Windows
SunBlade X4-2B	Oracle Solaris, Linux, Virtual Machine, VMware, and Windows

## Storage System Support

The HBA supports the following storage:

- Internal disk drives
- Sun Blade 6000 Virtualized Multi-Fabric 10GbE Network Express Module (NEM)
- Sun Blade 6000 Storage Module M2
- Sun Blade 6000 Virtualized Multi-Fabric 10GE NEM M2

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**Note** - For more information about support for the Sun Blade 6000 modular system, see the *SAS-1/SAS-2 Compatibility Upgrade Guide For the Sun Blade 6000 Modular System* document, located at: <http://download.oracle.com/docs/cd/E19938-01/index.html>

---

## Software Support

Install, Flash, and BIOS configuration utilities are provided. The HBA uses the Fusion-MPT architecture for all major operating systems, which allows for thinner drivers for better performance. To obtain the most up-to-date device drivers, firmware and boot code that support your operating system, go to: <http://www.lsi.com/sep/Pages/oracle/index.aspx>

## Boot Support

Booting through the HBA is supported in the following operating system and technology environments:

- Oracle Solaris 10 01/13 OS for the SPARC and x86 platforms
- Oracle Solaris 10 11.1 OS for the SPARC and x86 platforms
- RHEL 5.9 and 6.4 OSes
- SLES 11 SP2 OS
- Oracle Linux 5.9 and 6.4 OSes
- Oracle VM 3.2.1 OS
- Windows Server 2008 R2 including SP1 OS
- Windows Server 2012 OS
- ESX and ESXi Server, version 5.0 and 5.1 technology

# ◆◆◆ CHAPTER 2

## Hardware Installation and Removal

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This chapter explains how to install and remove the HBA. For detailed instructions, see your system installation or service manual and the installation manual for the storage devices to be connected to the HBA.

This chapter contains the following topics:

- [“Observing ESD and Handling Precautions” on page 15](#)
- [“Installing the HBA” on page 16](#)
- [“Validating the Solaris Labels of the HBA Logical Drives \(Solaris OS\)” on page 20](#)
- [“Next Steps” on page 22](#)
- [“Removing the HBA” on page 23](#)

### Observing ESD and Handling Precautions



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**Caution** - Damage to the HBA can occur as the result of careless handling or electrostatic discharge (ESD). Always handle the HBA with care to avoid damage to electrostatic sensitive components.

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To minimize the possibility of ESD-related damage, use both a workstation antistatic mat and an ESD wrist strap. You can get an ESD wrist strap from any reputable electronics store or from Oracle as part number #250-1007.

Observe the following precautions to avoid ESD-related problems:

- Leave the HBA in its antistatic bag until you are ready to install it in the system.
- Always use a properly fitted and grounded wrist strap or other suitable ESD protection when handling the HBA and observe proper ESD grounding techniques.
- Place the HBA on a properly grounded antistatic work surface pad when it is out of its protective antistatic bag.

## Installing the HBA

Before you start, read the instructions in this section as well as the installation instructions for the storage devices to be connected to the HBA. This section contains the following topics:

- [“To Prepare for Hardware Installation” on page 16](#)
- [“To Install the HBA” on page 17](#)
- [“To Connect the HBA to Drives” on page 18](#)
- [“To Complete the Installation” on page 18](#)
- [“To Verify That the Solaris Label of a Logical Drive Is Valid ” on page 21](#)

### ▼ To Prepare for Hardware Installation

1. **Make a backup of your data.**
2. **Familiarize yourself with the physical features of the HBA.**

See [“HBA Features” on page 9](#).

3. **Ensure that you have the right quantity of initialized disk drives for the RAID level you want to use for the arrays.**

For optimal performance, use like drives (type, speed, and size) when creating logical drives. All of the disk drives must have the same performance level. You can use different-sized disk drives in the array, but the array will be limited to the capacity of the smallest and slowest disk drive.

For more information, refer to the *MegaRAID SAS Software User's Guide* at: <http://www.lsi.com/sep/Pages/oracle/index.aspx>

The HBA supports SAS disk drives and SATA II disk drives.

4. **Unpack the box containing the HBA in a static-free environment and inspect it for damage.**

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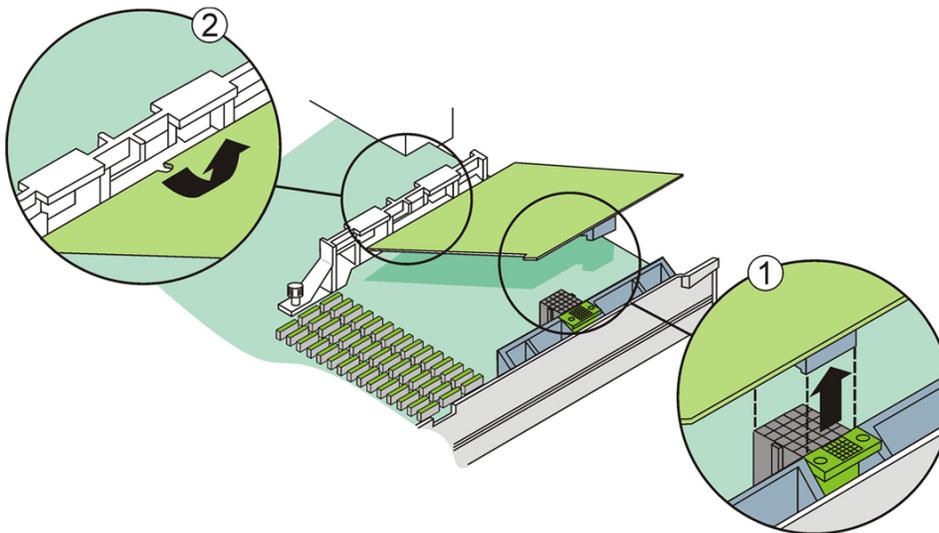
**Note** - Leave the HBA in the protective bag until you are ready to install it. If there is damage, contact Oracle customer support.

---

## ▼ To Install the HBA

1. Refer to the service or installation manual for your particular system for instructions about how to locate the REM connector in the chassis of the system.
2. Attach an antistatic wrist strap and remove the HBA from its packaging.  
See “Observing ESD and Handling Precautions” on page 15.
3. Insert the notch of the HBA into the bracket in the system (located near the mezzanine plug connector), and then connect the 210-pin mezzanine plug connector on the HBA to the 210-pin mezzanine plug connector on the system board (see [Figure 2-1](#)).

**FIGURE 2-1** Installing Oracle's Sun Storage 6 Gb SAS REM HBA



### Figure Legend

- 1 Insert the notch of the HBA onto the bracket.
- 2 Press down here.

---

**Note** - The configuration of the enclosure might not be the same as shown in this illustration.

---

4. **Press down gently and firmly to seat the HBA in the mezzanine plug connector.**

## ▼ To Connect the HBA to Drives

The HBA interfaces with the host system through a REM connector that implements x8 lane PCI-Express bus signaling. You can connect SAS hard disk drives or SATA hard disk drives to the HBA with the same REM connector. The interface can provide links for up to eight HDD ports.

- **Configure and install the SAS devices, SATA II devices, or both in the system.**

See the documentation for the devices for more information.

---

**Note** - You can connect one device per SAS PHY unless you use an expander.

---

Once the devices are configured and installed in the system, the HBA will be able to interface with the devices. You do not need to perform any additional steps.

## ▼ To Complete the Installation

1. **Attach the cover to the server module, as described in the system documentation.**
2. **Insert the fully assembled server module back into the chassis with any HDDs needed.**

---

**Note** - Ensure that power is applied to the SAS devices, SATA II devices, or both before or at the same time that the power is turned on to the server module. If the system is powered up before these devices, the devices might not be recognized.

---

3. **If you need to install an OS on your system, complete the procedures in [Chapter 3, “Creating a Bootable Drive in a Preboot Environment”](#) and then go to the next step.**
4. **If you already have an OS installed on an x86 system, review the BIOS bootup messages to ensure that you see the LSI BIOS initialization banner and that you are prompted for the BIOS utility (by pressing `ctrl+c`).**

If you see the banner and are prompted for the utility, it means the BIOS has detected the HBA card.

5. **If you already have an OS installed on a SPARC system, during the power-up process of the system, use the `probe-scsi-all` command at the OpenBoot PROM (OBP) ok prompt to verify that the system recognizes the HBA.**

The `probe-scsi-all` command displays the SCSI devices that are connected to the host, as shown in the following example.

```
{0} ok probe-scsi-all
/pci@0/pci@0/pci@8/pci@0/pci@a/LSI,sas@0
MPT Version 2.00, Firmware Version 4.00.00.00
Target 9
  Unit 0   Disk      SEAGATE ST914602SSUN146G0603   286739329 Blocks, 146 GB
  SASAddress 5000c5000b305b4d   PhyNum 0
Target a
  Unit 0   Disk      SEAGATE ST914602SSUN146G0603   286739329 Blocks, 146 GB
  SASAddress 5000c5000b304cad   PhyNum 1
Target b
  Unit 0   Disk      HITACHI H101414SCSUN146GSA23   286739329 Blocks, 146 GB
  SASAddress 5000cca000310015   PhyNum 2
Target c
  Unit 0   Disk      HITACHI H101414SCSUN146GSA23   286739329 Blocks, 146 GB
  SASAddress 5000cca0002cf035   PhyNum 3
{0} ok
```

This example shows a SAS 2 controller (LSI, sas@0) connected to four physical drives.

6. **(Optional) If you would like to create additional RAID volumes on the system (maximum of two RAID 0, 1, and 10 volumes per system), follow [Step 6.a](#) or [Step 6.b](#), then continue with [Step 6.c](#):**
  - a. **(SPARC only) During the power-up process of the system, access the OBP and create RAID volumes for the HBA by issuing the appropriate FCode commands.**

For more information about the different FCode commands that you can use to create RAID volumes, see [Chapter 3, “Creating a Bootable Drive in a Preboot Environment”](#).
  - b. **(x86 only) During the power-up process of the system, review the BIOS bootup messages, access the BIOS Configuration utility by pressing `ctrl+c`, when prompted, and create volumes for the HBA through the BIOS utility.**

For more information about creating volumes through the BIOS utility, see [Chapter 3, “Creating a Bootable Drive in a Preboot Environment”](#).

- c. **Go to the Oracle support area of the LSI web site (<http://www.lsi.com/sep/Pages/oracle/index.aspx>), download the SAS2IRCU utility, and issue the `sas2ircu` command, with no options, at the command-line or at a terminal window.**

Issuing the `sas2ircu` command, with no options, produces a list of SAS2IRCU utility commands that you can use to create RAID volumes for the HBA. Upon reviewing the list of commands, use the appropriate commands to create the RAID volumes.

---

**Note** - With version 04.250.04.02 of the SAS2IRCU utility, be careful when using the `DELETE` command. The `DELETE` command can take no arguments or a single argument. Issuing the `DELETE` command with no arguments deletes all RAID volumes. Issuing the command with a single argument deletes only the RAID volume that you specify in the argument. With version 6.250.02.00 of the SAS2IRCU utility or later, use the `DELETEVOLUME` command to delete a single RAID volume.

---

For more information about the RAID configuration utilities, see “[Installing the RAID Configuration Utilities](#)” on page 51.

- d. **Go to the Oracle support area of the LSI web site (<http://www.lsi.com/sep/Pages/oracle/index.aspx>), download the MegaRAID Storage Manager software and its supporting documentation, and create logical drives for the HBA through the software.**

For more information about the RAID configuration utilities, see “[Installing the RAID Configuration Utilities](#)” on page 51.

After you initiate the creation of a RAID 1 or RAID 10 volume, the HBA performs a background initialization task that synchronizes untouched blocks of each side of the mirror for the entire volume. This background task operates transparently, and does not prevent normal communication with the volume or immediate mirroring of new data written to the volume. However, applications might experience a performance degradation until the background initialization task is complete.

## Validating the Solaris Labels of the HBA Logical Drives (Solaris OS)

This section describes how to verify the Solaris labels of any raw physical drives and logical drives that you might have created for the HBA (as described in “[To Complete the Installation](#)” on page 18). The drives must have valid Solaris labels in order to be recognized by the Solaris OS. Sometimes, logical drives need to be relabeled by using the `format` command.

This section contains the following topic:

- [“To Verify That the Solaris Label of a Logical Drive Is Valid” on page 21](#)

## ▼ To Verify That the Solaris Label of a Logical Drive Is Valid

---

**Note** - You do not need to perform the steps in this procedure if you installed the HBA in a system that has an OS other than the Solaris OS installed.

---

### 1. Become a root user and use the `format` command.

```
# format
Searching for disks...done
c5t5000C5000B304CAFd0: configured with capacity of 136.71GB
c5t5000C5000B305B4Fd0: configured with capacity of 136.71GB
c5t5000CCA0002CF034d0: configured with capacity of 136.71GB
c5t5000CCA000310014d0: configured with capacity of 136.71GB
AVAILABLE DISK SELECTIONS:
0. c5t5000C5000B304CAFd0 <SUN146G cyl 14087 alt 2 hd 24 sec 848>
   /scsi_vhci/disk@g5000c5000b304caf
1. c5t5000C5000B305B4Fd0 <SUN146G cyl 14087 alt 2 hd 24 sec 848>
   /scsi_vhci/disk@g5000c5000b305b4f
2. c5t5000CCA0002CF034d0 <SUN146G cyl 14087 alt 2 hd 24 sec 848>
   /scsi_vhci/disk@g5000cca0002cf034
3. c5t5000CCA000310014d0 <SUN146G cyl 14087 alt 2 hd 24 sec 848>
   /scsi_vhci/disk@g5000cca000310014
Specify disk (enter its number):
```

### 2. When prompted, type the number of a disk drive that is attached to the newly installed HBA card, and press Enter.

```
# format
Searching for disks...done
c5t5000C5000B304CAFd0: configured with capacity of 136.71GB
c5t5000C5000B305B4Fd0: configured with capacity of 136.71GB
c5t5000CCA0002CF034d0: configured with capacity of 136.71GB
c5t5000CCA000310014d0: configured with capacity of 136.71GB
AVAILABLE DISK SELECTIONS:
0. c5t5000C5000B304CAFd0 <SUN146G cyl 14087 alt 2 hd 24 sec 848>
   /scsi_vhci/disk@g5000c5000b304caf
1. c5t5000C5000B305B4Fd0 <SUN146G cyl 14087 alt 2 hd 24 sec 848>
   /scsi_vhci/disk@g5000c5000b305b4f
2. c5t5000CCA0002CF034d0 <SUN146G cyl 14087 alt 2 hd 24 sec 848>
```

```
        /scsi_vhci/disk@g5000cca0002cf034
3. c5t5000CCA000310014d0 <SUN146G cyl 14087 alt 2 hd 24 sec 848>
        /scsi_vhci/disk@g5000cca000310014
AVAILABLE DISK SELECTIONS:
Specify disk (enter its number): 2
selecting c5t5000CCA0002CF034d0
[disk formatted]
```

The Format menu is displayed.

- 3. If you see a Disk not labeled. Label it now? message, type y to label the selected disk.**
- 4. Type q to exit the utility.**

```
FORMAT MENU:
disk - select a disk
type - select (define) a disk type
partition - select (define) a partition table
current - describe the current disk
format - format and analyze the disk
fdisk - run the fdisk program
repair - repair a defective sector
label - write label to the disk
analyze - surface analysis
defect - defect list management
backup - search for backup labels
verify - read and display labels
save - save new disk/partition definitions
inquiry - show vendor, product and revision
scsi - independent SCSI mode selects
cache - enable, disable or query SCSI disk cache
volname - set 8-character volume name
!<cmd> - execute <cmd>, then return
quit
format> q
#
```

The HBA is ready for use.

## Next Steps

Install any software required by the HBA, specific to your operating system, as described in [Chapter 4, “HBA Software Installation”](#).

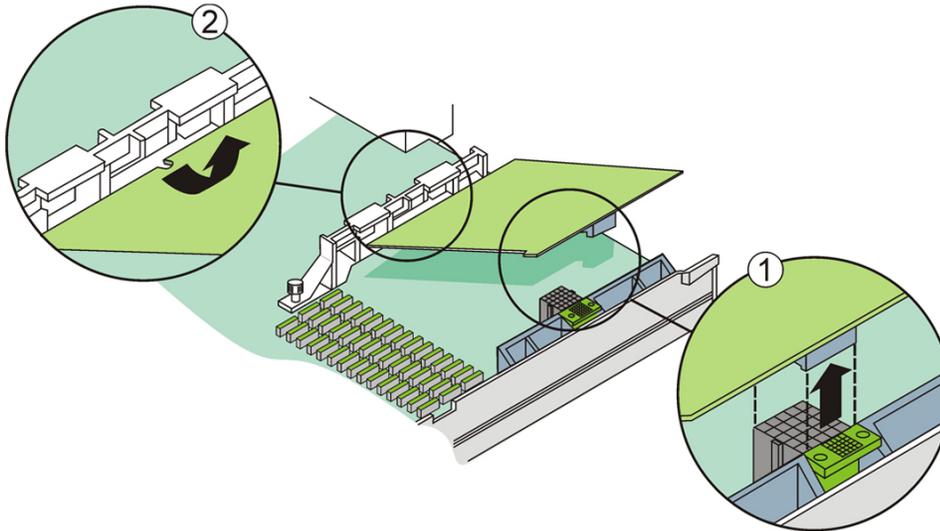
## Removing the HBA

If you need to remove the HBA from the system, for any reason, follow the procedure in this section.

### ▼ To Remove the HBA

1. Refer to the service manual for your specific server to locate the HBA in the chassis of the system.
2. Pull up gently and firmly to unseat the REM connector on the HBA from the corresponding REM connector on the chassis of the system, as shown in [Figure 2-2](#).

**FIGURE 2-2** Removal of Oracle's Sun Storage 6 Gb SAS REM HBA



#### Figure Legend

- 1 Pull up to unseat the mezzanine plug.
- 2 Remove the notch of the HBA from the bracket.

3. Remove the notch on the other end of the HBA from the bracket.

4. **Lift the HBA up and pull it away from the bracket.**
5. **Refer to the service manual for your specific system to replace the server module in the chassis of the system.**

## Creating a Bootable Drive in a Preboot Environment

---

This chapter describes how to use the HBA for your boot device prior to installing an operating system (OS) on the system.

---

**Note** - If you are installing the HBA into a system that already has an OS installed, do not perform any procedures in this chapter. Instead, complete the HBA installation, as described in [Chapter 2, “Hardware Installation and Removal”](#).

---

This chapter contains the following topics:

- [“Overview of Creating a Bootable Drive in a Preboot Environment” on page 25](#)
- [“Creating an Alias for a Bootable Drive \(SPARC\)” on page 30](#)
- [“Creating a Bootable Drive \(x86\)” on page 31](#)
- [“Installing the Oracle Solaris OS” on page 47](#)
- [“Next Steps” on page 48](#)

### Overview of Creating a Bootable Drive in a Preboot Environment

As an installation option, you can choose to install the HBA into a system that does not yet have an OS installed. With this installation option, if you plan to use the HBA as your boot device, you can optionally create a RAID volume for the HBA. You can then install the OS onto a physical drive or onto that RAID volume to enable you to boot from the HBA. On a SPARC system, you would perform these actions through the FCode utility. On an x86 system, you would do so either through the Unified Extensible Firmware Interface (UEFI) Drive Control menu of the BIOS Setup utility (UEFI booting) or through the BIOS Configuration utility (Legacy BIOS booting).

This section contains the following topics:

- [“Utilities Overview” on page 26](#)

- [“Methods For Creating a Bootable Drive” on page 26](#)

## Utilities Overview

You can specify the HBA to be your boot device by using one of these utilities:

- **FCode utility** - A utility that you can run on a SPARC system and that is accessible through the Open Boot PROM (OBP) environment. This utility consists of a set of special commands to display targets and manage RAID volumes.
- **UEFI menu of the BIOS Setup utility** - A utility that you can run on an x86 system only if you have set your system BIOS to boot in UEFI BIOS mode (which you can specify through the Boot menu of the BIOS Setup utility). You access this utility by pressing F2, when prompted, during bootup, and then using the right arrow key to navigate to the UEFI Driver Control menu at the top of the screen. The UEFI Driver Control menu provides a standard environment for booting an operating system, managing physical disks and RAID volumes, and running pre-boot applications.

---

**Note** - Some operating system versions do not support UEFI BIOS mode. For information about whether your operating system supports UEFI BIOS mode, see your system and operating system documentation.

---

- **BIOS Configuration utility** - A legacy booting utility that you can run on an x86 system only if you have set your system BIOS to boot in legacy mode (which you can specify through the Boot menu of the BIOS Setup utility). You access this utility by typing **Ctrl +C**, when prompted, during bootup. This utility consists of a text-based user interface that enables you to manage physical disks and RAID volumes.

---

**Note** - Entering the BIOS Configuration utility (even if you make no changes in the utility) might cause the system boot order list, provided by the system BIOS, to reset. To ensure that the boot order is accurate after exiting the utility, access the server mainboard BIOS during the next reboot of the system. Review the boot order list to verify that the order is correct, and make any changes, if necessary. This will occur each time you enter the utility.

---

## Methods For Creating a Bootable Drive

Based on the type of system in which you are installing the HBA (SPARC or x86), follow the procedures in one of these sections:

- **If you are installing the HBA into a SPARC system**, go to [“Creating a Bootable Drive \(SPARC\)” on page 27](#).

- If you are installing the HBA into an x86 system, go to [“Creating a Bootable Drive \(x86\)” on page 31](#).

## Creating a Bootable Drive (SPARC)

Follow the steps in this section to create a bootable drive in a preboot environment on a SPARC system:

- [“To Create a Bootable Drive \(SPARC\)” on page 27](#)

### ▼ To Create a Bootable Drive (SPARC)

You do not need to perform both steps in this procedure if you plan to install the Oracle Solaris OS onto a physical drive. If you plan to use a physical drive to install the OS, go directly to Step 2.

1. **Optionally create a RAID volume from which to boot** (see [“Using the FCode Utility to Create a Bootable Drive \(SPARC\)” on page 27](#)).
2. **Create an alias for the bootable drive** (see [“Creating an Alias for a Bootable Drive \(SPARC\)” on page 30](#)).

## Using the FCode Utility to Create a Bootable Drive (SPARC)

This section describes how to use the FCode utility to set up a RAID volume on a SPARC system prior to installing the Oracle Solaris operating system (OS). You can then use the RAID volume as your boot drive upon which to install the Oracle Solaris OS. This section contains the following topics:

- [“To Prepare to Use the FCode Utility \(SPARC\)” on page 27](#)
- [“To Create a RAID Volume With the FCode Utility \(SPARC\)” on page 29](#)

### ▼ To Prepare to Use the FCode Utility (SPARC)

Before using the FCode utility to set up a RAID volume on a SPARC system, prepare to use the FCode utility by doing the following:

---

**Note** - Do not perform the steps in this section if you want to install the OS on a non-RAID volume. Instead, go directly to [“To Create an Alias for a Bootable Drive \(SPARC\)” on page 30.](#)

---

**1. Open an xterm or a gnome terminal window.**

FCode commands can produce large amounts of detailed output. The xterm and gnome terminal windows provide scroll bar functionality, which helps with viewing such output.

**2. Enter the OBP environment by performing one of the following tasks:**

- Press **STOP+A** on a Sun keyboard from Oracle.
- Issue a break from a remote console.

**3. Use the `show-devs` command to list the device paths on the system and select the device path for the HBA.**

The `mpt_sas`-based controllers will end with `LSI, sas@number`.

```
{0} ok show-devs
<...>
/pci@1e,600000/pci@0/pci@3/LSI, sas@0
/pci@1e,600000/pci@0/pci@3/LSI, sas@0/disk
/pci@1e,600000/pci@0/pci@3/LSI, sas@1
<...>
```

**4. Use the `select` command to select the HBA on which the FCode commands that you issue will operate.**

```
{0} ok select /pci@1e,600000/pci@0/pci@3/LSI, sas@0
```

**5. If you were able to determine and select the card that you wanted in the previous step, skip to [Step 6](#). Otherwise, if more than one of the `mpt_sas`-based cards is displayed in the `show-devs` output, use the `select` and `.properties` commands to determine which card you want and then select that card.**

```
{0} ok select /pci@1e,600000/pci@0/pci@3/LSI, sas@0
{0} ok .properties
...
subsystem-id          00003180
```

The REM cards contain a subsystem-ID of `00003180`. To further specify the card, you can also display the SAS addresses of any connected drives by using the `show-children` command.

## 6. Review the following table for useful Fcode commands.

FCode Command	Description
show-children	Lists all connected physical drives and RAID volumes.
show-volumes	Lists all connected RAID volumes in detail.
create-raid0-volume	Creates a RAID 0 volume (minimum two targets).
create-raid1-volume	Creates a RAID 1 volume (exactly two targets).
create-raid10-volume	Creates a RAID 10 volume (minimum four targets).
delete-volume	Deletes a RAID volume.

You are now ready to use the FCode commands to optionally create a RAID volume on the HBA. For more information, see [“To Create a RAID Volume With the FCode Utility \(SPARC\)” on page 29](#). If you plan to install the OS onto a physical drive, go to [“To Create an Alias for a Bootable Drive \(SPARC\)” on page 30](#).

## ▼ To Create a RAID Volume With the FCode Utility (SPARC)

Perform the steps in this section if you want to optionally configure a RAID volume on a SPARC system. You can then install the Oracle Solaris operating system (OS) on that RAID volume.

---

**Note** - Do not perform the steps in this section if you want to install the OS on a non-RAID volume. Instead, go directly to [“To Create an Alias for a Bootable Drive \(SPARC\)” on page 30](#).

---

1. Use the `show-children` command to list all the physical drives attached to the HBA.

```
{0} ok show-children
MPT Version 2.00, Firmware Version 4.00.00.00
Target 9
<...>Unit 0 Disk SEAGATE ST914602SSUN146G0603 286739329 Blocks, 146 GB
SASAddress 5000c5000b305b4d PhyNum 0
Target a
Unit 0 Disk SEAGATE ST914602SSUN146G0603 286739329 Blocks, 146 GB
SASAddress 5000c5000b304cad PhyNum 1
Target b
```

```
Unit 0 Disk HITACHI H101414SCSUN146GSA23 286739329 Blocks, 146 GB
SASAddress 5000cca000310015 PhyNum 2
Target c
Unit 0 Disk HITACHI H101414SCSUN146GSA23 286739329 Blocks, 146 GB
SASAddress 5000cca0002cf035 PhyNum 3
```

2. Use the `create-raid0-volume`, `create-raid1-volume`, or `create-raid10-volume` command to create a RAID volume from the physical disks.

---

**Note** - The only volumes supported by the HBA are volumes created with size MAX (the volumes use the maximum drive space possible). Volumes using less than the maximum space of the smallest physical drive in the volume are not supported.

---

```
{0} ok 9 a create-raid0-volume -- for RAID 0, with targets 9 and a --
{0} ok 9 a b c create-raid10-volume -- for RAID 10 with targets 9, a, b and c --
```

3. Complete the steps in [“Creating an Alias for a Bootable Drive \(SPARC\)” on page 30](#).

## Creating an Alias for a Bootable Drive (SPARC)

This section describes how to create an alias for the bootable drive in order to help simplify the process of booting the drive. This section contains the following topic:

- [“To Create an Alias for a Bootable Drive \(SPARC\)” on page 30](#)

### ▼ To Create an Alias for a Bootable Drive (SPARC)

1. Issue the `show-disks` command to list the disks on the system.

Note that, as shown in the following example, you can determine the HBA drives by looking for the LSI, `sas@number` label, where *number* is 0 for the first HBA detected, and increments for each additional HBA detected.

```
{0} ok show-disks
<...>
a) /pci@1e,600000/pci@0/pci@3/LSI,sas@0/disk
b) /pci@1e,600000/pci@0/pci@3/LSI,sas@1/disk
c) /pci@1e,600000/pci@0/pci@3/LSI,sas@2/disk
<...>
```

```
q) NO SELECTION
Enter Selection, q to quit:
```

**2. Select the bootable drive for which you want to create an alias.**

```
a) /pci@1e,600000/pci@0/pci@3/LSI,sas@0/disk
b) /pci@1e,600000/pci@0/pci@3/LSI,sas@1/disk
c) /pci@1e,600000/pci@0/pci@3/LSI,sas@2/disk
<...>
q) NO SELECTION
Enter Selection, q to quit: c
/pci@1e,600000/pci@0/pci@3/LSI,sas@2/disk has been selected.
```

**3. Use the `nvalias alias-name HBA-drive-path` command to create an alias for the bootable drive that you selected in [Step 2](#) (you can press `Ctrl+Y` to paste the device path).**

In the following example, the alias name is `mydev`.

```
{0} ok nvalias mydev /pci@1e,600000/pci@0/pci@3/LSI,sas@2/disk
```

**4. You can now boot from the bootable drive by using the `boot alias-name` command.**

```
{0} ok boot mydev
```

**5. To optionally add the bootable drive to the boot-device list and then automatically boot from the drive by controlling the boot device order, issue the following commands, as shown.**

```
{0} ok printenv boot-device
boot-device = disk0 disk1
{0} ok setenv boot-device mydev disk0
boot-device = mydev disk0
```

In this example, the `mydev` alias is set as `disk0`, the first disk in the boot device list. This results in the automatic booting of the bootable drive, `/pci@1e,600000/pci@0/pci@3/LSI,sas@2/disk`.

**6. Install the Oracle Solaris OS on the bootable drive by following the steps in [“To Install the Oracle Solaris OS” on page 47](#).**

## Creating a Bootable Drive (x86)

You have the following methods for creating a bootable drive on an x86 system:

- **If you have set your system BIOS to boot in UEFI BIOS mode (which you can specify through the Boot menu of the BIOS Setup utility), do one of the following:**
  - Install the OS on a non-RAID volume by using the Oracle System Assistant utility. For more information, see the Oracle System Assistant documentation.
  - Install the OS on a RAID volume by setting up a RAID volume with the UEFI menu of the Setup utility, as described in [“Using the UEFI Menu to Create a Bootable RAID Volume \(x86\)” on page 32](#).
- **If you have set your system BIOS to boot in legacy mode (which you can specify through the Boot menu of the BIOS Setup utility), follow the steps in [“Using the BIOS Configuration Utility \(Legacy BIOS Booting\) to Create a Bootable Drive \(x86\)” on page 42](#).**

## Using the UEFI Menu to Create a Bootable RAID Volume (x86)

This section describes how to use the UEFI Driver Control menu in the BIOS Setup utility to optionally set up a RAID volume on an x86 system. You can then install the operating system onto that RAID volume.

---

**Note** - If you want to install the OS on a non-RAID volume, you do not need to perform the steps in this section. Instead, during bootup, launch Oracle System Assistant and specify a bootable drive on which to install an OS. For more information, see the Oracle System Assistant documentation.

---

In order to configure a RAID volume, the HBA must have firmware version 11.05.02.00, at minimum, installed. Before performing the steps in this section, verify the firmware level on the HBA and perform any firmware updates, as necessary. For information about updating firmware, see .

Perform the following procedures, in the order listed below, to configure a RAID volume on an x86 system:

- [“To Verify the Drives and Their Slots \(x86\)” on page 32](#)
- [“To Create a RAID Volume \(x86\)” on page 36](#)
- [“To Confirm the RAID Volume Creation \(x86\)” on page 40](#)

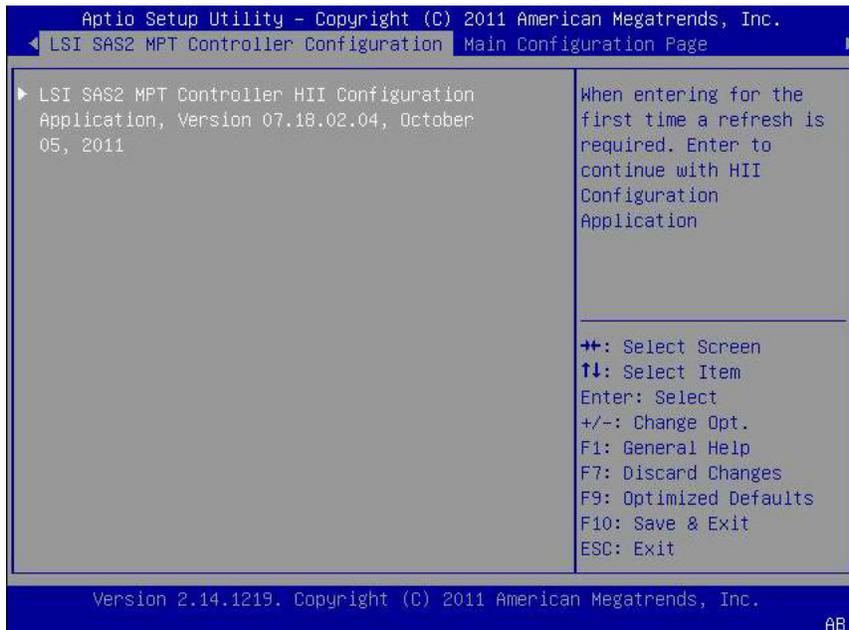
### ▼ To Verify the Drives and Their Slots (x86)

This procedure helps you identify drives to be used in a RAID volume configuration.

1. **From the Integrated Lights Out Manager (iLOM) software or Video Graphics Array (VGA) video port, access the system console.**
2. **Initiate a system boot.**  
During the boot process, the BIOS initialization banner lists information about the discovered SAS adapters and devices that are attached to the discovered HBAs in the system.
3. **Press F2 during the boot process, when prompted, to launch the BIOS Setup utility, and then use the right arrow key to navigate to UEFI Driver Control menu.**
4. **From the list of controllers that are displayed, use the up and down arrow keys to navigate to the LSI SAS2 MPT Controller menu option and press Enter.**

In the following example, the LSI SAS2 MPT Controller HII Configuration Application field is then displayed in the left tab of the utility.

**FIGURE 3-1** LSI SAS2 MPT Controller HII Configuration Application Field



5. **Press Enter to display the Controller Management, Virtual Disk Management, and Physical Disk Management menu options.**

6. Use the arrow keys to navigate to the Physical Disk Management menu option and press Enter.

**FIGURE 3-2** Selecting the Physical Disk Management Menu Option



7. From the menu options that are displayed, navigate to the View Physical Disk Properties menu option and press Enter.

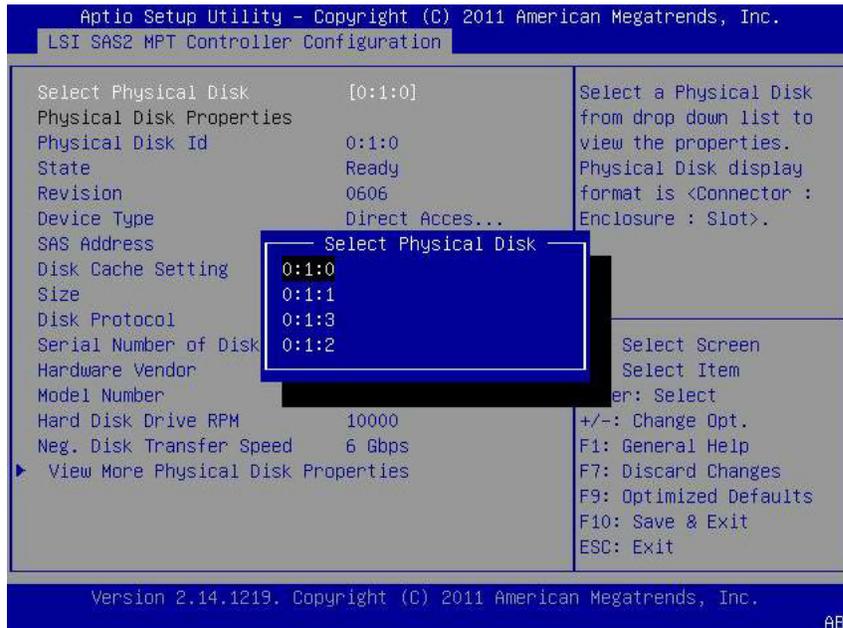
FIGURE 3-3 Selecting the View Physical Properties Menu Option



**8. On the properties page that is displayed, navigate to the View Physical Disk Properties field and press Enter.**

The Select Physical Disk pop-up window is displayed. In the following example, there are 4 drives in Slots 0, 1, 2, and 3.

FIGURE 3-4 Select Physical Disk Pop-up Window



9. Review the physical disks and note their respective slots for future reference.

You can use these disks to be part of your RAID volume configuration. See [“To Create a RAID Volume \(x86\)” on page 36](#).

▼ To Create a RAID Volume (x86)

After you have verified which drives are available for RAID volume configuration, as described in [“To Verify the Drives and Their Slots \(x86\)” on page 32](#), you can use those drives to create a RAID volume. In the following procedure, drives 2 and 3 from [Step 8 \(0:1:2, 0:1:3\)](#) are being used to create a RAID 1 volume.

---

**Note** - Do not perform the steps in this procedure if you want to install the operating system on a non-RAID volume. Instead, use Oracle System Assistant.

---

**Before You Begin** The HBA must have firmware level 11.05.02.00, at minimum, installed.

1. From the Select Physical Disk pop-up window (Figure 3-4), use the Esc key to return to the Controller Management menu option, and press Enter.

FIGURE 3-5 Selecting the Controller Management Menu Option



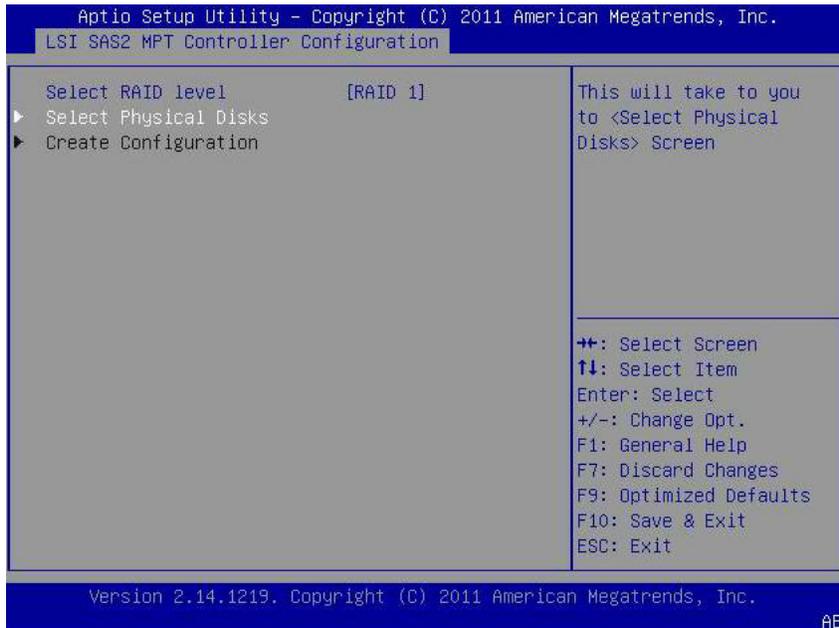
2. From the menu options that are displayed, use the arrow keys to navigate to the Create Configuration menu option and press Enter.

**FIGURE 3-6** Selecting the Create Configuration Menu Option



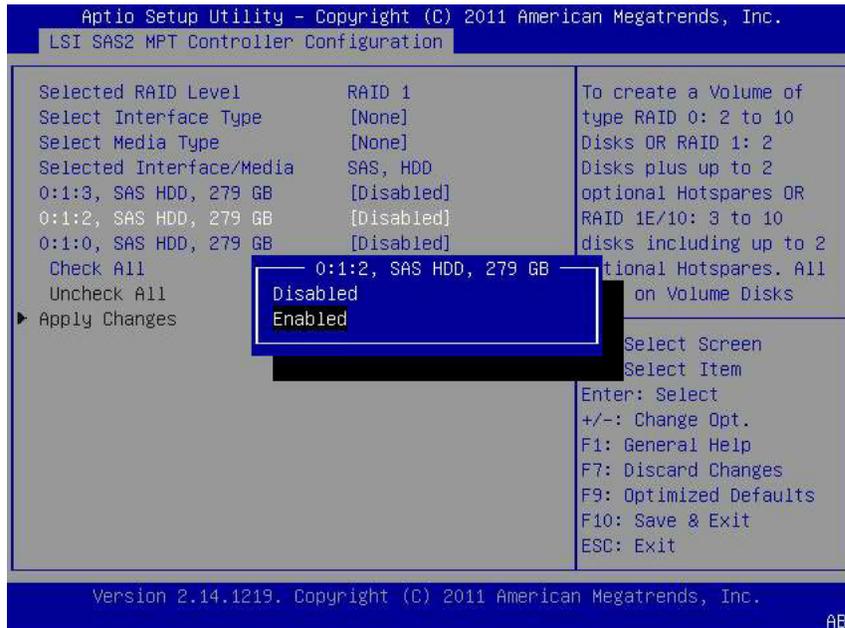
- 3. From the menu options that are displayed, use the arrow keys to navigate to the Select Physical Disks menu option and press Enter.**

In the following example, note that the RAID 1 level is selected. You might want to create a different level of RAID volume, based on your requirements.

**FIGURE 3-7** Selecting the Select Physical Disks Menu Option

4. **For each drive that you want in the RAID volume configuration, do the following:**
  - a. **Use the arrow keys to navigate to the drive.**
  - b. **Press Enter to launch the Enabled/Disabled pop-up window for that drive.**
  - c. **In the pop-up window, navigate to the Enabled field and press Enter.**  
The pop-up window closes and the drive is now listed as Enabled.

**FIGURE 3-8** Enabling the Drives for RAID Volume Configuration



5. After you have enabled all the drives that you want to be part of the RAID volume, use the arrow keys to navigate to the Apply Changes field on the same page, and press Enter.

The RAID volume is now created with the drives that you enabled.

6. Complete the steps in [“To Confirm the RAID Volume Creation \(x86\)”](#) on page 40.

## ▼ To Confirm the RAID Volume Creation (x86)

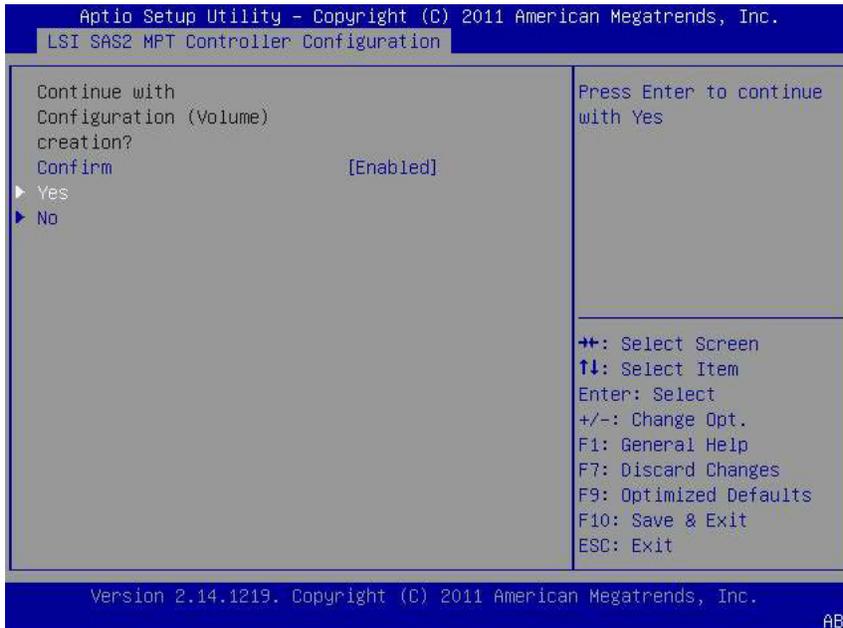
**Before You Begin** Before performing this procedure, verify the drives and their slots ([“To Verify the Drives and Their Slots \(x86\)”](#) on page 32) and create a RAID volume ([“To Create a RAID Volume \(x86\)”](#) on page 36).

1. Use the Esc key to return to the Create Configuration menu option ([Figure 3-7](#)) and press Enter.

A page is displayed that asks if you would like to continue with the volume creation.

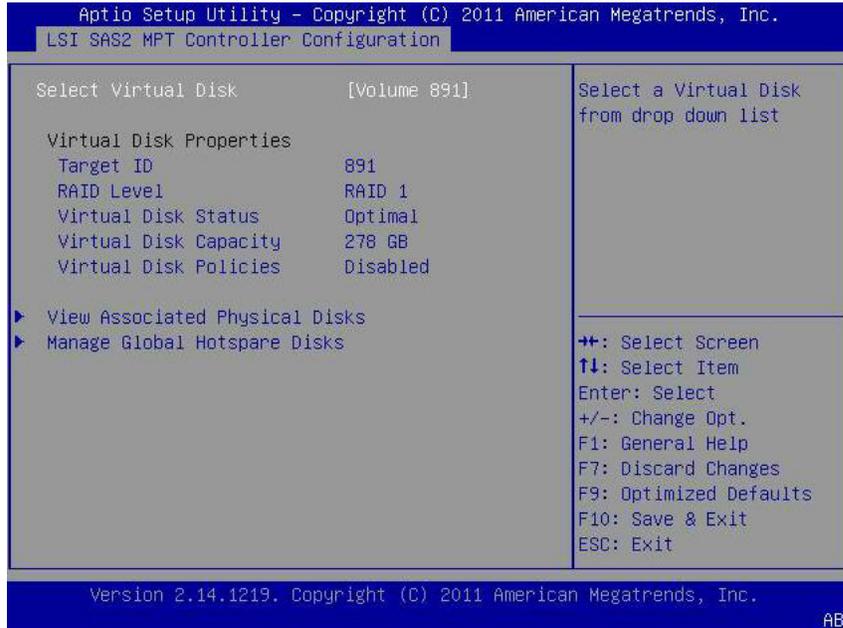
2. **Confirm the volume creation by doing the following:**
  - a. **Use the arrow keys to navigate to the Confirm field.**
  - b. **Change the value of the Confirm field to Enabled and press Enter.**  
Yes and No fields are displayed.
  - c. **Use the arrow key to navigate to the Yes field and press Enter.**  
This completes the RAID volume creation process.

**FIGURE 3-9** Confirming the RAID Volume Creation



3. **To verify that the RAID volume (logical volume) was created, use the arrow keys to navigate to the Virtual Disk Management menu option (Figure 3-2), press Enter, and review the RAID volume information on the page that is displayed.**  
In the following example, a RAID 1 volume is created with a target ID of 891.

FIGURE 3-10 Viewing the Newly Created RAID Volume



4. Exit the Setup utility and reboot into the Oracle System Assistant utility to install an OS on that RAID volume or manipulate the boot drive.

## Using the BIOS Configuration Utility (Legacy BIOS Booting) to Create a Bootable Drive (x86)

This section describes how to use the BIOS Configuration utility to set up a drive on an x864 system prior to installing an OS. You can then use the drive as your boot drive upon which to install the OS. This section contains the following topics:

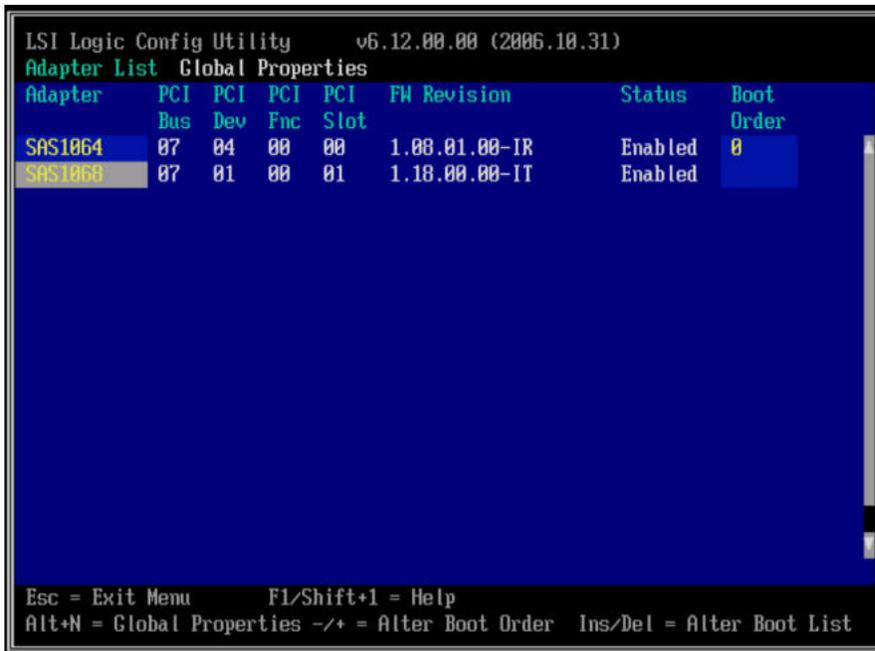
- [“To Prepare to Use the BIOS Configuration Utility” on page 43](#)
- [“To Create a RAID Volume With the BIOS Configuration Utility \(x86\)” on page 45](#)

## ▼ To Prepare to Use the BIOS Configuration Utility

1. From the Integrated Lights Out Manager (iLOM) software or Video Graphics Array (VGA) video port, access the system console.
2. Initiate a system boot.  
During the boot process, the BIOS initialization banner lists information about the discovered SAS adapters and devices that are attached to the discovered HBAs in the system.
3. Upon seeing the prompt, Press Ctrl-C to start LSI Corp Configuration Utility..., immediately press ctrl+c to access the LSI Corp Config Utility utility.

The LSI Corp Config Utility menu is displayed (see [Figure 3-11](#)).

FIGURE 3-11 LSI Corp Config Utility Menu



```

LSI Logic Config Utility      v6.12.00.00 (2006.10.31)
Adapter List Global Properties
Adapter  PCI  PCI  PCI  PCI  FW Revision  Status  Boot
         Bus Dev Fnc Slot
SAS1064  07  04  00  00  1.00.01.00-IR  Enabled  0
SAS1068  07  01  00  01  1.18.00.00-IT  Enabled
  
```

Esc = Exit Menu      F1/Shift+1 = Help  
Alt+N = Global Properties   -/+ = Alter Boot Order   Ins/Del = Alter Boot List

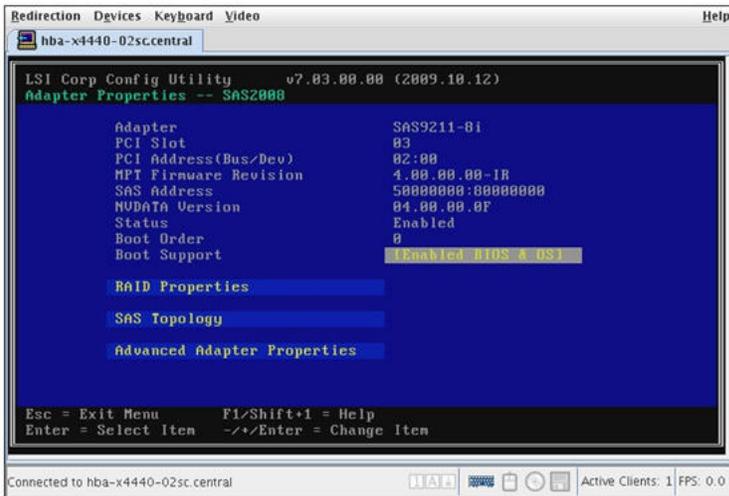
4. To change the boot options, use the arrow keys to navigate to the Boot Order field, and use the keys on your keyboard to change the values (see the following table).

Key	Function
Insert	Enables booting
Del	Disables booting
Plus (+)	Increases the numeric value in order to change the boot order
Minus (-)	Decreases the numeric value in order to change the boot order

5. To change other options, use the arrow keys to navigate to the HBA that you want, and press Enter.

The Adapter Properties screen is displayed for the selected HBA (see [Figure 3-12](#)).

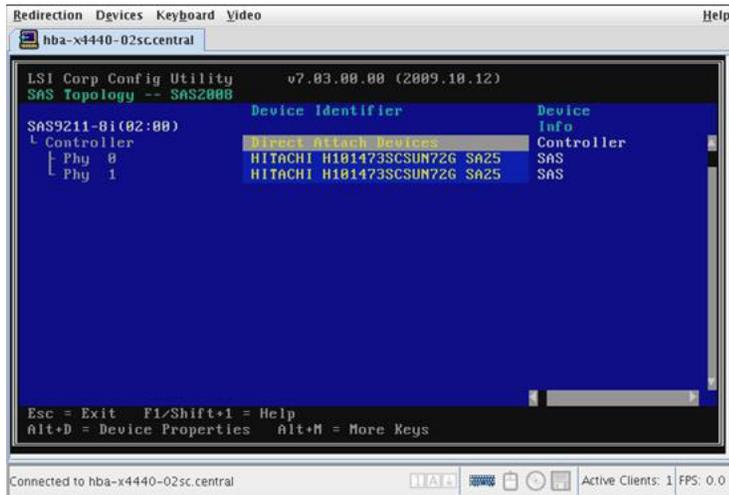
**FIGURE 3-12** Adapter Properties Screen



6. To view the devices and RAID volumes attached to the HBA, use the arrow keys to navigate to the SAS Topology field, and press Enter.

The SAS Topology screen is displayed (see [Figure 3-13](#)).

FIGURE 3-13 SAS Topology Screen



You can now use the BIOS Configuration utility to create a RAID volume on the HBA.

## ▼ To Create a RAID Volume With the BIOS Configuration Utility (x86)

---

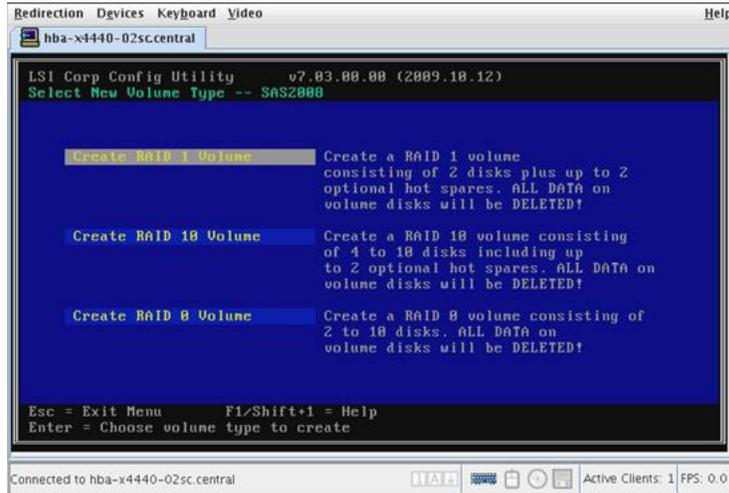
**Note** - Do not perform the steps in this section if you want to install the OS on a non-RAID volume. Instead, go directly to [“To Select a Bootable Drive \(x86\)”](#) on page 46.

---

1. From the Adapter Properties screen of the LSI Corp Config Utility utility, use the arrow keys to navigate to the RAID Properties field, and press Enter.

The Select New Volume Type screen is displayed (see [Figure 3-14](#)).

FIGURE 3-14 Select New Volume Type Screen



2. **Navigate to the type of volume that you want to create and press Enter.**
3. **Press c to create the volume, choose to Save the changes, then exit the menu.**  
You are returned to the Adapter Properties screen, and have successfully created a RAID volume on which to install an OS.
4. **Perform the steps in “[Selecting a Bootable Drive \(x86\)](#)” on page 46.**

## Selecting a Bootable Drive (x86)

This section describes how to select the bootable drive on which you want to install the OS on an x86 system. This section contains the following topic:

- [“To Select a Bootable Drive \(x86\)” on page 46](#)

### ▼ To Select a Bootable Drive (x86)

1. **From the Adapter Properties screen of the LSI Corp Config Utility utility, navigate to the SAS Topology field, and press Enter.**

The SAS Topology screen is displayed.

2. **Navigate to the device that you want, and press Alt+B to select the device as the primary boot device.**
3. **If you want an alternate boot device, navigate to the device that you want, and press Alt+A.**
4. **Confirm the changes you have made, save the configuration, and then press Esc to exit the utility.**

---

**Note** - Additional boot devices for the HBA might be present in the system BIOS as possible disk selections. However, these devices are not guaranteed to be consistent through storage configuration changes.

---

5. **Install an OS (for a list of supported OSEs, see [“Operating System and Technology Requirements” on page 11](#). If you plan to install the Oracle Solaris OS, follow the instructions in [“To Install the Oracle Solaris OS” on page 47](#).**

## Installing the Oracle Solaris OS

You can install the Oracle Solaris 10 01/13 OS, at minimum, on the bootable drive that you created, as described in this chapter. Starting with the Oracle Solaris 10 01/13 OS, the driver required by the HBA is provided with the Oracle Solaris OS. This section contains the following topics:

- [“To Prepare to Install the Oracle Solaris OS” on page 47](#)
- [“To Install the Oracle Solaris OS” on page 47](#)

### ▼ To Prepare to Install the Oracle Solaris OS

- Ensure that you have a bootable drive upon which to install the Oracle Solaris OS, as described in this chapter.

### ▼ To Install the Oracle Solaris OS

1. Obtain the Oracle Solaris 10 01/13 OS, at minimum, from the download site:

<http://www.oracle.com/technetwork/server-storage/solaris10/overview/index.html>

2. **Perform a normal installation, as described in the Solaris 10 installation documentation.**
3. **Apply any patches that are specifically required for the system.**

You can obtain these Oracle Solaris patches at:

<http://support.oracle.com>

4. **Reboot the system.**

```
# reboot
```

The system will now be able to see, and boot from, the RAID volume on which you installed the Oracle Solaris OS.

## Next Steps

Continue with the HBA installation, as described in [“To Complete the Installation” on page 18](#).

# ◆◆◆ CHAPTER 4

## HBA Software Installation

---

After you have completed the hardware installation and powered on the system, follow the instructions presented in this chapter for your operating system to install the HBA driver and any other utilities required for the installation.

This chapter contains the following topics:

- “Installing the Oracle Solaris Driver and Firmware” on page 49
- “Installing the Linux Driver and Firmware” on page 50
- “Installing the Windows Server Driver and Firmware” on page 51
- “Installing the VMware Driver and Firmware” on page 51
- “Installing the RAID Configuration Utilities” on page 51

### Installing the Oracle Solaris Driver and Firmware

The latest driver (`mpt_sas`) for this HBA is included as part of the Oracle Solaris 10 01/13 OS and the Oracle Solaris 11.1 OS. You can obtain the latest version of the Oracle Solaris OS at:

<http://www.oracle.com/technetwork/server-storage/solaris10/overview/index.html>

The HBA requires the the following patches and SRUs, at minimum, for the driver to work:

- **Oracle Solaris 10 01/13 (for the SPARC environment):** patches 149175-02 and 145648-04
- **Oracle Solaris 10 01/13 (for the x86 environment):** patches 149176-02 and 45649-04
- **Oracle Solaris 11.1:** SRU 7

You can obtain these Solaris patches at:

<http://support.oracle.com>

## Firmware Updates

The Solaris firmware and boot code update for the HBA, along with any accompanying documentation, are available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

## Installing the Linux Driver and Firmware

Consult the Oracle hardware platform document to determine which Linux releases are supported on your specific host platform.

The Linux driver required to run the HBA with the Linux OS is available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

### ▼ To Install the Linux Driver

1. **Log in to the host.**
2. **In a browser, go to <http://www.lsi.com/sep/Pages/oracle/index.aspx>.**
3. **Select the type and then model of the HBA that you want (SG(X)-SAS6-REM-Z).**
4. **Select and download the Linux driver that is supported by the Linux release (Red Hat Enterprise Linux, SuSE Linux Enterprise Server, or Oracle Enterprise Linux) on your hardware platform.**
5. **Select and download the corresponding Readme file for the Linux driver, and follow the instructions in the Readme file to complete the driver installation.**

## Firmware Updates

The Linux firmware and boot code update for the HBA, along with any accompanying documentation, are available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

## Installing the Windows Server Driver and Firmware

Consult the Oracle hardware platform document to determine which Windows releases are supported on your specific host platform.

The Windows Server driver required to run the HBA is available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

### ▼ To Install the Windows Driver

1. **Log in to the host.**
2. **In a browser, go to <http://www.lsi.com/sep/Pages/oracle/index.aspx>.**
3. **Select the type and then model of the HBA that you want (SG(X)-SAS6-REM-Z).**
4. **Select and download the specific Windows driver that is supported by the Windows release on your hardware platform.**
5. **Select and download the corresponding Readme file for the Windows driver, and follow the instructions in the Readme file to complete the driver installation.**

### Firmware Updates

The Windows firmware and boot code update for the HBA, along with any accompanying documentation, are available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

## Installing the VMware Driver and Firmware

The HBA driver is included as part of the VMware ESX Server installation. The VMware ESX Server installation requires nothing from the user.

## Installing the RAID Configuration Utilities

The HBA can be configured for RAID 0, 1, and 10. The following RAID configuration utilities are available for the HBA:

- **MegaRAID SAS Software** - A graphical user interface from which you can create RAID volumes for the HBA.
- **SAS2IRC utility** - A command-line utility from which you can create RAID volumes for the HBA.

These utilities, and their associated documentation, are available for download at:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

## Activating Volumes

---

This chapter describes how to make the HBA recognize a newly connected RAID volume that was created prior to its connection with the HBA or that was previously connected to a different HBA.

This chapter contains the following section:

- [“Overview of Volume Activation” on page 53](#)
- [“Activating Volumes” on page 53](#)

### Overview of Volume Activation

When you connect a RAID volume to the HBA, and that volume was created outside of the HBA or was previously connected to a different HBA, the HBA considers this volume to be a *foreign* RAID volume. To protect data, the foreign RAID volume is unusable by the operating system or system boot loader until you manually activate it. You must manually activate a volume in the following situations:

- You need to move the physical disks that make up a hardware RAID volume from one system to another system with the HBA.
- You need to replace an existing HBA that is managing hardware RAID volumes with a new HBA.

### Activating Volumes

Based on your configuration, use the appropriate utility to manually activate a RAID volume:

- **If the HBA is installed in a SPARC System** - Use the FCode utility. See [“To Activate a Volume \(SPARC\)” on page 54](#).
- **If the HBA is installed in an x86 System** - Use the BIOS Configuration utility. See [“To Activate a Volume \(x86\)” on page 54](#).

- **From an operating system (OS)** - Use the SAS2IRCU utility. See “[To Activate a Volume \(From an OS\)](#)” on page 54.

## ▼ To Activate a Volume (SPARC)

1. **Select the HBA to which the foreign volume is connected, as described in “[To Prepare to Use the FCode Utility \(SPARC\)](#)” on page 27.**
2. **List the active and foreign volumes by issuing the `show-volumes` command.**
3. **Issue the `volume-number-of-foreign-volume activate-volume` command.**

The volume is now activated, and can be used by the HBA.

## ▼ To Activate a Volume (x86)

1. **Enter the BIOS Configuration utility, as described in “[To Prepare to Use the BIOS Configuration Utility](#)” on page 43.**
2. **Navigate to the HBA to which the foreign volume is connected and press Enter.**
3. **Navigate to the RAID Properties field and press Enter.**
4. **Navigate to View Existing Volume and press Enter.**
5. **Ensure that the appropriate foreign volume is displayed on the screen.**

You can toggle between the two volumes by pressing `Alt+N`.

6. **Navigate to Manage Volume and press Enter.**
7. **Navigate to Activate Volume and press Enter.**

The volume is now activated, and can be used by the HBA.

## ▼ To Activate a Volume (From an OS)

1. **Go to the Oracle support area of the LSI web site (<http://www.lsi.com/sep/Pages/oracle/index.aspx>), download the SAS2IRCU utility, and issue the `sas2ircu` command, with no options, at the command-line or at a terminal window.**

2. **To display a synopsis of the SAS2IRCU utility command-line arguments, issue the `sas2ircu 0 activate` command.**
3. **To obtain the controller ID, issue the `sas2ircu list` command.**
4. **To obtain the volume ID, issue the `sas2ircu controller-ID display` command.**

The volume is now activated, and can be used by the HBA.



## Known Issues

---

This chapter provides supplementary and workaround information about the HBA. Specific bug identification numbers are provided for service personnel.

This chapter contains the following sections:

- “MegaRAID Storage Manager-Related Issues” on page 57
- “Utility-Related Issues” on page 58
- “Storage-Related Issues” on page 61

### MegaRAID Storage Manager-Related Issues

This section contains the following information:

- “Cannot Upgrade Firmware on the HBA Through MSM” on page 57
- “Cannot Hotplug the HBA Card” on page 58
- “Cannot Assign a Global Hot Spare Through the MSM GUI” on page 58

#### Cannot Upgrade Firmware on the HBA Through MSM

##### Bug 15664024

**Issue:** The firmware level on the HBA remains the same after using the MegaRAID Storage Manager software to upgrade the firmware. You might also encounter a message that states the update failed.

**Workaround:** Upgrading firmware through the MegaRAID Storage Manager software is not supported for this HBA. To upgrade firmware on the HBA, use the SAS2IRCU utility. You can obtain the SAS2IRCU utility from the Oracle support area of the LSI web site:

<http://www.lsi.com/sep/Pages/oracle/index.aspx>

## Cannot Hotplug the HBA Card

**Bugs 15700904, 15757240**

**Issue:** If the MegaRAID Storage Manager (MSM) software is installed on the system, and the MSM software services are running, you cannot perform hotplug remove and insert operations on the HBA. When attempting to perform such an operation, a popup window is displayed stating that the HBA card is busy and that you must close the program that is accessing the card.

**Workaround:** Use the Task Manager application to stop the following MSM software services:

- MSMFframework
- MegaMontiorSrv

After you have stopped these services, you can perform HBA card hotplug operations. You can restart the MSM software services after the hotplug operations are complete.

## Cannot Assign a Global Hot Spare Through the MSM GUI

**Bug 15762780**

**Issue:** From the MegaRAID Storage Manager (MSM) graphical user interface (GUI), after creating a drive using 2 hard disks, the option to create a global host spare from a third hard drive becomes inactive.

**Workaround:** Assigning global hot spares is not supported through the MSM GUI. Instead, use the SAS2IRCU utility to assign global hot spares.

## Utility-Related Issues

This sections contains the following information:

- [“Non-Alphabetical Characters Are Displayed in RAID Volume Names”](#) on page 59
- [“Cannot Delete a RAID Volume Using the SAS2IRCU Utility”](#) on page 59
- [“There Is No FCode Utility Command for Creating a RAID 10 Volume”](#) on page 59
- [“Virtual Drives Are Displayed Twice”](#) on page 60
- [“A Hard Drive is Not Displayed in the BIOS Setup Utility”](#) on page 60

- [“Cannot View Newly Inserted Drive” on page 60](#)

## Non-Alphabetical Characters Are Displayed in RAID Volume Names

### Bug 15597943

**Issue:** In the LSI BIOS Configuration utility, non-alphabetical characters are occasionally displayed in the volume names of RAID volumes. This occurs intermittently; subsequent reboots might cause the characters to go away, resulting in the correct volume names being displayed, or might cause the garbled characters to continue to be displayed. This is a cosmetic issue only. The volumes are fully functional and usable.

**Workaround:** You can identify each volume in the LSI BIOS Configuration utility by reviewing the volume number or the constituent disks of the volume.

## Cannot Delete a RAID Volume Using the SAS2IRCU Utility

### Bug 15625274

**Issue:** There are no SAS2IRCU utility Help instructions on how to delete a RAID volume through the SAS2IRCU utility.

**Workaround:** For information about how to delete a specific RAID volume using the SAS2IRCU utility, see the Note in [Step 6.c](#) of [“To Complete the Installation” on page 18](#).

## There Is No FCode Utility Command for Creating a RAID 10 Volume

### Bug 15635981

**Issue:** The supported RAID types for this HBA are 0, 1, and 10. However, there is no FCode command (in the SPARC OBP environment) that enables you to create a RAID 10 volume. Instead, there is a command that lets you create a RAID 1E volume (`create-raid1e-volume` command). When you use this command to create a volume, the SAS2IRCU utility displays this volume as a RAID 10 volume.

**Workaround:** To create a RAID 10 volume through the FCode utility, use the `create-raid1e-volume` command.

## Virtual Drives Are Displayed Twice

### Bug 15758202

**Issue:** When the system BIOS is in UEFI booting mode and two NEMs are installed in the system chassis, some virtual drives that you configure on the HBA might be displayed twice in the BIOS Setup utility.

**Workaround:** You can prevent this from occurring by performing one of the following procedures.

#### Procedure 1:

1. Remove one of the NEMs installed in the system chassis.  
The physical drives will now be listed once in the BIOS Setup utility.
2. Access the BIOS Setup utility by pressing F2, when prompted, during system bootup.
3. Create the virtual drive.
4. Replace the NEM in the system chassis.

#### Procedure 2:

1. Access the BIOS Setup utility by pressing F2, when prompted, during system bootup.
2. Through the Boot menu of the BIOS Setup utility, change the system BIOS booting mode so that that the system boots in Legacy mode.
3. Use the BIOS Configuration utility (that you access by typing `ctrl+c`, when prompted, during bootup) to create the virtual drive.
4. After the drive is created, revert back to UEFI booting mode through the Boot menu of the BIOS Setup utility.

## A Hard Drive is Not Displayed in the BIOS Setup Utility

### Bug 15769403

**Issue:** After removing and reinserting a hard drive that is part of a RAID-1 virtual drive configuration on the HBA, the hard drive is no longer displayed in the BIOS Setup utility.

**Workaround:** None. This is expected behaviour. To view the hard drive after reinsertion, reboot the system and enter the BIOS Setup utility. You can now view the hard drive.

## Cannot View Newly Inserted Drive

### Bug 15772754

**Issue:** If you remove a drive from a RAID volume that is configured on the HBA, the removal causes the RAID volume to be in a Failed state. If you then insert a new drive to replace the drive that you removed, that new drive might not display on the SAS Topology > Direct Attach Drives screen in the legacy BIOS Configuration utility.

**Workaround:** None. You can view the new drive on the RAID Properties > View Existing Volumes screen in the legacy BIOS Configuration utility.

## Storage-Related Issues

This section contains the following information:

- [“Blue Ready-to-Remove LED Does Not Illuminate After Issuing the `cfgadm -c unconfigure` Command” on page 61](#)
- [“Only 24 Devices Are Displayed In The System BIOS Boot List” on page 63](#)
- [“Typing `ctrl+N` Does Not Initiate a Network Boot Nor Load the HBA Option ROM As Expected” on page 64](#)
- [“The Oracle Solaris Operating System Installation Hangs” on page 64](#)
- [“The System Hangs After Deleting a RAID Volume” on page 64](#)
- [“Green LED Does Not Blink During the Volume Rebuild Process” on page 65](#)

### Blue Ready-to-Remove LED Does Not Illuminate After Issuing the `cfgadm -c unconfigure` Command

#### Bug 15622936

**Issue:** If you need to replace a drive connected to the HBA on a system running the Oracle Solaris OS, it is difficult to physically locate that drive after issuing the `cfgadm -c unconfigure` command. This is because the blue Ready-to-Remove LED is not illuminating on the drive, as it is expected to do.

**Workaround:** To determine the physical location of the disk, and then to hot plug the disk, perform the procedure in this section.

#### ▼ Determine the Physical Location, and Then Hot Plug, a Disk

1. Run the `format` command on the disk that you want to physically locate in the chassis of the system.

In the following example, the disk that needs to be replaced is `/dev/dsk/c14t50010B90004BEF66d0`.

```
# format c14t50010B90004BEF66d0
selecting c14t50010B90004BEF66d0
[disk formatted]
FORMAT MENU:
disk - select a disk
type - select (define) a disk type
partition - select (define) a partition table
current - describe the current disk
format - format and analyze the disk
fdisk - run the fdisk program
repair - repair a defective sector
label - write label to the disk
analyze - surface analysis
defect - defect list management
backup - search for backup labels
verify - read and display labels
save - save new disk/partition definitions
inquiry - show vendor, product and revision
volname - set 8-character volume name
!<cmd> - execute <cmd>, then return
quit
format>
```

**2. Issue the `analyze format` command.**

```
format> analyze
ANALYZE MENU:
read - read only test (doesn't harm SunOS)
refresh - read then write (doesn't harm data)
test - pattern testing (doesn't harm data)
write - write then read (corrupts data)
compare - write, read, compare (corrupts data)
purge - write, read, write (corrupts data)
verify - write entire disk, then verify (corrupts data)
print - display data buffer
setup - set analysis parameters
config - show analysis parameters
!<cmd> - execute <cmd> , then return
quit
quit
```

**3. Issue the `read analyze` command and type `y` at the prompt.**

```
analyze> read
Ready to analyze (won't harm SunOS). This takes a long time,
but is interruptable with CTRL-C. Continue? ypass 0
```

4. **To find the physical drive slot in the chassis of the system, check the activity blinking LEDs on the drives.**

The activity LED blink rate will be consistent on the drive that you want to replace.

5. **If you are unable to determine the drive slot due to other drive activity blink rates, do the following:**
  - a. **Press `ctrl+z` at the command-line to suspend the analyze function.**
  - b. **Look at the drive slots and verify that the drive that you want has a solid activity LED on the drive (the LED is no longer blinking, but remains illuminated).**
  - c. **After you have found the drive slot that you want, run the `fg` command to resume the analyze function.**
6. **Type `ctrl+c` at the command-line to interrupt the read test.**
7. **If you are unable to identify the drive, as described [Step 4](#) and [Step 5](#) in this procedure, do the following:**
  - a. **Take the system to single-user mode in order to quiesce all other system activity**
  - b. **Repeat [Step 1](#) through [Step 6](#).**
8. **Now that you have physically located the drive, issue the `cfgadm -c unconfigure` command to unconfigure the drive, and then remove the drive from the chassis.**

## Only 24 Devices Are Displayed In The System BIOS Boot List

### Bug 15648283

**Issue:** If you install multiple HBA cards in an x86 system, the total number of devices populated across all cards can be no more than 24. Additional devices will not be displayed in the system BIOS boot list.

**Workaround:** Use the BIOS Configuration Utility to select which adapters are candidates for booting and which drives connected to those adapters you want designated as boot drives. This enables you to guarantee which drives are consistently listed in the system BIOS boot list.

## Typing `Ctrl+N` Does Not Initiate a Network Boot Nor Load the HBA Option ROM As Expected

### Bug 15601623

**Issue:** If the HBA is installed in an x86 system, and you type `Ctrl+N` on the serial console to initiate a network boot, the network boot might not be initiated, and the Option ROM for the HBA might not be loaded.

**Workaround:** Do one of the following:

- Use the ILOM Remote Console and press `F12` to initiate a network boot.
- If using the serial console, type `Ctrl+E` to get to the BIOS Boot Device Priority menu, and then move the desired PXE adapter (network boot device) to the top of the Boot Device Priority list. The PXE adapter will then be used as the boot device.
- Type `Ctrl+N` during, or after, the HBA Option ROM code is running. The Option ROM code is running when the following banner is displayed: LSI Corporation MPT SAS2 BIOS. Copyright 2000-2010 LSI Corporation.

## The Oracle Solaris Operating System Installation Hangs

### Bug 15761911

**Issue:** If you use the graphical user interface (GUI) mode to install the Oracle Solaris operating system (OS), and you install the OS onto a volume configured on the HBA, the OS installation might hang during the “detecting locale” portion of the installation.

**Workaround:** Verify that the volume on which you plan to install the OS is not a resyncing RAID 1 or RAID 10 volume. To prevent hangs, ensure that the volume is in optimal mode, rather than resync mode, prior to installing the OS.

## The System Hangs After Deleting a RAID Volume

### Bug 15764098

**Issue:** If you delete a RAID volume configured on the HBA, and that volume is in resync mode, the system in which the HBA is installed might hang.

**Workaround:** When you need to delete a RAID volume that is configured on the HBA, verify that the volume is in optimal mode, not in resync mode. If the volume is resyncing, wait to delete the volume until after the resync process is complete.

## Green LED Does Not Blink During the Volume Rebuild Process

### **Bug 15761906**

**Issue:** After inserting drives to rebuild a RAID 10 volume, the green LED on each newly inserted drive does not blink as expected.

**Workaround:** None. Ignore the green LED during the rebuild process.



## HBA Specifications

---

This appendix contains the specifications for the HBA. This appendix contains the following topics:

- [“Physical Dimensions” on page 67](#)
- [“PCI Performance” on page 67](#)
- [“SAS Port Bandwidths” on page 68](#)
- [“Environmental Requirements” on page 68](#)
- [“Characteristics of the HBA” on page 69](#)

### Physical Dimensions

The HBA board is 4.5-in. x 5.5-in. The PCIe and SAS/SATA interface connections are through a mezzanine connector, J1. It conforms to the PCIe Card Electromechanical Specification 2.0.

### PCI Performance

The PCI Express features of the HBA include the following:

- Provides a scalable interface
  - Single-lane aggregate bandwidth of up to 0.5 GB/s (500 MB/s)
  - Quad-lane aggregate bandwidth of up to 2 GB/s (2000 MB/s)
  - 8-lane aggregate bandwidth of up to 4.0 GB/s (4000 MB/s)
- Supports serial point-to-point interconnections between devices
- Supports lane reversal and polarity inversion
- Supports the PCI Express advanced error reporting capabilities
- Uses a packetized and layered architecture
- Achieves a high bandwidth per pin with low overhead and low latency
- PCI Express is software compatible with PCI and PCI-X software
  - Leverages existing PCI device drivers

- Supports the memory, I/O, and configuration address spaces
- Supports memory read/write transactions, I/O read/write transactions, and configuration read/write transactions
- Provides 4-KB of PCI configuration address space per device
- Supports posted and nonposted transactions
- Supports traffic class 0 and class 1 virtual channel
- Supports message signaled interrupts (both MSI and MSI-X) as well as INTx interrupt signaling for legacy PCI support
- Supports end-to-end CRC (ECRC) and advanced error reporting

## SAS Port Bandwidths

The HBA supports narrow and wide ports, as described in the following table.

**TABLE A-1** 6 Gb SAS Bandwidths

Half Duplex	Full Duplex
Narrow Port (1 Lane), 600 MB/s	Narrow Port (1 Lane), 1200 MB/s
Wide Port (2 Lanes), 1200 MB/s	Wide Port (2 Lanes), 2400 MB/s
Wide Port (4 Lanes), 2400 MB/s	Wide Port (4 Lanes), 4800 MB/s

## Environmental Requirements

The HBA environmental requirements are listed in [Table A-2](#).

**TABLE A-2** HBA Environmental Specifications

Specification	Operating	Non-Operating
Temperature	<ul style="list-style-type: none"> <li>■ +10°C to +60°C without battery backup unit</li> <li>■ +10°C to +44.8°C with iBBU battery backup</li> </ul>	<ul style="list-style-type: none"> <li>■ -30°C to +80°C without battery backup unit</li> <li>■ 0°C to +45°C with iBBU battery backup</li> </ul>
Humidity	5% to 90% RH, non-condensing, 40°C max, 27°C max wet bulb, 16 hour dwells at extreme	93% RH, non-condensing, 40°C max, 120 hours
Altitude	3200m at 40°C, 4 hour dwell	12,200m at 0°C, 4 hour dwell
Vibration	0.25G in all axes swept for 5-500-5 Hz, 5 sweeps in all at 1 octave/min	1.2G in all axes swept for 5-500-5 Hz, 5 sweeps in all at 1 octave/min
Shock	5.5G, 11 ms half-sine, 10 shocks in x-, y-, and z-axes	33G, 11 ms half-sine, 3 shocks in x-, y-, and z-axes

Specification	Operating	Non-Operating
Airflow	At least 200 linear feet per minute (LFPM)	At least 200 linear feet per minute (LFPM)

## Characteristics of the HBA

The HBA provides 6 Gb SAS performance using the HBA controller for Oracle-specified servers. The board has on-board Flash ROM for firmware and BIOS, and NVSRAM for embedded mirroring. Each of the eight PHYs on the HBA is capable of 6 Gb, 3 Gb, or 1.5 Gb SAS or SATA link rates.

### LEDs

The board has eight activity LEDs that blink green for SAS activity, eight port-fault LEDs that are solid yellow, indicating a faulty link in the port, and one Heartbeat LED that blinks green for firmware heartbeat and indicates the card is capable of general activity.

### Connectors

This section provides a description of the different connectors on the host bus adapter.

- SAS/SATA and PCIe Mezzanine Connector (J1). Supports x8 PCIe interface and a x8 SAS/SATA interface.
- UART Connector (J4). Debug port requiring a special cable and Oracle support to gather detailed IOC status.

[Table A-3](#) lists the UART connections and their functions.

**TABLE A-3** UART Connections

Pin	Function
1	TX_OUT
2	GND
3	RX_IN
4	3.3 V



# Glossary

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## A, B

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

## C

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

## D

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

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

**drive group** A group of physical drives that combines the storage space on the drives into a single segment of storage space. A hot-spare drive does not actively participate in a drive group.

## E

**EEPROM** Acronym for electronically erasable programmable read-only memory. It is a memory chip that typically stores configuration information, as it provides stable storage for long periods without electricity and can be reprogrammed. Refer to NVRAM.

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

## F

**Fusion-MPT architecture** An acronym for Fusion-Message Passing Technology architecture. Fusion-MPT consists of several main elements: Fusion-MPT firmware, the Fibre Channel and SCSI hardware, and the operating system level drivers that support these architectures. Fusion-MPT architecture offers a single binary, operating system driver that supports both Fibre Channel and SCSI devices.

## G, H

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

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

**host bus adapter** A piece of hardware that connects a host to network and storage devices.

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

When a drive fails, the adapter firmware automatically replaces and rebuilds the data from the failed drive to the hot spare. Data can be rebuilt only from virtual drives with redundancy (RAID levels 1, 5, 6, 10, 50, and 60; not RAID level 0), and the hot spare must have sufficient capacity.

## I

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

## J, K, L, M

**main memory** The part of computer memory that is directly accessible by the CPU (usually synonymous with RAM).

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**N**

**NVRAM** Acronym for nonvolatile random access memory. An EEPROM (electronically erasable read-only memory) chip that stores configuration information. Refer to EEPROM.

**O, P**

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

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

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

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

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

**Q, R, S**

**SAS** Acronym for Serial Attached SCSI. A serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. The SAS interface provides improved performance, simplified cabling, smaller connections, lower pin count, and lower power requirements when compared to parallel SCSI. SAS adapters leverage a common electrical and physical connection interface that is compatible with Serial ATA. The SAS adapters support the ANSI Serial Attached SCSI Standard, Version 2.0. In addition, the adapter supports the Serial ATA II (SATA II) protocol defined by the Serial ATA Specification, Version 1.0a. Supporting both the SAS interface and the SATA II interface, the SAS adapter is a versatile adapter that provides the backbone of both server and high-end workstation environments. Each port on the SAS RAID adapter supports SAS devices, SATA II devices, or both.

<b>SAS device</b>	Any device that conforms to the SAS standard and is attached to the SAS bus by a SAS cable. This includes SAS RAID adapters (host adapters) and SAS peripherals.
<b>SATA</b>	Acronym for Serial Advanced Technology Attachment. A physical storage interface standard, SATA is a serial link that provides point-to-point connections between devices. The thinner serial cables enable better airflow within the system and permit smaller chassis designs.
<b>SMP</b>	Acronym for Serial Management Protocol. SMP communicates topology management information directly with an attached SAS expander device. Each PHY on the adapter can function as an SMP initiator.
<b>spanning</b>	A method for combining multiple drives into a single logical drive. If you want to have all of the drive capacity in one drive group, you can span (merge) the drives so that the operating system sees just one large drive. For more information, refer to the MegaRAID SAS Software User's Guide, located at: <a href="http://www.lsi.com/sep/Pages/oracle/index.aspx">http://www.lsi.com/sep/Pages/oracle/index.aspx</a> .
<b>SSP</b>	Acronym for Serial SCSI Protocol. SSP enables communication with other SAS devices. Each PHY on the SAS adapter can function as an SSP initiator or SSP target.
<b>STP</b>	Acronym for Serial Tunneling Protocol. STP enables communication with a SATA II device through an attached expander. Each PHY on the SAS adapter can function as an STP initiator.
<b>stripe size</b>	<p>The total drive space consumed by a stripe not including a parity drive. For example, consider a stripe that contains 64 Kbytes of drive space and has 16 Kbytes of data residing on each drive in the stripe. In this case, the stripe size is 64 Kbytes and the stripe element size is 16 Kbytes. The stripe depth is four (four drives in the stripe). You can specify stripe sizes of 8 Kbytes, 16 Kbytes, 32 Kbytes, 64 Kbytes, 128 Kbytes, 256 Kbytes, 512 Kbytes, or 1 Mbyte for each logical drive.</p> <p>A larger stripe size produces improved read performance, especially if most of the reads are sequential. For mostly random reads, select a smaller stripe size.</p>
<b>striping</b>	Drive striping writes data across two or more drives. Each stripe spans two or more drives but consumes only a portion of each drive. Each drive, therefore, may have several stripes. The amount of space consumed by a stripe is the same on each drive that is included in the stripe. The portion of a stripe that resides on a single drive is a stripe element. Striping by itself does not provide data redundancy; striping in combination with parity provides data redundancy.

## T, U, V, W, X, Y, Z

<b>virtual drive</b>	A storage unit created by a RAID controller from one or more drives. Although a virtual drive may be created from several drives, it is seen by the operating system as a single drive. Depending on the RAID level used, the virtual drive can retain redundant data in case of a drive failure.
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