**Sun™ Storage J4500 Array
System Overview**

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Contents

Preface

This document provides an overview of the Sun™ Storage J4500 array. Information described here includes details about installing, configuring, managing and troubleshooting your Sun Storage J4500 array.

Related Documentation

For the most up-to-date information about the Sun Storage J4500 array, go to the sites listed in the following table. For a complete list of documents for your J4500 array product, see the *Where to Find Sun Storage J4500 Array Documentation* sheet shipped in your product, or on the web:

Documentation	Web Site
Storage J4500 documentation set	http://docs.sun.com/app/docs/prod/j4500.array
Solaris Operating System Installation	http://docs.sun.com/
All Sun hardware documentation	http://docs.sun.com/

Translated versions of some of the documents in the J4500 array documentation set are available in French, Simplified Chinese and Japanese on the Sun documentation web site http://docs.sun.com. The English documentation is revised more frequently and might be more up-to-date than the translated documentation.

Third-Party Web Sites

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Typographic Conventions

Typeface	Meaning	Examples
AaBbCc123	The names of commands, files, and directories; on-screen computer output	Edit your `.login` file. Use `ls -a` to list all files. `% You have mail.`
AaBbCc123	What you type, when contrasted with on-screen computer output	`% `**`su`** `Password:`
AaBbCc123	Book titles, new words or terms, words to be emphasized. Replace command-line variables with real names or values.	Read Chapter 6 in the *User's Guide*. These are called *class* options. You *must* be superuser to do this. To delete a file, type **rm** *filename*.

Note – Characters display differently depending on browser settings. If characters do not display correctly, change the character encoding in your browser to Unicode UTF-8.

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Please include the title and part number of your document with your feedback:

Sun Storage J4500 Array System Overview , part number 820-3163-12.

Change History

The following describes the change history of this document:

- 820-3163-10, October 2008, initial publication.
- 820-3163-11, June 2009, updated to include support for additional servers, multipathing, and zoning of array storage for multiple hosts using the Sun Common Array Manager.
- 820-3163-12, March 2013, updated to remove restriction on mixing drives from different supported manufacturers.

Hardware Overview

This chapter contains overview information about your Sun Storage J4500 array hardware and includes the following sections:

Overview of the Sun Storage J4500 Array

The Sun Storage J4500 array is a JBOD (Just-a-Bunch-Of-Disks) enclosure that connects to x64 or SPARC architecture host servers through a supported SAS (Serial Attached SCSI) host bus adapter.

The array comes fully loaded with 48 SATA hard disks supplying up to 48 terabytes of storage. It contains SAS expanders—switching circuits that can connect disks in complex patterns. There are four SAS expanders configured in two sets (each set containing an outside and inside expander) that provide a primary and secondary (redundant) path to all 48 SATA disks. The array supports SES (SCSI Enclosure Services)-based management to identify components, read sensor data and log alerts. FIGURE 1-1 shows a schematic view of the J4500 array solution.

FIGURE 1-1 The Main Components of the Sun Storage J4500 Array
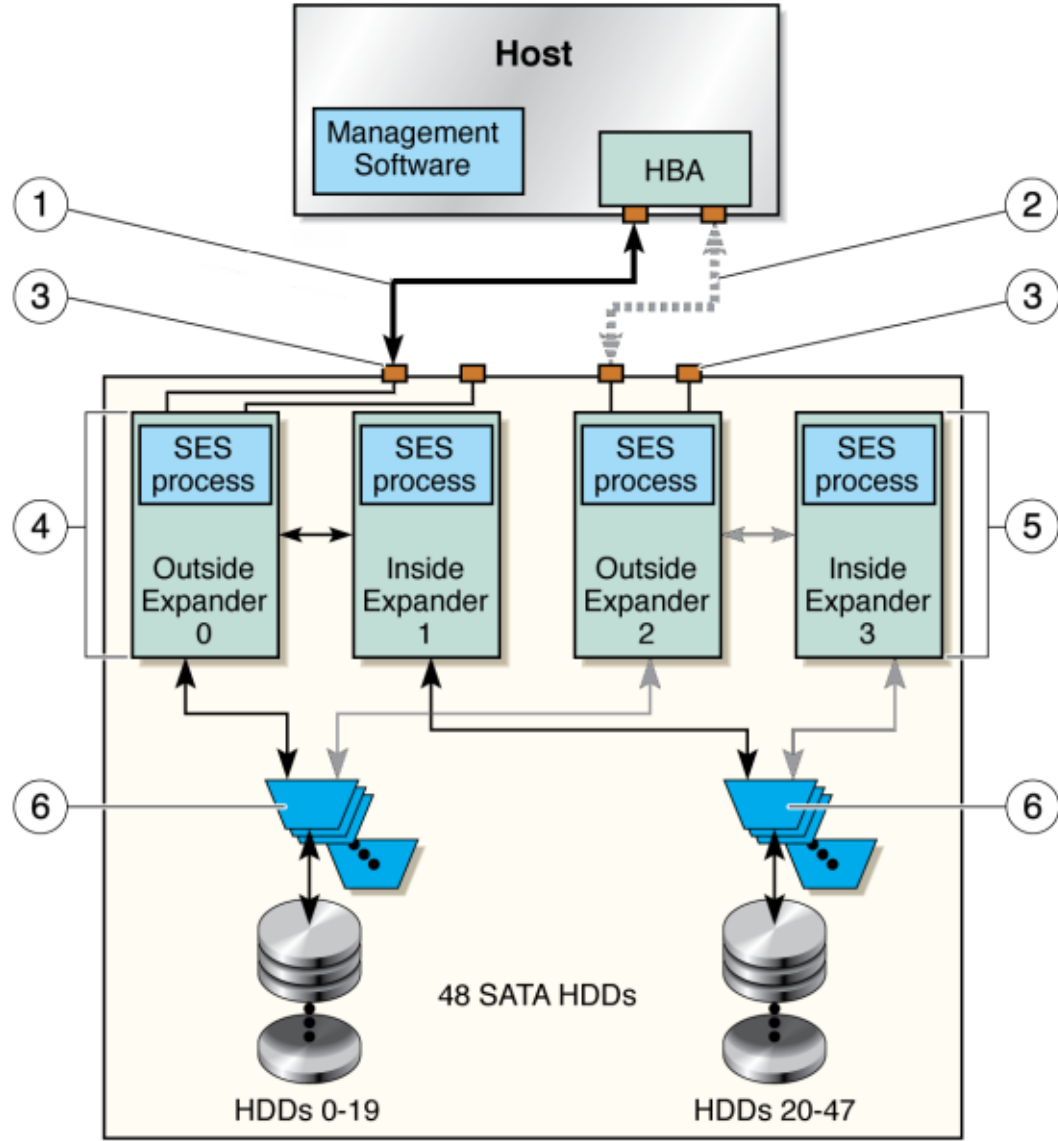
Figure Legend

1	Host to J4500 x4 PHY SAS cable link	**4**	Primary expanders (two per fabric)
2	Secondary host to J4500 cable link	**5**	Secondary expanders (two per fabric)
3	SAS x4 ports (two per fabric)	**6**	SAS/SATA AAMUX (one per disk)

The following is a description of J4500 array components:

- Four LSI™ SAS x36 port expanders structured in a dual fabric system provides the communications link to the array disks. A bridge in each expander converts SAS to SATA (to support the array's 48 SATA hard disk drives). Each fabric includes an outside and inside expander. The outside expander links to 20 of the array disks and provides an 8-lane path (in the form of two SAS x4 connectors) to upstream initiators (host HBA) or downstream target devices (daisy-chained J4500 arrays) outside of the array enclosure. The inside expander links to the outside expander through an 8-lane path and to the other 28 array disks. Together, the set of expanders provide each external array SAS connector a path to all 48 SATA disks—the second set of expanders provides a redundant path.

- Forty-eight SAS/SATA active-active multiplexers (AAMUX) provide dual port functionality to single port SATA disk drives.

- Four external mini-SAS x4 (by four) connector ports, each connector contains four PHYs (physical links) enabling eight SAS lanes per fabric to connect to storage. Each x4 connector port links to all 48 disks.

- A Host Bus Adapter (HBA) installed in a host server allows you to configure volumes and access the disks.

- Enclosure management software using SMP and SES-2 running on the host server with SES processes running on each set of array expanders allows you to monitor and manage the health of the array enclosure and its components (such as hard disks, expanders, array LEDs, temperature and voltage sensors).

Features

The J4500 array is a mid-level, modular, rack-optimized, expansion storage solution in the Sun storage product family. It is designed for deployment into commercial server markets in a slide-mounted, horizontally biased 4U enclosure for rack cabinet installations, primarily in data center locations.

TABLE 1-1 summarizes the features of the J4500 array.

TABLE 1-1   Sun Storage J4500 Array Summary of Features

Feature or Component	Description
Hard disks	Up to forty-eight 3.5-inch SATA II drives of 500 GB, 750 GB or 1 TB capacity each (48 TB total array enclosure capacity), 3 Gbit/sec data rates, hot-pluggable.
System Controller	The System Controller contains four LSI SAS x36 expanders. These expanders provide a redundant set of independent SAS fabrics (two expanders per fabric), enabling two paths to the J4500 array's 48 drives. Four external mini-SAS x4 connector ports, each connector contains four PHYs (physical links) enabling eight SAS lanes per fabric to connect to storage. Each x4 connector port links to all 48 disks. The System Controller module is hot-pluggable.
RAID options	RAID support is specific to the supported host bus adapter.
Data rates	The SAS interface allows 1.5 and 3 Gbit/sec SAS and SATA with auto-negotiation.
Bandwidth	Up to 48 Gb/sec total bandwidth: 2 (x4-wide) SAS host/uplink ports (24 Gb/sec bandwidth) 2 (x4-wide) SAS expansion port (24 Gb/sec bandwidth)
Protocols	Supports SSP, STP, SMP as defined in the Serial Attached SCSI (SAS) v1.0 and v1.1 specifications.
Management	Enclosure management is provided through SMP and SES-2.
I/O	Four external mini-SAS x4 connector ports (a two-port primary path and a redundant two-port secondary path).
Power	Two 1500 W DC max output power supplies, two bays, 1+1 redundancy (array continues to operate with one power supply), hot-swappable. 110–220 VAC input voltage 47-63 Hz input frequency 1100 W DC max power consumption
Cooling	Five variable-speed fan modules (two per module), hot-swappable. Additionally, each power supply has its own fan. Cooling is front-to-back forced air.
SAS cables	Two mini-SAS x4 SFF-8088 cables are supplied with the array.

Exterior Features, Controls, and Indicators

This section describes the features and the controls and indicators on the front and rear panels of the J4500 array.

Front Panel

FIGURE 1-2 shows the front panel. FIGURE 1-3 shows a close up of the controls and indicators. TABLE 1-2 lists and describes the front panel controls and indicators.

FIGURE 1-2   Sun Storage J4500 Array Front Panel Features
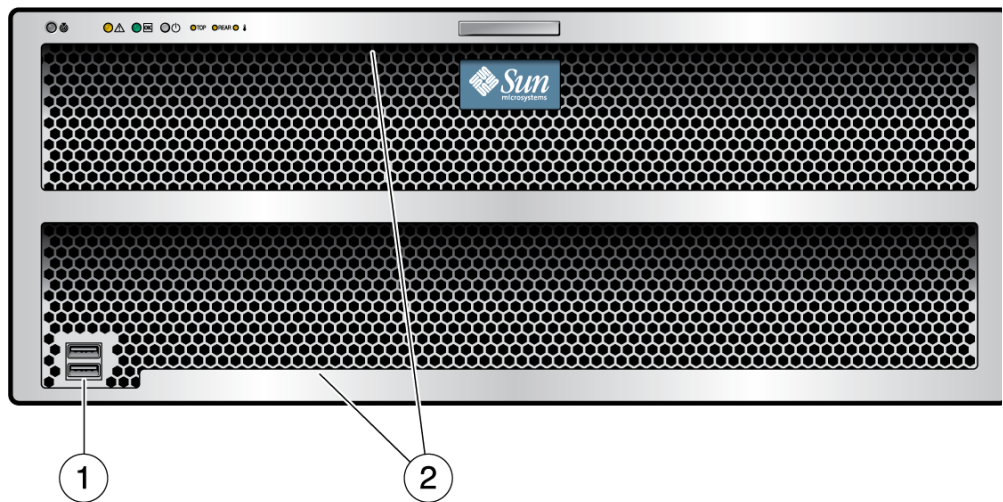
Figure Legend

1	USB ports—Not used
2	Serial numbers on ledge

FIGURE 1-3   Sun Storage J4500 Array Front Panel Controls and Indicators
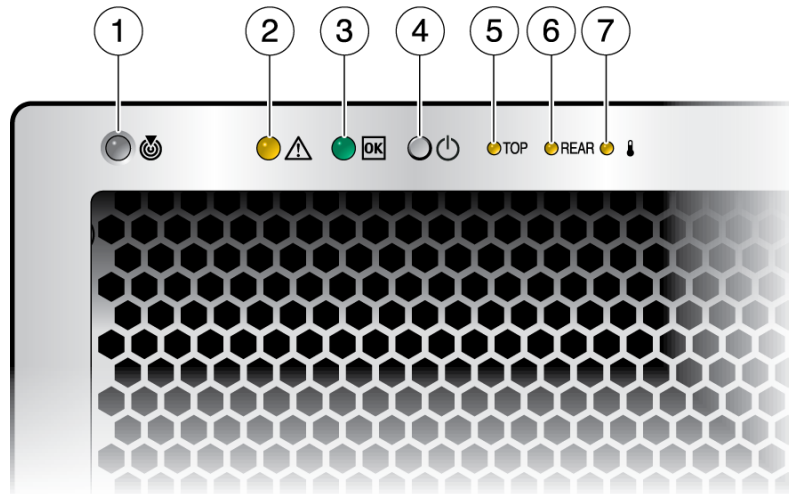
TABLE 1-2   Front Panel Controls and Indicators

#	Name	Description
1	Locate button/LED	Using array management software, operators can turn this LED on remotely to help them to locate the array enclosure in a crowded server room. Press to turn off.
2	System fault	On – service action is required
3	Power LED	On – Power is on Blinking – Standby power is on but main power is off Off – Power is off
4	Enclosure power button	See "Powering On and Off the Array" on page 24 for details.
5	Top fault LED	On – Hard disk or fan fault
6	Rear fault LED	On – Power supply, or system controller fault (service is required)
7	Over temperature LED	On – The array enclosure has exceeded the operating temperature

Back Panel

FIGURE 1-5 shows the features of the back panel. TABLE 1-3 lists and describes each feature.

FIGURE 1-4   Sun Storage J4500 Array Back Panel
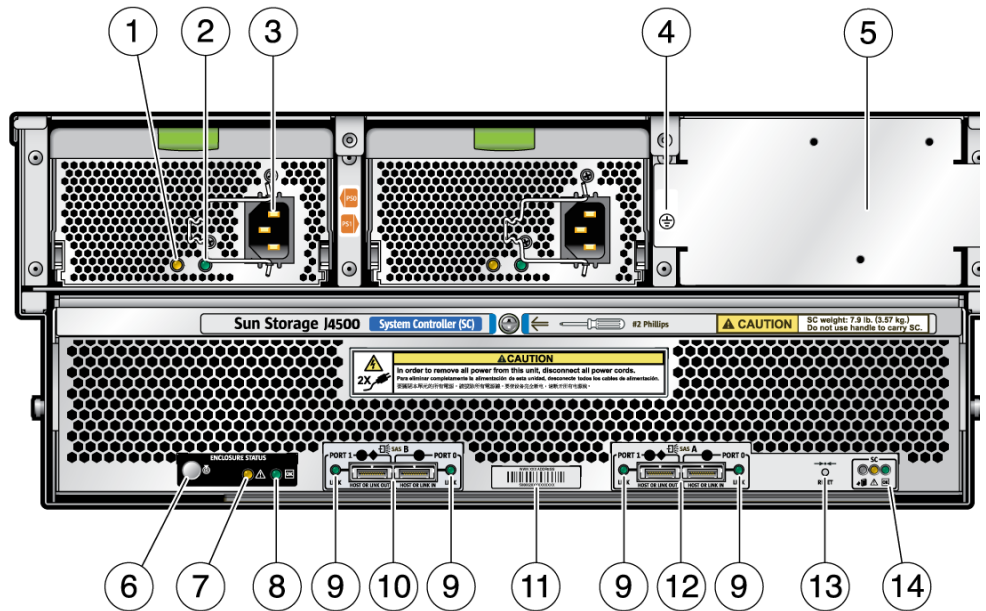
TABLE 1-3   Rear Panel Features

#	Name	Description
1	Power supply fault LED (amber)	On – Service action is required
2	Power supply LED (green)	On – Power is on (AC/DC are OK) Blinking – Standby power is on (AC is OK) Off – Power is off
3	AC power connector	Each power supply has its own AC connector with a clip to secure its power cable.
4	Chassis ground	Connect grounding straps here.
5	Filler panel	This filler panel seals an access area in the chassis used by service personnel.
6	Locate button/LED (white)	Using array management software, operators can turn this LED on remotely to help them to locate the enclosure in a crowded server room. Press to turn off.
7	System fault LED (amber)	On – Service action is required
8	System power LED (green)	On – Power is on Blinking – Standby power is on but main power is off Off – Power is off

TABLE 1-3 Rear Panel Features *(Continued)*

#	Name	Description
9	SAS link activity LED (green)	Each SAS port has a SAS Link Activity LED: On – 1 to 4 links are ready Blinking – Read/Write port activity Off – Link is lost
10	Two mini-SAS x4 connector ports (SAS B)	Secondary (redundant) SAS ports 0 and 1, each with SAS Link activity LEDs. Port 0 uses subtractive or direct routing and connects to a host or upstream devices. Port 1 is universal, using table and direct routing, and connects to a host or downstream devices.
11	SAS ID (or WWN)	The label placed here lists the unique SAS ID address (also known as World-Wide Name) of the enclosure.
12	Two mini-SAS x4 connector ports (SAS A)	Primary SAS ports 0 and 1, each with SAS Link activity LEDs. Port 0 uses subtractive or direct routing and connects to a host or upstream devices. Port 1 is universal, using table and direct routing, and connects to a host or downstream devices.
13	Enclosure reset button	Resets the array enclosure hardware without powering down the array. For more information, see Chapter 5.
14	System controller status LEDs	Blue – Ready to remove (service action allowed) Amber – Fault (Service action required) Green – OK (no action required)

Supported Server Platforms

The Sun Storage J4500 Array is supported for use with the following Sun servers and workstations:

TABLE 1-4 Supported Sun x64 and SPARC Servers

x64 Servers	SPARC Servers
X2100 M2, X2200 M2, X2250, X4100 M2, X4200 M2, X4140, X4150, X4240, X4250, X4440, X4450, X4540, X4600, X4600 M2, X6220, X6240, X6250, X6440, X6450	M3000, M4000, M5000, M8000, M9000, T1000, T2000, T5120, T5140, T5220, T5240, T5440, T6300, T6320, T6340, U45, V215, V245, V445

A list of all supported server platforms for the Sun Storage J4500 array is available on the Sun web site

(http://www.sun.com/storagetek/disk_systems/expansion/4500/specs
.xml)

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Supported Host Bus Adapters

The following Host Bus Adapters (HBAs) are supported for use with the Sun
Storage J4500 array:

Note – Support information listed here describes basic, single connection support
for HBAs and the J4500 array. For multipath configurations, refer to Chapter 4.

- **Sun StorageTek PCI Express SAS 8-Channel HBA** (SG-XPCIE8SAS-E-Z, LSI™-
  based disk controller):
  - Installed in a free PCIe slot in supported Sun Fire and SPARC servers to
    provide an external connection to the J4500 array.
  - The minimum required HBA firmware revision for J4500 array support:
    firmware 1.26.03.00-IT, BIOS 6.24.00.00, Fcode 1.00.49, hardware revision B3.
    Updates may be obtained at: http://www.lsi.com/support/sun
  - The HBA hardware must have a Sun manufacturing part number of 375-3487-
    02 or higher (for example, 375-3487-03 is supported while 375-3487-01 is not
    supported).
  - The minimum driver version for operating system support for this HBA when
    connected to the J4500 array is described in the following table:

OS Supported	Minimum SG-XPCIE8SAS-E-Z HBA Driver Version Supported
Solaris 10 5/08, x86	MPT 1.77. An earlier version of the MPT driver may be updated with OS patch 137137-09 (SPARC) or 137138-09 (x86)
Solaris 10 5/08, SPARC	MPT 1.77. An earlier version of the MPT driver may be updated with OS patch 137137-09 (SPARC) or 137138-09 (x86)
Solaris 10 10/08, x86	MPT 1.77
Solaris 10 10/08, SPARC	MPT 1.77
Windows Server 2003, 32/64-bit	1.28.03, additional J4500 driver is required. See "Updated Driver Files Required for Windows" on page 30.

OS Supported	Minimum SG-XPCIE8SAS-E-Z HBA Driver Version Supported
Windows Server 2008, 32/64-bit	1.28.03, additional J4500 driver is required. See "Updated Driver Files Required for Windows" on page 30. Note that the Sun Common Array Manager 6.1.2 is not supported for use with data host servers running Windows Server 2008.
Red Hat Enterprise Linux (RHEL) 4.6 32/64-bit	MPT 3.16.00.00
RHEL 5.1 32/64-bit	MPT 4.16.00.00
RHEL 5.2 32/64-bit	MPT 4.16.00.00
SUSE Linux Enterprise Server (SLES) 9 SP4 32/64-bit	MPT 3.16.00.00
SLES 10 SP1 32/64-bit	MPT 4.16.00.00
SLES 10 SP2 32/64-bit	MPT 4.16.00.00

- **Sun StorageTek SAS RAID Eight-Port, External HBA** (SG-XPCIESAS-R-EXT-Z, Adaptec™-based RAID controller):

  - Installed in a free PCIe slot in supported Sun Fire and SPARC servers to provide an external connection to the J4500 array.

  - The initial firmware/BIOS version shipped with this HBA will support its use with the J4500 array. For detailed information, refer to the *Sun StorageTek RAID Manager Software Release Notes* (820-2755).

  - The initial drivers and software shipped with this HBA will support its use with the J4500 array. For a complete listing of operating system driver support, refer to the *Sun StorageTek RAID Manager Software Release Notes* (820-2755). For Windows installations, an additional J4500 array driver is required. See "Updated Driver Files Required for Windows" on page 30.

- **Sun StorageTek ExpressModule SAS 8-Channel HBA** (SG-PCIE8SAS-EB-Z, LSI-based disk controller):

  - Installed in a free PCI ExpressModule slot in a Sun blade chassis to provide an external connection to the J4500 array for supported Sun blade x64 and SPARC server modules.

  - The minimum required HBA firmware revision for J4500 array support: firmware 1.26.03.00-IT, BIOS 6.24.00.00, Fcode 1.00.49. Updates may be obtained at: http://www.lsi.com/support/sun

  - The minimum driver version for operating system support for this HBA when connected to the J4500 array is described in the following table:

OS Supported	Minimum SG-PCIE8SAS-EB-Z HBA Driver Version Supported
Solaris 10 5/08, x86	MPT 1.77. An earlier version of the MPT driver may be updated with OS patch 137137-09 (SPARC) or 137138-09 (x86)
Solaris 10 5/08, SPARC	MPT 1.77. An earlier version of the MPT driver may be updated with OS patch 137137-09 (SPARC) or 137138-09 (x86)
Solaris 10 10/08, x86	MPT 1.77
Solaris 10 10/08, SPARC	MPT 1.77
Windows Server 2003, 32/64-bit	1.28.03, additional J4500 driver is required. See "Updated Driver Files Required for Windows" on page 30.
Windows Server 2008, 32/64-bit	1.28.03, additional J4500 driver is required. See "Updated Driver Files Required for Windows" on page 30. Note that the Sun Common Array Manager 6.1.2 is not supported for use with data host servers running Windows Server 2008.
Red Hat Enterprise Linux (RHEL) 4.6 32/64-bit	MPT 3.16.00.00
RHEL 5.1 32/64-bit	MPT 4.16.00.00
RHEL 5.2 32/64-bit	MPT 4.16.00.00
SUSE Linux Enterprise Server (SLES) 9 SP4 32/64-bit	MPT 3.16.00.00
SLES 10 SP1 32/64-bit	MPT 4.16.00.00
SLES 10 SP2 32/64-bit	MPT 4.16.00.00

Installation Overview

After unpacking your array, perform the following tasks:

1. Ensure that the host server with the supported HBA is close enough to where you rack the array so that the SAS cables reach.

2. Install the J4500 array into a compatible rack using orderable slide rails.

   - "Sun Storage J4500 Array Rack Slide Rails" on page 12
   - "Compatible Racks" on page 12
   - "Tools and Staff Required" on page 13

3. Connect the SAS cable(s). See .

4. Power on the system (host and array) as follows:

    a. First, power on the J4500 array by connecting the AC power cords. See .

    b. After one minute, power on the host server.

Note – This sequence is recommended in order to limit the amount of array start up messages going to your server's event log.

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5. Create volumes and install software. Refer to your HBA and operating system software. For more on management options for your array, refer to Chapter 2.

Sun Storage J4500 Array Rack Slide Rails

The J4500 array uses the Sun X4500-J Slide Rail Kit. For information on attaching slide rails and rack-mounting the J4500 array, refer to the *Sun X4500-J Slide Rail Installation Guide* (820-7238) on the Sun documentation web site:

http://docs.sun.com/app/docs/prod/j4500.array

Compatible Racks

The X4500-J slide rails used with the J4500 array are compatible with a wide range of equipment racks that meet the following standards:

- Four-post structure (mounting at both front and rear). Note that two-post racks and two-post racks converted to four-post racks are not compatible.
- Rack horizontal opening and unit vertical pitch conforming to ANSI/EIA 310-D-1992 or IEC 60927 standards.
- Distance between front and rear mounting planes between 23 and 34 inches (580 mm and 870 mm).
- Minimum clearance depth (to front cabinet door) in front of front rack mounting plane: 1.85 inches (47 mm).
- Minimum clearance depth (to rear cabinet door) behind front rack mounting plane: 33.5 inches (851 mm) without cable management arm (a cable management arm is not included or supported with this product). The J4500 array fits best in 1000 mm racks. Sun recommends using the **Sun Rack 1000-42**, **Sun Rack 1000-38**, **Sun Rack II 1042/E**, or **Sun Rack II 1242/E** products with your X4500-J slide rails.

- Minimum clearance width between the structural supports and cable troughs: 19inches (483 mm).
- Minimum clearance width (not between structural supports and cable troughs) between front and rear mounting planes: 18 inches (456 mm).

Caution – Always load equipment into a rack from the bottom up so that it will not become top-heavy and tip over. Do not attempt to install more than eight J4500 array enclosures in a rack. Deploy your rack's anti-tilt bar to prevent the rack from tipping during equipment installation. For instructions, see the service label on the J4500 array enclosure cover or the label on the rack.

Tools and Staff Required

- #2 Phillips screwdriver, 10 inches, magnetic tip recommended
- Mechanical lift is highly recommended. The J4500 array can weigh up to 170 pounds (77 kg)
- Level (carpenters spirit or bubble)

Staff Required

At least *three* people are needed to install the J4500 array into the rack:

- Two to install the array enclosure and operate the lift
- A spotter to ensure rails are engaged correctly

Caution – This assumes a mechanical lift is used. If a mechanical lift is not available, the array enclosure must be depopulated of most components as described below.

Removing Components to Reduce Weight

If a lift is not available, remove the following components to reduce the weight:

- Both power supplies
- System controller
- Hard disk drives in slots 0 to 47 (Sun recommends that you label any hard drives with data before you remove them and make sure they are replaced in the same slot that they are removed from (refer to the service label on the top cover for bay slot numbers)

■ Do not remove the fan trays

⚠ **Caution –** Once components have been removed, do NOT attempt to lift the chassis at these openings, as the sheet metal might deform. Use the lifting handles on the sides of the chassis.

Configuration and Cabling

The J4500 array can be connected to one or more supported HBAs (Host Bus Adapters) in single or multipath configuration. The rules for connecting the J4500 array are described in this section.

Term Definitions

There are several terms used in this document that you will need to become familiar with to better understand J4500 array configuration options:

TABLE 1-5 Sun Storage J4500 Array Configuration Terms and Definitions

Term	Definition
HBA	Host bus adapter (also called an initiator) is disk controlling circuity embedded on a server's motherboard, or optional expansion card used to control a set of disks. Some HBAs support hardware RAID (Redundant Array of Independent Disks), which is configured by the HBA software and provides redundancy in the event of a disk failure.
SAS target	A device containing logical units and target ports that receives requests from, and responds to, an initiator. An example of a target device is a hard disk. Other terms used to describe a SAS target are "device" and "end device." In multipath configurations, each hard disk is seen by the HBA as two targets.
SAS fabric	A SAS fabric is conceptually similar to a network segment. A SAS fabric is made up of an initiator, targets, and a set of linked expanders that work like network switches linking end point devices (intitiators and targets) together as a discreet storage system. The J4500 array uses a dual fabric scheme with a primary SAS fabric "A" and a secondary, redundant SAS fabric "B". A fabric can be expanded by daisy-chaining additional J4500 arrays. There are two 4-lane (or x4) connector ports (Port 0 and Port 1) per fabric. Each connector port links to all 48 disks.

Term	Definition
Single path configuration	This is a single path connection from a host to a one of the array's SAS fabrics (A or B). No path redundancy is available.
Multipath configuration	This is a dual path connection from a host to both of the array's SAS fabrics (A and B). Provides two paths to the array's disks and uses the redundant SAS fabric capability of the array for failover.
Daisy-chaining (or cascading)	A method for linking several J4500 arrays together to increase the amount of available disks to the host. When cascading multiple arrays using a multipath configuration, Sun recommends cascading the host links in opposite directions from the edge of the SAS fabrics to prevent a single array failure from preventing access to other arrays in the cascade.
Zoning	Zoning is a configuration method that takes the available connected storage and allows each host to have its own storage resources. Zoning is done on a per hard disk level and hard disks owned by one host cannot be accessed by other hosts. Sun Common Array Manager (CAM) version 6.4.1 software is required to perform host initiator-to-disk access configuration (zoning).

Configuration Rules

Before attaching cables to the J4500 array, read through the following configuration rules:

General Rules

- The array enclosure drive bays must be fully populated. All 48 SATA hard disk drives must be present and the same size. Do not mix drive capacities in the array enclosure; however you could, for example, have one J4500 populated with 750 GB SATA drives and a daisy-chained J4500 array with 1 TB SATA drives. The J4500 array does not support SAS drives.

- The mini-SAS connector ports are configured as follows: **Port 0** uses subtractive or direct routing (indicated by the circle above the connector, see FIGURE 1-5) and connects to upstream devices (either an HBA, or an upstream J4500 array). **Port 1** is universal (indicated by the diamond and circle icons), using table and direct routing, and connects to either an upstream HBA or a downstream J4500 array.

- Use only supported mini-SAS x4 cables (SFF-8088). There are two cables included with the array. Refer to the *Sun Storage J4500 Array Service Manual* (820-3160) available on the Sun documentation web site for additional cable options http://docs.sun.com/app/docs/prod/j4500.array. Maximum cable lengths between devices is 6 meters. Using non-Sun certified cables or longer cables is not supported.

- Do not cross connect an array enclosure's SAS fabrics. **The SAS A ports of an array enclosure must not be cross connected to its SAS B ports**.

Caution – Cross connecting the SAS fabrics of a J4500 array (connecting its SAS A ports to its SAS B ports) can cause the HBA to be unable to properly identify or access drives in the array which could lead to data loss.

Connecting Host Bus Adapters (HBAs)

HBAs can be connected to a J4500 array as follows:

- Use only supported HBAs with the array. At the publication of this document, supported HBAs for use with your array product are:
  - Sun StorageTek SAS RAID Eight-Port, External HBA (SG-XPCIESAS-R-EXT-Z, Adaptec™-based RAID controller). **Single path configurations only.**
  - Sun StorageTek PCI Express SAS 8-Channel External HBA (SG-XPCIE8SAS-E-Z, LSI™-based disk controller). **Single or multipath configurations supported.**
  - Sun StorageTek ExpressModule SAS 8-Channel External HBA (SG-PCIE8SAS-EB-Z, LSI-based disk controller). **Single or multipath configurations supported.**

  An updated list of supported HBAs is maintained in the *Sun Storage J4500 Array Product Notes* (820-3162) available on the Sun documentation web site http://docs.sun.com/app/docs/prod/j4500.array.

- A single path configuration consists of a single SAS cable connecting a single HBA to one of the array's SAS fabrics, either A or B.

- A multipath configuration consists of connections to both of the J4500 array's SAS fabrics, A and B, using one or more HBAs in order to create a dual path. More on configuring your array for multipathing can be found in Chapter 4.

- Configuring zoning of the array storage is currently only available using the Sun Common Array Manager (CAM) through an LSI-based HBA connected to the array. For more information on zoning, see Chapter 3.

Connecting Multiple Sun Storage J4500 Arrays

J4500 arrays can be **daisy-chained**, or **cascaded**, together as follows:

- The maximum number of arrays that can be daisy-chained together is limited by the number of SAS targets (also called "devices" or "end devices") supported by the attached HBA. Check the HBA's documentation to see how many SAS targets are supported. Also see "SAS Target Limits" on page 17.

- In single path configuration, arrays may be cascaded from **Port 1 (out)** of the upstream array to **Port 0 (in)** of the downstream array. Array cascade port connections must be of compatible types (for example, **no array cascading from Port 1-to-1, Port 0-to-0, or Port 0-to1**).

- In a multipath configuration (creating a dual path by utilizing both SAS fabrics), Sun recommends cascading the host links in opposite directions from the edge of the SAS fabric. For example, the first host connection goes to the top of the SAS A fabric and cascades down, while the second host connection goes to the bottom of the SAS B fabric and cascades up. Array cascade port connections must be of compatible types (for example, **no array cascading from Port 1-to-1 or Port 0-to-0**). For more on configuring for multipathing, see Chapter 4.

- **Do not mix a J4500 array with any other type of JBOD array in a daisy-chain.** Check the Sun Storage J4500 Array Product Notes (820-3162) for updated configuration information.

SAS Target Limits

To ensure a given configuration of J4500 arrays does not exceed the HBA's **target limit**, the following rules apply:

- For single path configurations, each hard disk visible to an HBA consumes one target.

- For multipath configurations, each hard disk visible to an HBA consumes two targets.

- Each expander visible to an HBA consumes three targets. There are two expanders per SAS fabric in the array.

- When zoning is being used on array storage, there must be a host that runs the zoning manager. This host must be able to communicate with all targets in the system. This means that the number of targets seen by the zoning host's HBA(s) must not exceed the target limit for that HBA.

- Refer to your HBA documentation to find out how many targets it can support. Targets might also be called "devices" or "end devices."

Configuration with Blade Servers

For Sun Blade Server Modules, the same configuration rules listed above for J4500 arrays apply with the following blade-specific rules:

- An array may be connected to a Sun Blade Server Module in **single path** or **multipath** configuration using a supported SAS PCIe ExpressModule HBA that includes SAS x4-wide connectors. An updated list of supported HBAs are maintained in the *Sun Storage J4500 Array Product Notes* (820-3162) available on the Sun documentation web site.

- The array may not be connected to a SAS NEM in the chassis (a Network Expansion Module that includes external SAS connectors). A server blade may also have its own set of drives and expanders, or be connected to a storage blade and already be using the SAS NEM. This can limit the number of available SAS targets supported by the blade server's internal HBA. Therefore, the J4500 array should only be connected to a supported SAS PCIe ExpressModule HBA that is used exclusively to connect external SAS devices.

Cabling the SAS Connectors

The following figure shows the SAS connector ports for cabling J4500 array to your server's HBA. Before cabling a J4500 array to your server's HBA, refer to the "Configuration Rules" on page 15.

FIGURE 1-5   Sun Storage J4500 Array Back Panel SAS Ports
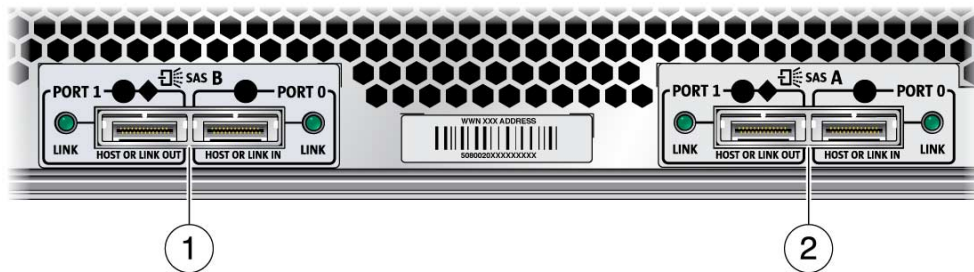
Figure Legend

1	SAS B (secondary fabric)
2	SAS A (primary fabric)

The J4500 array has two SAS fabrics: SAS A (primary) and SAS B (secondary). Each connector port on both fabrics connects to all 48 disks. SAS B is a redundant fabric. SAS port descriptions and assignments are shown in FIGURE 1-6.

Examples of supported configurations can be found in "Example Configurations" on page 19.
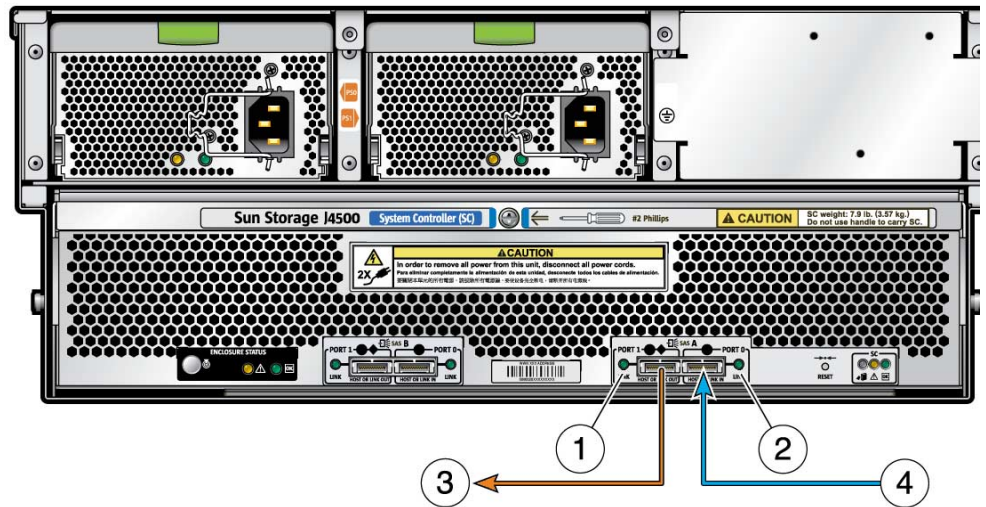
Figure Legend

1	SAS Port 1 (4 PHYs, activity LED, supports direct or table routing)
2	SAS Port 0 (4 PHYs, activity LED, supports direct or subtractive routing)
3	Port 1 connects to an HBA, or to a downstream J4500 array
4	Port 0 connects to an HBA, or from an upstream J4500 array

Example Configurations

This section includes examples of supported single path and multipath configurations for your J4500 array.

Single Host Direct Connection

FIGURE 1-7 shows a simple host to array connection. In this configuration, the host connection can be to any port, either SAS fabric.

FIGURE 1-7 Single Host to Array Connection
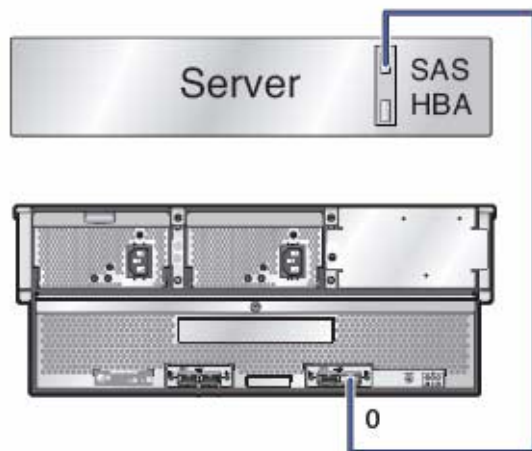
Single Host With Cascaded Arrays

FIGURE 1-8 shows a host with two cascaded arrays. In this configuration, the cascaded arrays consume a total of 108 SAS targets (96 disk targets and 12 expander targets). All of the supported HBAs for the J4500 array can support this number.

FIGURE 1-8 Host to Cascaded Arrays
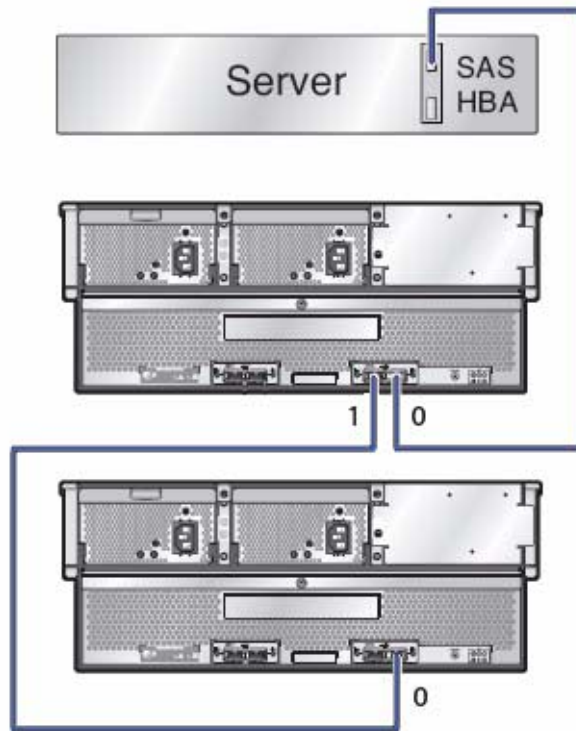
Single Host Direct Connection to Two Arrays

FIGURE 1-9 shows a host with two cascaded arrays. In this configuration, the two arrays also consume a total of 108 SAS targets (96 disk targets and 12 expander targets). All of the supported HBAs for the J4500 array can support this number.

FIGURE 1-9   Host with Two Direct-Connected Arrays
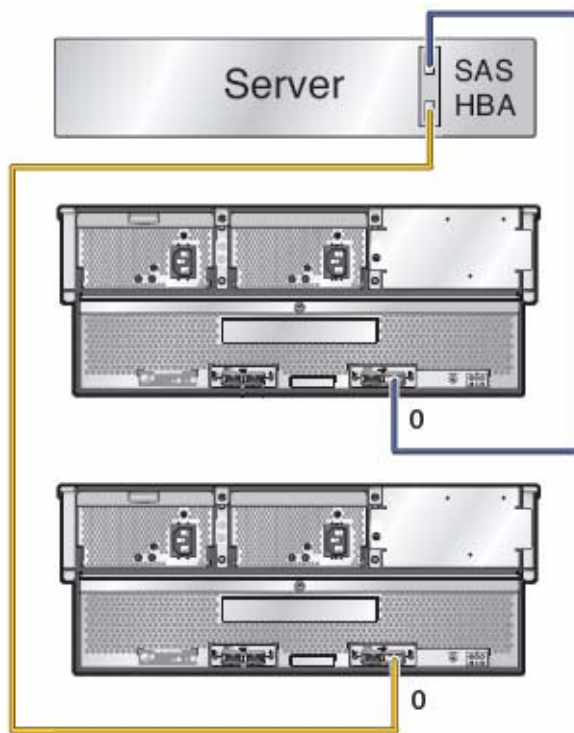
Multipath Connection to the Array

FIGURE 1-10 shows an example of multipath cabling using one host, two HBAs and two cascaded arrays. Note that the host links are cascaded in opposite directions from the edge of the SAS fabric so that if one array enclosure fails, there is still host access to the working array enclosure. This configuration supports zoned storage and failover. For more information on configuring multipath, see Chapter 4.

FIGURE 1-10 Host with Multipath-Connected Arrays
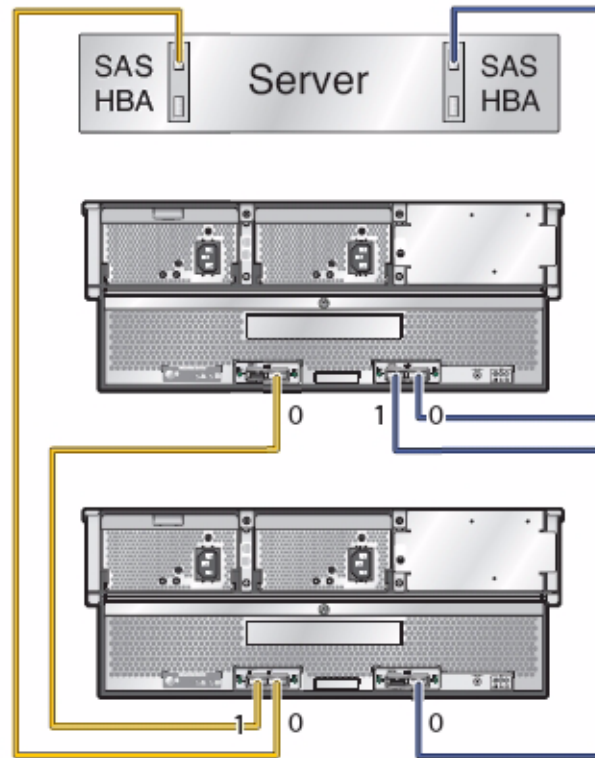
Multi-host Zoned Connection to the Array

FIGURE 1-11 shows a color-coded example of four hosts connected in single path configuration to an array. In this configuration, the storage in the array has been separated into four zones. Each host (indicated by a separate cable color) can only see the disks in its assigned zone. In this configuration, each of the hosts must have the Sun Common Array Manager (CAM) proxy agent installed and running, or one of the hosts can act as the CAM management host while the others run the proxy agent. The CAM management host is used to configure and manage zones on the array. For more information on configuring zoning, see Chapter 3.

FIGURE 1-11 Four Hosts Directly Connected to a Zoned Array
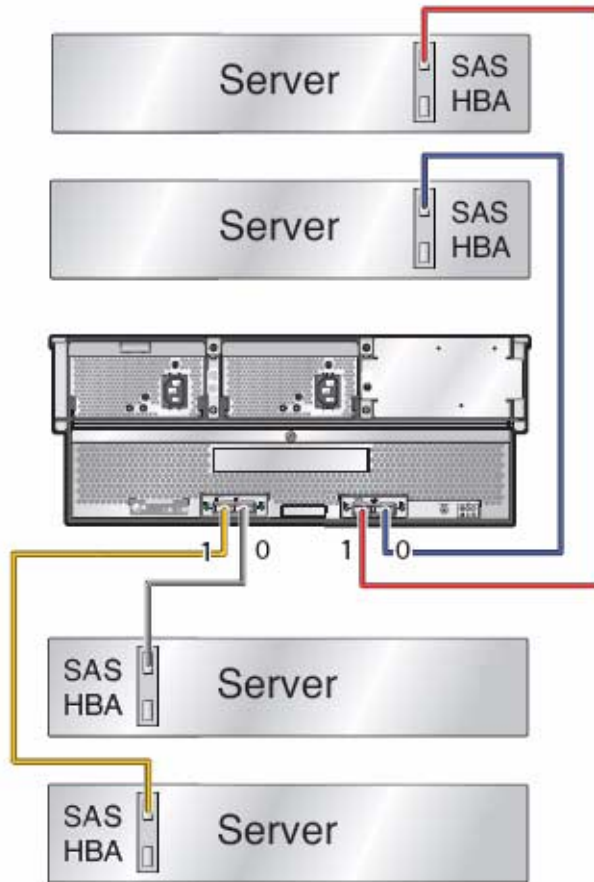
Powering On and Off the Array

The J4500 array has two levels of power: standby power and main power. The initial setup of the array should be done before plugging in AC power. The procedures for powering on to main power mode and going from main power mode to standby power mode are included in this section.

Caution – Do not operate the array enclosure without all fans, component heatsinks, air baffles, and covers installed. Severe damage to array components can occur if the enclosure is operated without adequate cooling mechanisms.

▼ To Power On the Array

The proper power-up sequence for a system connected to the J4500 array is to first power on the array, wait one minute, then power on the host server. This wait time allows all 48 array hard disk drives to power up to the point where the server can see them and helps reduce the number of start-up device link messages saved to the server's log file.

To apply main power to the array, do the following:

1. **Connect two grounded AC power cords to the two AC power supply connectors at the back of the array enclosure.**

2. **Then connect the other ends of the two AC power cords to grounded AC (110-220 VAC) power outlets.**

   Connecting the AC power cords to the array automatically applies main power to the array. In main power mode, the array Power/OK LED next to the Power button lights and remains lit.

Note – See the service label on the hard disk drive access cover for an explanation of the LEDs on the hard disk drives, fans, power supply, and system controller. Or, refer to the *Sun Storage J4500 Array Service Manual* (820-3160) on the Sun documentation web site http://docs.sun.com.

▼ To Place the Array Into Standby Power Mode

The front panel power button is used to switch the array from main power to standby power (or from standby power back to main power). Standby power mode leaves the power supplies partially on, but powers down the array hard disks, SAS expanders and SAS links.

1. **To switch the array enclosure from main power mode to standby mode, use a stylus to press and hold in the power button on the front panel (see** FIGURE 1-3**) for 5 or more seconds (during which the locate LED will flash).**

   As the enclosure enters standby power mode, the Power/OK LED on the front and back panel blinks, indicating that standby power mode is working. For the power LED location, see FIGURE 1-3 and FIGURE 1-4.

2. **Release the power button on the front panel.**

   With AC power connected, the array takes about 10 seconds to go fully into standby power mode.

Caution – To power off the array completely, you must disconnect the AC power cords from the power supplies at the back of the array enclosure. It takes a full 20 seconds with the AC power cords unplugged for internal power to be completely drained from the enclosure.

---

3. **To reapply main power to the array from standby power mode, use a stylus to press and release the recessed Power button on the array front panel. See** FIGURE 1-3**.**

   When main power is applied to the array, the Power/OK LED next to the Power button lights and remains lit.

▼ To Power Off the Array

To power off the array completely, you must disconnect the AC power cords from the power supplies at the back of the array enclosure. The power switch is only used for switching the array to standby power mode, or to main power from standby power mode. Do the following to power off the array:

- **To completely power off the array, disconnect the two AC power cords from the power supplies at the back of the enclosure.**

  It takes a full 20 seconds with the AC power cords unplugged for the internal power to be completely drained form the enclosure.

AC Power Failure Auto-Recovery

If AC power is temporarily lost to the array, for example if the municipal power grid experiences an outage, the array automatically restarts to main power mode when power is restored. No user intervention is required.

The same behavior occurs if you disconnect the AC power cords from the back of a powered-on array and then reconnect them.

Software Overview

This chapter describes the software available for managing your Sun Storage J4500 array. It includes the following sections:

Operating System Support

Operating system support for your J4500 array is dependant on the supported Host Bus Adapter (HBA). The HBA typically includes drivers required for the HBA to work in the supported operating system environment. If the HBA includes hardware

RAID support, instructions to configure hardware RAID support for your array will be included with the HBA. Refer to your HBA documentation for a list of supported operating systems and RAID solutions.

An up-to-date list of supported HBAs is listed in the *Sun Storage J4500 Array Product Notes* (820-3162) available on the Sun documentation web site http://docs.sun.com/app/docs/prod/j4500.array.

Updated Driver Files Required for Windows

If your J4500 array is connected to a server running Microsoft Windows Server 2003 or 2008, you need to download and install an updated driver package for Windows Device Manager to properly recognize the array. Go to the Sun software download site:

http://www.sun.com/download/index.jsp

Click on the **View by Category** tab, and then choose **Systems Administration > Storage Management** and look for the appropriate J4500 array downloadable package.

Clustering Software Not Supported With the J4500 Array

Clustering is not supported with the J4500 array. For the latest information on operating system support, refer to the *Sun J4500 Array Product Notes*.

Array Management Overview

Management of your array is done at two levels: disk management and enclosure management. Tasks done through the OS or HBA to create volumes, disk spares, view logged disk errors, mount and unmount disks, replace faulty disks are examples of disk management. Tasks done through a SES management tool to monitor the health of the array, check device status, obtain FRU information, update firmware and receive alerts are examples of enclosure management.

The following sections describe the various options for managing your J4500 array.

Management Term Definitions

There are several terms used in this chapter that you will need to become familiar with to better understand J4500 array enclosure management processes:

TABLE 2-1   Management Terms and Definitions

Term	Definition
In-Band	In-Band management uses the primary data path (the SAS link) between a host and storage device for management traffic.
Out-of-Band	Out-Of-Band management occurs over an Ethernet network outside of the primary data path between the host and storage device. Other types of out-of-band management for the array would include using the array's physical indicators and controls to perform tasks such as enclosure reset and component fault isolation using the array LEDs.
SES	SCSI Enclosure Services. Allows HBA or enclosure management software that supports SES to monitor and control the array enclosure using the in-band SAS signal. Managed SES elements include hard disks, chassis LEDs, and temp and voltage sensors. SES processes run on the array expanders and are used to execute diagnostic commands from the management software. The J4500 array supports SES-2.
SMP	SMP (Serial Management Protocol). In addition to SES, a management client can use SMP to perform enclosure management functions in-band over the SAS links. It provides for management of the array enclosure including hard disk and chassis LEDs, storage zoning, and temperature and voltage sensors.
Polling	The duration of time between component status updates to the management client.
Alert (or event)	A change in the state of a device (hard disks, enclosure temperature, etc.). Alerts include a severity level to describe informational, non-critical, critical and unrecoverable device status. Alerts are displayed on the management client or an alert notification may be received by email.
FRU	Field Replaceable Unit. These are replaceable parts, such as power supplies, hard disk drives and fans that may be monitored for faults. If they fail, these parts can be replaced. Most can be replaced without completely removing the enclosure from the rack. Note that all FRUs in the J4500 array are also CRUs (Customer Replaceable Units).
Disk management	Tasks done through the OS or HBA to create volumes, view logged disk errors, mount and unmount disks, replace faulty disks.
Enclosure management	Tasks done through the management tool to monitor the health of the array enclosure, check device status, obtain FRU information, receive alerts, update firmware, configure storage zoning, reset the enclosure.

About Enclosure Management

Your J4500 array supports a powerful set of enclosure management features accessible from a management client that supports SES-2 (SCSI Enclosure Services) and SMP (Serial Management Protocol). Some or all of these features are available through supported management software, such as the Sun Common Array Manager (CAM), or the Sun StorageTek RAID Manager software. These features provide a system administrator at the array-connected server or network-connected management client the following capabilities:

- Utilize tools and functions independent of HBA, using the server's generic SCSI driver
- Monitor the enclosure status (on/off line status, component health)
- Monitor the enclosure environment (voltage and temperature)
- Remotely identify and locate enclosure components
- Obtain Field Replaceable Unit (FRU) identification and status (hard disks, fans, power supplies)
- Remove and install FRU components
- Remotely reset the enclosure
- Remotely upgrade enclosure firmware (expanders and hard disk—must use CAM)
- View the enclosure event log to aid in troubleshooting
- Receive email alert notification

Array Management Options

The options available for managing your array depend on the capabilities of the connected HBA and supported management software. System administrators might need to use a mix of tools to manage all aspects of the array.

Basic management options available for your J4500 array when connected to a supported HBA are shown in the following sections.

- "Management Options When Using the StorageTek SAS RAID External HBA (Adaptec-Based)" on page 33
- "Management Options When Using the StorageTek SAS External HBA (LSI-Based)" on page 34

Management Options When Using the StorageTek SAS RAID External HBA (Adaptec-Based)

The Sun StorageTek SAS RAID External HBA (SG-XPCIESAS-R-EXT-Z, RAID controller) includes StorageTek RAID Manager software and a Command Line Interface (arcconf). Your management options are:

- **Disk management** is available through the Sun StorageTek RAID Manager and allows you to perform tasks such as hardware RAID volume creation (at HBA BIOS or OS level), disk error logging, disk removal and replacement.

- **Enclosure management** is available through the Sun StorageTek RAID Manager or CLI and allow you to perform tasks such as monitoring component status, configuring email alert notification, obtaining FRU identification, performing fault isolation and upgrading HBA firmware. Additional enclosure management tasks available through CAM include upgrading array firmware, resetting the enclosure, and resolving problems using Service Advisor and Sun Auto Service Request (see "Using the Common Array Manager Software" on page 35).

The following table lists the basic tasks you can perform with each management tool.

TABLE 2-2   StorageTek SAS RAID External HBA Management Option Tasks

Option/Task	CAM	RAID Manager	OS (Using arcconf)
Disk Management:			
HBA-hardware RAID configuration (support for RAID levels 0, 1, 10, 1E, 5, 6, 50, 5EE, and 0)		X	X
Local and remote disk management		X	X
HBA firmware upgrade		X	X
Enclosure Management:			
Event and fault monitoring	X	X	X
Email alert notification	X	X	
FRU identification and status	X	X	X
Enclosure reset	X		
Array firmware upgrade	X		

Option/Task	CAM	RAID Manager	OS (Using arcconf)
Fault isolation	X	X	X
Service Advisor wizard for problem resolution	X		
Sun Auto Service Request (ASR) uses fault telemetry 24/7 to automatically initiate a service request and begin the problem resolution process as soon as a problem occurs	X		

Management Options When Using the StorageTek SAS External HBA (LSI-Based)

When using the Sun StorageTek SAS External HBA (SG-XPCIE8SAS-E-Z) or Sun StorageTek ExpressModule SAS External HBA (SG-PCIE8SAS-EB-Z) with your J4500 array, your management options are:

- **Disk management** is available through the operating system and allows you to perform tasks such as disk volume creation, disk error logging, disk removal and replacement.
- **Enclosure management** is available through CAM and allows you to perform tasks such as monitoring component status, configuring email alert notification, obtaining FRU identification, upgrading array firmware, zoning storage resources, resetting the enclosure, resolving problems using Service Advisor and Sun Auto Service Request (see "Using the Common Array Manager Software" on page 35).

The following table lists the basic tasks you can perform with each management tool.

TABLE 2-3   StorageTek SAS External HBA Management Option Tasks

Option/Task	CAM	OS (Using Driver)
Disk Management:		
OS-based software RAID configuration (Solaris, Windows, Linux). For Solaris 10 OS or OpenSolaris ZFS with RAID-Z, there is support for RAID levels 0, 1, 5 and 6. For other operating systems, refer to your OS documentation for supported RAID levels.		X
Local and remote disk management		X
HBA firmware upgrade		X (HBA utility)

Option/Task	CAM	OS (Using Driver)
Enclosure Management:		
Event and fault monitoring	X	
Email alert notification	X	
FRU identification and status	X	
Array storage zoning	X	
Enclosure reset	X	
Array firmware upgrade	X	
Fault isolation	X	
Service Advisor wizard for problem resolution	X	
Sun Auto Service Request (ASR) uses fault telemetry 24/7 to automatically initiate a service request and begin the problem resolution process as soon as a problem occurs.	X	

Using the Common Array Manager Software

The Sun StorageTek Common Array Manager (CAM) software suite is your main tool for Sun Storage array enclosure management, monitoring, and service capabilities. The software has both a secure browser interface and a command-line interface (CLI). CAM is supported for use with Solaris, Linux and Windows platforms.

Viewing Sun Storage J4500 Array Information With CAM

CAM provides both a browser and command line interface. When using the browser interface, you set up user accounts to manage your array storage. When an authorized user logs in, information is laid out in pages. A handy navigation tree lists available information, see FIGURE 2-1.

FIGURE 2-1 Example CAM Summary and FRU Information for the J4500 Array
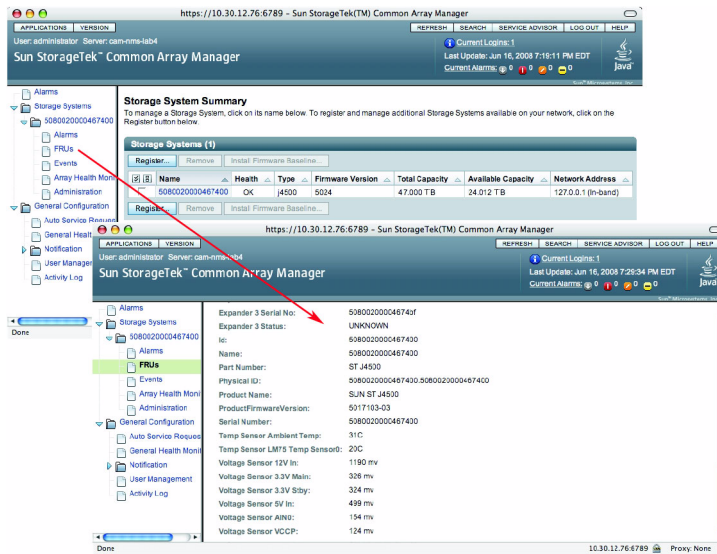
Use the navigation tree to move among pages within an application. You can click a link to get details about a selected item (such as alarms, FRUs, events, array health). You can also sort and filter information displayed on a page. When you place your pointer over a button, tree object, link, icon, or column, a tooltip provides a brief description of the object.

Information about using CAM the web interface or CLI is available on the Sun documentation web site. Refer to the appropriate version of CAM documentation for complete details about installing and using CAM:

http://docs.sun.com/app/docs/prod/stor.arrmgr#hic

Problem Resolution

CAM provides two helpful tools for resolving problems that might occur with the array:

- Auto Service Request (ASR) monitors the array system's health and performance and automatically notifies the Sun Technical Support Center when critical events occur. Critical alarms generate an Auto Service Request case. These notifications enable Sun Service to respond faster and more accurately to critical on-site issues.

To use ASR, you must provide Sun online account information to enroll your CAM software to participate in the ASR service. After you enroll CAM with ASR, you can choose which arrays you want to be monitored and enable them individually.

■ Service Advisor is a troubleshooting wizard that provides information and procedures for replacing array components.

Zoning Array Storage Resources Using CAM

Starting with CAM 6.4.1, support for zoning of J4500 array storage has been added. Zoning is a configuration method that takes the available connected storage and allows each host to have its own storage resources. Zoning is done on a per host, per hard disk level. Zoning allows for storage resource segregation, controlled resource sharing, protection, and topology control. The Sun Common Array Manager (CAM) is required to configure the J4500 storage for zoning.

For more information about zoning array storage resources, see Chapter 3.

Upgrading Sun Storage J4500 Array Firmware Using CAM

The J4500 array enclosure contains upgradable firmware. You may want to upgrade the enclosure firmware to:

■ Install the latest bug fixes and performance enhancements
■ Add new features and capabilities as they become available

The Sun Common Array Management (CAM) software provides firmware upgrade capabilities for the J4500 array connected to any supported HBA. For more information on using the CAM software, refer to the appropriate version of CAM documentation:

http://docs.sun.com/app/docs/prod/stor.arrmgr#hic

Ensure Both SAS Fabrics are Upgraded to the Same Firmware Revision Level

The J4500 array enclosure contains two SAS fabrics (A and B). Each fabric has its own set of SAS expanders. The firmware upgrade process is only performed on the fabric with the active SAS link to the HBA. When upgrading array enclosure firmware, Sun recommends that you upgrade firmware on both SAS fabrics to ensure they are at the same revision level.

This will require you to take the following steps:

1. Using CAM, perform the upgrade on the enclosure's primary SAS fabric.

2. Then, at a convenient time, move the SAS cable to the enclosure's secondary SAS fabric.

   When performing this action, allow time between the removal of the link from the primary fabric and the reconnection to the secondary fabric for your HBA to recover from the lost and then re-established SAS link. Depending on the HBA, this can take up to 3 minutes for each link state change. For example, wait 3 minutes after the SAS cable is disconnected for the HBA to confirm that the link is lost; wait 3 minutes after the SAS cable is connected for the HBA to discover the drives.

3. Using CAM, perform the upgrade on the enclosure's secondary SAS fabric.

4. Repeat steps 1-3 on any daisy-chained J4500 array.

Obtaining CAM Software

Support for the J4500 array is available starting with CAM version 6.1.2; support for zoning is available with CAM version CAM 6.4.1. To obtain the latest CAM software (which includes J4500 array firmware), go to the

Sun software download site
(http://www.sun.com/storagetek/management_software/resource_management/cam/get_it.html)

.

Refer to the appropriate version of CAM documentation for complete details about installing and using CAM.

http://docs.sun.com/app/docs/prod/stor.arrmgr#hic

Using the StorageTek RAID Manager Software

The Sun StorageTek RAID Manager is included with the StorageTek SAS RAID External HBA (SG-XPCIESAS-R-EXT-Z, Adaptec-based RAID controller). It provides a GUI and a command line interface. In addition to RAID volume management, it supports SES-2 component monitoring and status, email alerts, FRU identification, fault isolation and HBA firmware upgrade.

You can compliment enclosure management with the additional capabilities available using CAM, such as array firmware upgrade, enclosure reset, the Service Advisor wizard and Sun Auto Service Request for problem resolution (see "Using the Common Array Manager Software" on page 35).

Information about using the Sun StorageTek RAID Manager is available with the HBA documentation on the Sun documentation web site:

http://docs.sun.com/app/docs/prod/j4500.array

Viewing Sun Storage J4500 Array Information With the Sun StorageTek RAID Manager

After connecting your J4500 array, configuring RAID volumes and installing the StorageTek RAID Manager software, starting the software will display the main window, shown in FIGURE 2-2. The main window depicts the array enclosure topology as interpreted by the HBA and shows an HBA with two daisy-chained J4500 arrays connected to it.

FIGURE 2-2 Sun StorageTek RAID Manager Main Window
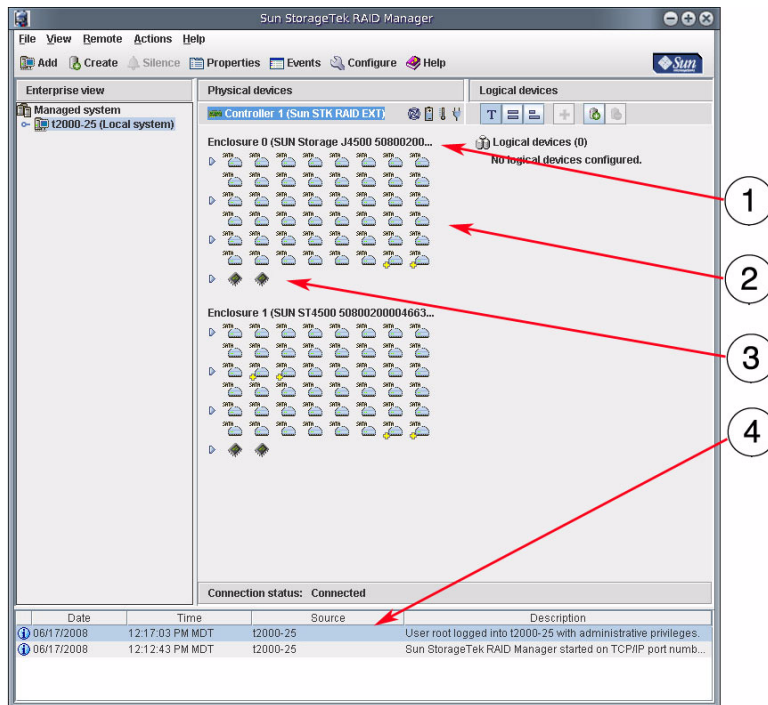
Figure Legend

1	Enclosure identifier and SAS ID (unique WWN number found on the back of the enclosure)
2	Enclosure disks (48)
3	Enclosure management devices (represent the outside and inside SAS expanders)
4	Enclosure event viewer

The J4500 array is represented as an enclosure with 48 disks. Disks are listed in the StorageTek RAID Manager main window from left to right and top to bottom, starting with the lowest number found in each enclosure.

The enclosure management device icons represent the two SAS expanders linking to all 48 disks (refer to FIGURE 1-1):

- One expander links to array disks 0-19 and supplies enclosure status information
- The other expander links to array disks 20-47

In addition to disk management, you can use the StorageTek RAID Manager software to obtain status information about the enclosure. This includes information on voltages, temperature, and the status of enclosure power supplies and fans. In the J4500 array, enclosure status information is provided by through the outside expanders (expander 0 for SAS fabric A, and expander 2 for SAS fabric B).

To view enclosure status information, double-click the enclosure management device icon for the array's outside expander, and then click the Status tab. See FIGURE 2-3.

Note – The array's outside expanders, which include the enclosure management information, always link array disks 0-19.

FIGURE 2-3 Displaying Array Enclosure Status
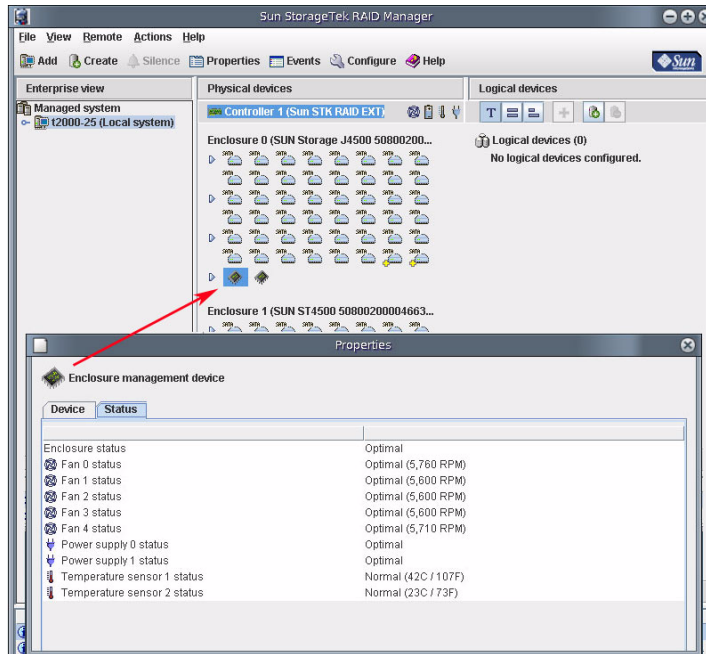
Multiple Array Identification

If you have two J4500 arrays daisy-chained it might be difficult to tell one from the other unless you have the two arrays configured differently. During boot, the HBA will create a map of the attached arrays (one of the array's will be mapped as enclosure 0 and the other array will be mapped as enclosure 1), but the order in which enclosures are found might change after a system (host and array) power cycle.

One way to tell one enclosure from another is with the unique WWN number listed in the enclosure identifier. This WWN number matches what's on the WWN label at the back of the enclosure.

In a situation where you have multiple systems and arrays, you can use the StorageTek RAID Manager's blink enclosure feature available by right-clicking on the enclosure management icon (see FIGURE 2-3). This lights the Locate LED on the front and back of the array (see FIGURE 1-3). Then, use the enclosure's internal fault indicators to identify components requiring service.

Adding and Zoning Array Storage Using CAM

This chapter describes how to zone storage resources between multiple hosts and add (cascade) additional array storage to your Sun Storage J4500 array. It includes the following sections:

Overview of Zoning

Starting with the Sun StorageTek Common Array Manager (CAM) 6.4.1, support for Access Configuration (also known as "zoning") of the Sun StorageTek J4000 array series (J4200, J4400, and J4500) has been added. Through CAM Access Configuration, you can assign each host (and each initiator in a host) its own storage resources. Accomplished on a per host initiator (HBA) port, per hard-disk level basis, Access Configuration offers the following benefits: storage resource segregation, controlled resource sharing, protection, and topology control.

FIGURE 3-1 shows a color-coded example of how you might divide the array storage among multiple hosts using zoning. Four connected hosts (on the left), each has exclusive ownership of a specific set of disks allocated to their zone (as indicated by the matching color disks shown in the open cover view of the array on the right). Disks may be zoned in a single array or across cascaded arrays.

FIGURE 3-1 Sun Storage J4500 Array with Zoned Storage
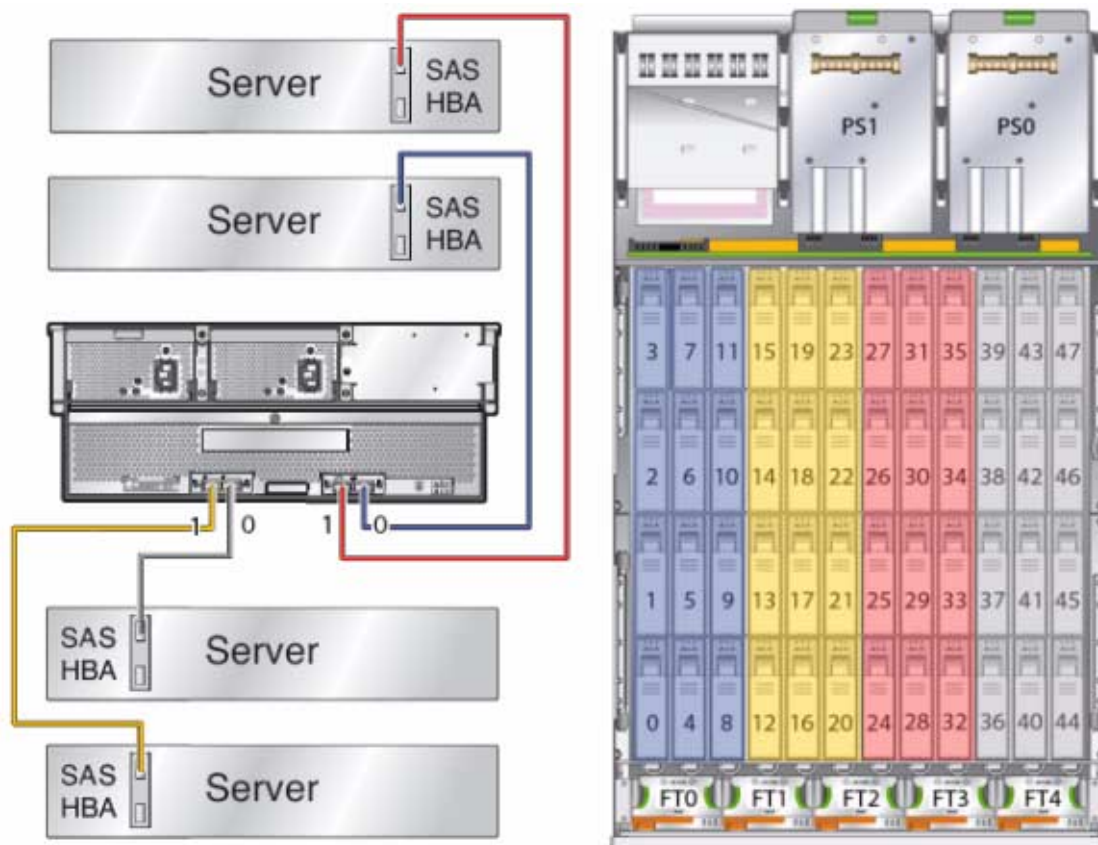
The dual SAS fabric design of the J4500 array (SAS A and B) is seen in CAM as two separate SAS domains. These domains are zoned separately. In a multipath situation, where you want two initiators to have access to the same disks for failover, each domain, or path, must be configured identically in CAM. CAM provides zoning templates to aid the user in setting up the appropriate configurations, as well as the ability to import and export user-defined templates.

Note – For multipath failover support with zoned disks, you will need to perform Access Configuration in CAM first, and then enable the appropriate multipath driver for your operating system. For information on enabling a multipath driver, refer to Chapter 4.

FIGURE 3-2 shows a zoned configuration of the J4500 array's 48 disks with host 1 owning the even number disks, and host 2 owning the odd numbered disks.

FIGURE 3-2 Two Hosts With Zoned Disks in CAM

> ⚠ **Caution –** In a multipath failover configuration, granting multiple hosts access to the same disks is not supported. Only single host, multi-initiator access is allowed.

System Requirements

The minimum CAM software, J4500 array firmware and HBA requirements for zoning are:

- CAM version 6.4.1 must be running on the CAM management host or CAM data host (running CAM proxy agent software) and be directly connected to the J4500 array.

- A supported LSI-based HBA (SG-XPCIE8SAS-E-Z or SG-PCIE8SAS-EB-Z) with the minimum required firmware must be installed in the CAM management or data host and be directly connected to the J4500 array.

- J4500 array(s) to be zoned must have a minimum array enclosure firmware version of 5.03.73.

> **Note –** At a minimum, CAM 6.4.1 must be used to upgrade the J4500 firmware to baseline. The two SAS fabrics (SAS A and B) on the J4500 array must be at the same firmware level. Each SAS fabric must be upgraded separately. See "Upgrading Sun Storage J4500 Array Firmware Using CAM" on page 37.

Access Configuration (Zoning) Guidelines

Use the following guidelines when configuring access for array storage resources, whether you are performing an initial setup, or adding to an existing setup.

Make a note of the following:

- **SATA affiliation.** The J4500 array uses SATA drives. When SATA drives are used, an affiliation (dedication) to the initiator (HBA port) is automatically created. This complies with the SATA protocol and is point-to-point in nature. If multiple initiators are attached to a single SAS fabric (either SAS A or B), the drive-to-initiator affiliation will be arbitrarily chosen which can create potential issues. To avoid issues with SATA affiliation, when using the CAM Access Configuration feature to configure array storage access between initiators and drives, the following rules apply:
  - In a configuration that includes multiple array-connected hosts, all Access Configuration changes must be done from a designated primary host. The primary host can be either an array-connected server with a full version of CAM installed, or a combination of a network-connected Management station and a single CAM proxy server (designated as the primary host) directly connected to array storage.
  - Use the primary host to perform Access Configuration for both the primary host and additional host initiators. CAM proxy agents on the additional hosts must be either unregistered or uninstalled until Access Configuration is complete for all initiators (from any connected host) using the primary host.
  - Until the CAM Access Configuration is complete using the primary host, do not run commands or other I/O on other array-connected hosts which might attempt to access the attached storage.
  - If you move an initiator connection from one array port to another on the array, any access configurations that were previously created must be recreated (or imported from a saved file) for that initiator.

- **Using Linux hosts.** When using Linux hosts, if you add or remove array disks either physically, or through CAM Access Configuration, the host might hang or panic due to known Linux kernel issues. If you encounter this problem, a reboot of the host should resolve it.

- **Multipathing initiators.** When multipathing initiators in a host for failover, unless otherwise specified in the guidelines, configure zoning of array storage first using CAM, then install the operating system multipath drivers.

- **Saving zoning information.** After the desired CAM Access Configuration is completed, you should export the current SAS domain settings using the import/export functionality within the CAM Access Configuration page. This will allow you to revert back to functional settings in the event of mis-configuration, or if the J4500 array System Controller module (where zoning configurations are stored) is replaced.

Note – For the latest information on using CAM for zoning storage with the J4500 array, refer to the appropriate version of CAM documentation on the Sun web site: `http://docs.sun.com/app/docs/prod/stor.arrmgr#hic`

Adding (Cascading) a J4500 Array to An Existing Zoned J4500 Array

The example in the following section describes how to add array storage to an existing configured array. There are three sets of steps required to cascade (or add) a J4500 array to an existing J4500 array using the CAM browser interface:

▼ To Prepare an Existing Array Prior to Cascading Additional Storage

This procedure takes you through the steps required to temporarily disable the Access Configuration state for an existing array, in preparation for cascading an additional array. These instructions assume that CAM is currently used to manage existing array storage.

1. **Verify a backup of any existing data is made.**

   This is a precautionary step and therefore a best practice.

2. **Log into the CAM management host by opening the browser and entering the following address:**

   https://*host-name*:6789

   Where *host-name* is the DNS name of the server connected to the array.

3. **In the left navigation pane, expand the tree for the connected server host and click Access Configuration for the first SAS Domain which is represented by the domain's SAS address number. See** FIGURE 3-3**.**

FIGURE 3-3   Example SAS Domain Access Configuration Summary Page

4. **Click Configure.**

   The Configure Access Between Initiators and Disks page displays. See FIGURE 3-4.

FIGURE 3-4   Example Initiator to Disk Access Configuration Page

5. **Write down the initiator SAS address and associated drives for the SAS domain, and then perform an Export operation to save a copy of the existing initiator-to-disk access configurations.**

6. **In the left navigation pane, click the Administration page for the domain.**

   The Administration page displays.

FIGURE 3-5   Example SAS Domain Administration Page
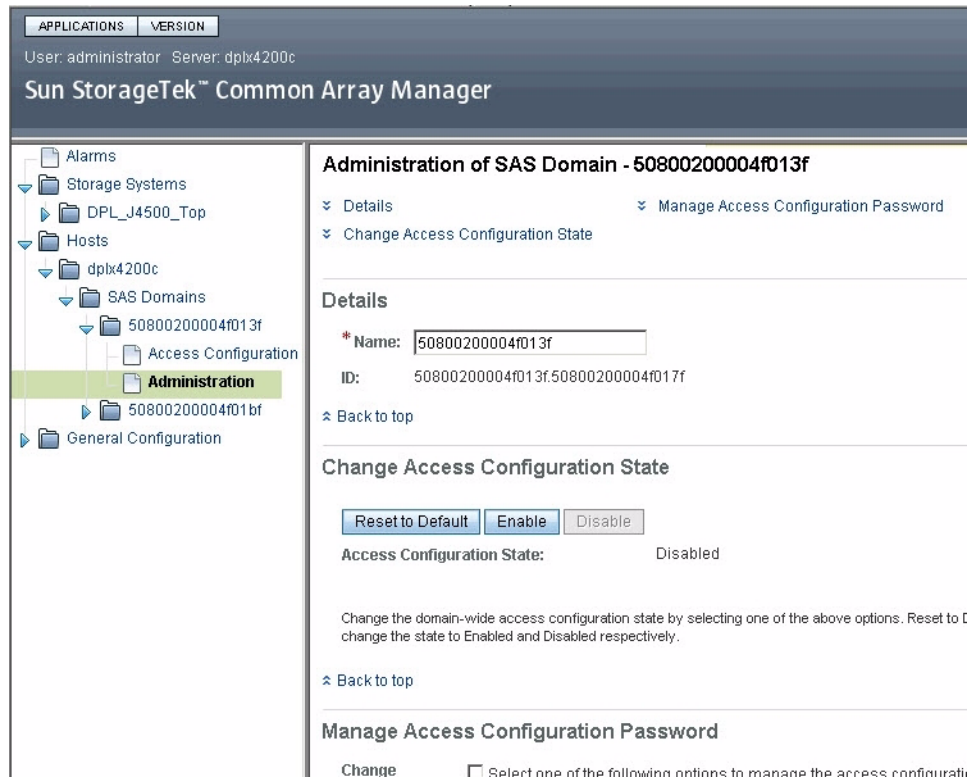
7. **Change the access configuration state for the SAS domain to Disabled (see** FIGURE 3-5**)**

8. **Click Save.**

9. **Repeat Steps 3 though 8 for the *second* SAS domain.**

   Be sure to perform an Export operation to save a copy of the existing initiator-to-disk access configurations since you might need them later.

10. **Un-register the array in CAM.**

   a. **From the left navigation pane, select Storage Systems.**

      The Storage System Summary page displays.

   b. **Select the checkbox to the left of the array.**

      This enables the Remove button.

c. Click Remove.

The array is unregistered and removed from the Storage System Summary. The Proxy hosts connected to the un-registered array will automatically be removed as well.

11. **Disconnect the array from the server, and disconnect AC power to the array.**

▼ To Prepare a New J4500 Array for Cascading

Before cascading can occur, all arrays that will be cascaded together either using new out-of-the-box arrays, or an array that is being added to an existing array setup, must be prepared using the steps in this procedure.

1. **Connect a server host running a full version of CAM (6.4.1 at a minimum) to both SAS fabrics of the new array (with a connection to the J4500 array SAS A and a connection to SAS B). See** FIGURE 3-6**. This host will be the primary host.**

   The array must not be cascaded to any other J4500 array at this time. This procedure is performed on one array at a time.

FIGURE 3-6   New Array Being Prepared for Cascading
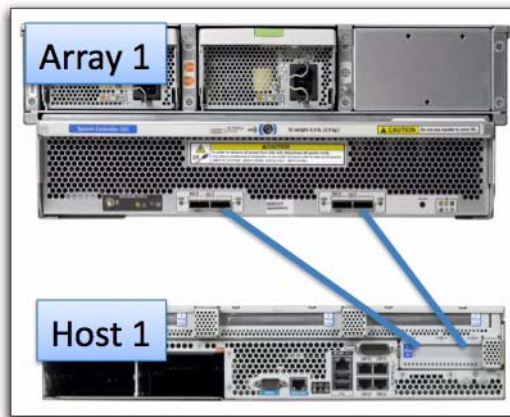
2. **Power on the array by connecting AC power.**

3. **After one minute, power on the primary host, if not already powered on.**

4. **Log into CAM on the primary host by opening the browser and entering the following address:**

   https://*host-name*:6789

   Where *host-name* is the DNS name of the server connected to the array.

5. **From the Storage System Summary page, click Register and follow the wizard to register the new array using the host name or host IP address of the host in the Registration window.**

6. **In the left navigation pane, expand the tree for the connected server host and click Access Configuration for the first SAS Domain which is represented by the domain's SAS address number. See** FIGURE 3-7.

FIGURE 3-7   Example Access Configuration Summary for SAS Domain Selected in CAM

Caution – Be sure that you have selected the appropriate array before going to the next step. The Reset to Default procedure clears any existing zoning configurations. If there are pre-existing zoning configurations, they can be reset to defaults by CAM if you know the SAS domain passwords. If you do not know the SAS domain passwords, you must clear the enclosure zoning passwords as described in Chapter 5.

7. **Click Reset to Default.**

   This action clears any previous access configurations for the SAS domain of the array.

8. **Read the pop-up warning message and then click OK.**

9. **From the Access Configuration Summary page for the SAS domain which you just reset to defaults, click Configure.**

   The Configure Access Between Initiators and Disks page displays. See FIGURE 3-8.
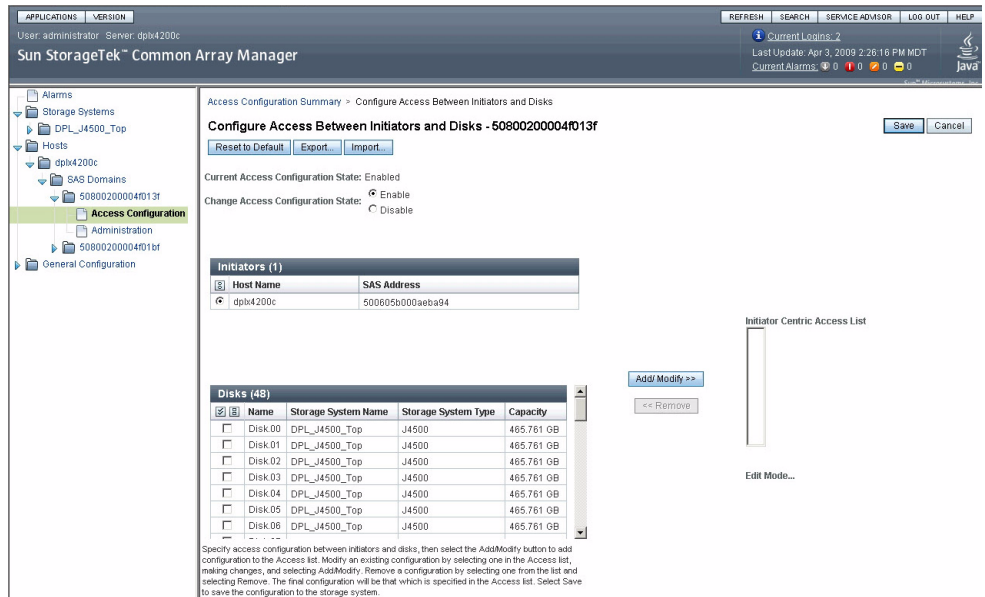
10. **Clear old initiator-to-disk access lists, if any, by selecting those entries in the Initiator Centric Access List and clicking Remove.**

11. **Click Save.**

    This clears any old initiator to disk access configurations in the domain.

12. **Repeat Steps 6 through 11 for the *second* SAS domain of the array.**

    When done, all of the storage in this array will be accessible in both of the SAS domains: the initiator connected to array SAS A will see all of the disks, and the initiator connected to array SAS B will also see all of the disks.

13. **Un-register the array in CAM.**

    a. **From the left navigation pane, select Storage Systems.**

       The Storage System Summary page displays.

    b. **Select the checkbox to the left of the array.**

       This enables the Remove button.

    c. **Click Remove.**

14. **Disconnect the array from the server, and disconnect AC power to the array.**

▼ To Cascade Arrays Using CAM

Before cascading arrays, make a note of the following and take actions as required:

- Existing arrays with CAM access configurations that you want to save should have been prepared as described in "To Prepare an Existing Array Prior to Cascading Additional Storage" on page 47.

- New arrays being cascaded together, or added to an existing array, should have been prepared as described in "To Prepare a New J4500 Array for Cascading" on page 51.

- If any initiators (HBA connections) from any attached hosts are not seen in CAM during the following process, verify that operating system multipathing software is disabled on those hosts. In addition, a reboot might be necessary to force an attached host to register their initiators with the storage arrays.

1. **Disconnect all attached hosts to the existing array setup. Then, cable the existing and new arrays to the first (primary) host as shown in** FIGURE 3-9**.**

   The primary host should have an initiator connection to array SAS fabric A and an initiator connection to SAS fabric B. Array 1 is either an existing or a new storage array. Array 2 is a new array which is attached to the primary host.

Note – This cascade configuration differs from the supported configuration that will be used during normal operation. This configuration is temporary but required in order to synchronize certain settings between the existing array and the new array that is being added.

FIGURE 3-9 Temporary Cascade Configuration
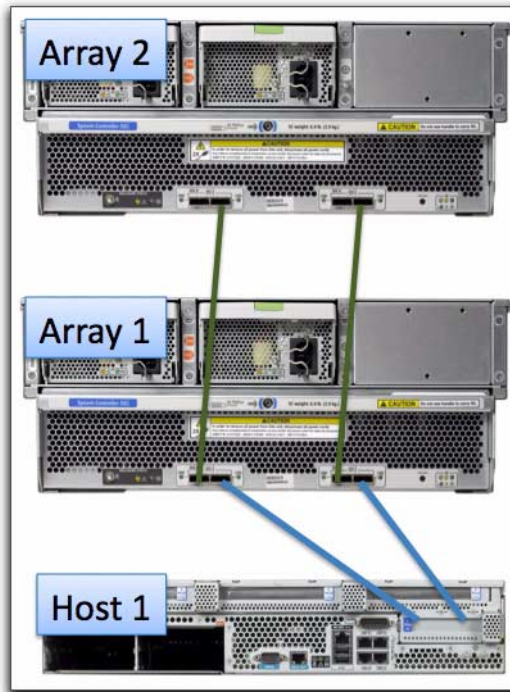
2. **Power on the cascaded arrays by reconnecting AC power.**

   The new arrays might take a few minutes for all drives to be recognized by the server's initiators.

3. **After one minute, power on the primary host, if not already powered on.**

4. **Log into CAM on the primary host by opening the browser and entering the following address:**

   https://*host-name*:6789

   Where *host-name* is the DNS name of the server connected to the array.

5. **From the Storage System Summary page, click Register and follow the wizard to register the cascaded arrays using the host name or host IP address of the primary host in the Registration window.**

   All attached arrays should be found. If they are not, perform a host reboot (i.e. Full reboot reconfigure on Solaris) and attempt the registration again.

6. **In the left navigation pane, expand the tree for the connected server host and click Administration for the first SAS Domain which is represented by the domain's SAS address number.**

   The Administration page displays. See FIGURE 3-10.

FIGURE 3-10 Example SAS Domain Administration Page
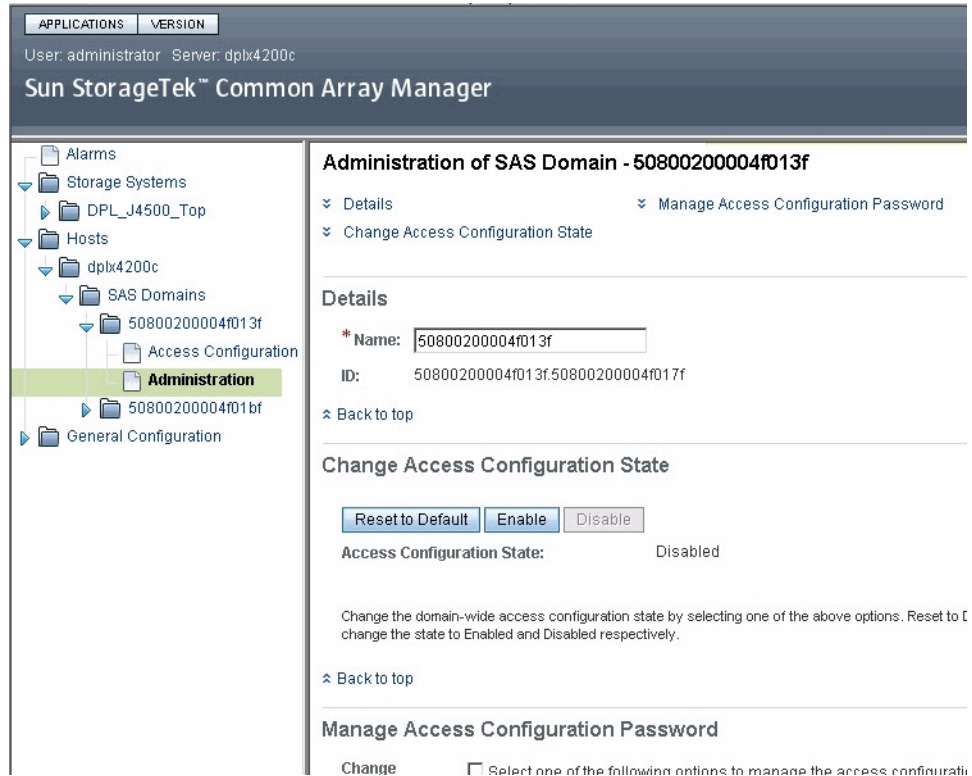
7. **Click Enable for the first SAS domain found underneath the entry for your primary host.**

8. **Click the Change Password checkbox.**

9. **Select the "Change Password in the Array Registration Database" option (see FIGURE 3-10), enter your desired (or existing) password, and click Save.**

10. **From the Administration page for the domain, click Disable.**

11. **Repeat Steps 6 through 10 for each SAS domain under the primary host.**

    This will synchronize your password information so that it is the same for both SAS domains and for both J4500 arrays.

12. **Attach the second host and change the cabling from the primary (first) host to conform to a supported cascaded array configuration (refer to** "Multipathing Configuration Guidelines" on page 69**). An example for a two host configuration is shown in** FIGURE 3-11**.**

   Due to the large number of disks, it may take a few minutes to discover all of the arrays and initiators.

   When you have completed this step, all the arrays in the cascade should be discovered and the access configuration for all SAS domains will be in the "disabled" state.

FIGURE 3-11 Supported Cascade Cabling for a Two-Host Configuration
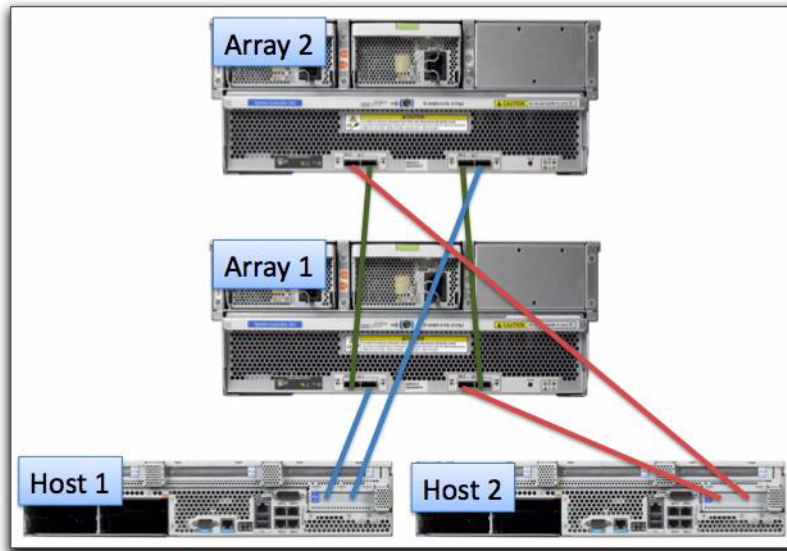
⚠ **Caution –** **Do not discover your proxy hosts at this time**. When SATA drives are in use, all Access Configuration changes must be done from the primary host, including the Access Configuration for secondary host initiators. Do not run any I/O, commands (i.e., format) or software on any hosts other than the primary CAM host. All configuration must be done from the primary host.

13. **In the left navigation pane, expand the tree for the connected server host and click Access Configuration for the first SAS Domain which is represented by the domain's SAS address number.**

   The Access Configuration Summary page displays. See FIGURE 3-12.

FIGURE 3-12 Access Configuration Summary Page
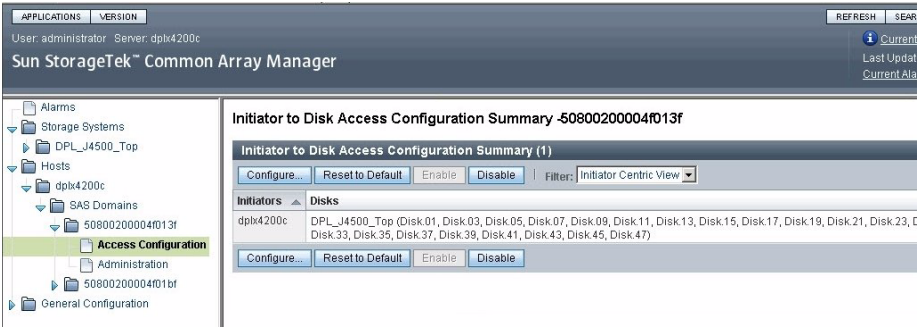
14. **Click Configure.**

    The Configure Access Between Initiators and Disks page displays. See FIGURE 3-13.

    At this time, all arrays, domains, and initiators from all attached hosts should be seen within the corresponding Access Configuration Pages.

    If any initiators from any attached hosts are not seen, verify that the OS multipathing software is disabled on those hosts. In addition, a reboot might be necessary to force an attached host to register their initiators with the storage arrays.

FIGURE 3-13 Example Configure Access Between Initiators and Disks Page

15. **At the Configure Access Between Initiators and Disks page, configure initiator-to-disk relationships for an initiator as follows:**

   a. **Select an initiator and then select the disks to be given access to that initiator.**

   - If the initiator selected is from a host whose cable *did not* need to be moved from one array port to another in order to conform to a supported array cascade configuration, you can implement an existing access configuration for it. Any host connections that were moved from their original array port connection to a different array port *must* have access configuration manually recreated for that initiator.

   - If multipathing is planned, drives may be shared by the initiators of a single host. The initiators must be attached to separate SAS domains to ensure a separate failover path. Disk drives in the array should *never* be shared by more than one host whether multipathing or not.

Note – The J4500 array is not supported in a clustering configuration.

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   b. **Click Add/Modify to store the configuration to the Initiator Centric Access List.**

   c. **Verify the Access Configuration state is set to "Enable".**

   d. **Click Save.**

   e. **Repeat Steps A through D for each initiator.**

   All initiators connected to the domain should be configured at this time (i.e., initiator #1 might have all odd numbered disks and initiator #2 might have all even numbered disks). This includes the initiators of other attached hosts.

16. **Repeat Steps 13 through 15 to configure other initiator-to-disk relationships for the other SAS domains found under the entry for the primary host.**

   If multiple initiators are seen, access configuration should also be performed at this time. This includes the initiators of other attached hosts.

17. **Configure operating system multipath software for each attached host (refer to Chapter 4).**

   This is only required in a situation where two initiators of a host were configured in CAM to share the same drives in different SAS domains. Operating system multipath drivers are used to control path failover.

Configuring Multiple Host Access for a J4500 Array

The example in this section describes an initial multi-host set up with each host owning a separate portion of array storage that is configured using the CAM browser interface. The storage owned by each host is configured for multipath failover. Do the following before you begin:

- If you have already configured operating system multipath software for a host, disable the multipath software until after the CAM access configuration is complete so that CAM will see all array-connected initiators.

- If your server is running the Windows Server 2008 operating system and you have already configured multipathing, remove the J4500 array disk drives from the **MPIO-ed Devices** list (through **Control Panel** -> **MPIO properties**).

▼ To Configure Multiple Host Access for a J4500 Array

1. **If not done already, install the full version of CAM (6.4.1 at a minimum) on a server you designate as the primary (first) host.**

   The server used to configure access configuration can also be the combination of a network-connected Management station and a single proxy server directly connected to array storage designated as the primary host.

Note – For other hosts that will be connected, you must remove CAM proxy agents (if installed) prior to performing the following steps in order to prevent SATA affiliation issues. In addition, no commands that might access the disks should be run from any host other than the chosen primary host. For more information see the "Troubleshooting Access Configuration" section in the *Sun StorageTek Common Array Manager Release Notes*.

---

2. **Cable your servers to the arrays in a supported configuration (refer to** "Multipathing Configuration Guidelines" on page 69**). When multipathing using two initiators, connect one path to array SAS A and one to SAS B. Initiator connections should be at opposite ends of the array SAS fabrics (see** FIGURE 3-9**).**

Note – If any re-cabling of an existing host and array setup is required to achieve a supported multi-host cascaded configuration, you must record the initiator SAS address and any desired disk associations from the CAM Access Configuration page before re-cabling. If the initiator moves from one array connector port to another (even in the same SAS fabric) its disk access configuration will need to be re-created.

FIGURE 3-14 Multiple Host Connection to Cascaded J4500 Arrays
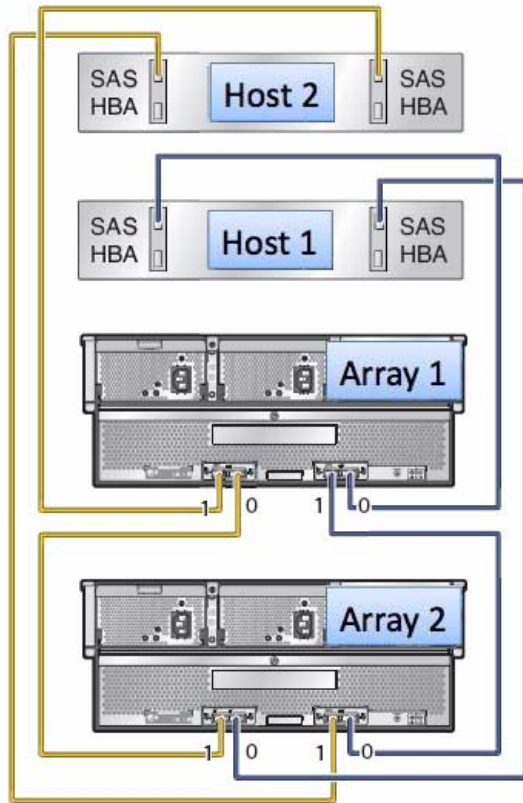
3. **Power on the arrays by reconnecting AC power.**

4. **After a minute, power on the primary host.**

5. **Log into CAM on the primary host by opening the browser and entering the following address:**

   https://*host-name*:6789

   Where *host-name* is the DNS name of the server connected to the array.

6. **From the Storage System Summary page, click Register and follow the wizard to register the cascaded arrays using the host name or host IP address of the primary host in the Registration window.**

   All attached arrays should be found. If they are not, perform a host reboot (i.e. Full reboot reconfigure on Solaris) and attempt the registration again.

7. **In the left navigation pane, expand the tree for the connected server host and click Access Configuration for the first SAS Domain which is represented by the domain's SAS address number.**

   The Access Configuration Summary page displays. See FIGURE 3-15.

FIGURE 3-15 Example Access Configuration Summary Page

8. **Click Configure.**

   The Configure Access Between Initiators and Disks page displays. See FIGURE 3-16.

   At this time, all arrays, domains, and initiators from all attached hosts should be seen within the corresponding Access Configuration Pages.

   If any initiators from any attached hosts are not seen, verify that the OS multipathing software is disabled on those hosts. In addition, a reboot might be necessary to force an attached host to register their initiators with the storage arrays.

Note – In the Access Configuration page, the initiator(s) from the additional host(s) should be visible; however, they may only be represented as unique SAS addresses (no host names) since the proxy has not been discovered yet.

FIGURE 3-16 Example Access Configuration Between Initiator and Disks Page

9. **At the Configure Access Between Initiators and Disks page, configure initiator-to-disk relationships for an initiator as follows:**

   a. **Select an initiator and then select the disks to be given access to that initiator.**

   - If the initiator selected is from a host whose cable *did not* need to be moved from one array port to another in order to conform to a supported array cascade configuration, you can implement an existing access configuration for it. Any host connections that were moved from their original array port connection to a different array port *must* have access configuration manually recreated for that initiator.

   - If multipathing is planned, drives may be shared by the initiators of a single host. The initiators must be attached to separate SAS domains to ensure a separate failover path. Disk drives in the array should *never* be shared by more than one host whether multipathing or not.

Note – The J4500 array is not supported in a clustering configuration.

   b. **Click Add/Modify to store the configuration to the Initiator Centric Access List.**

   c. **Verify the Access Configuration state is set to "Enable".**

   d. **Click Save.**

e. Repeat Steps A through D for each initiator.

All initiators should be configured at this time (i.e., initiator #1 might have all odd numbered disks and initiator #2 might have all even numbered disks). This includes the initiators of other attached hosts.

10. **Repeat Steps 7 through 9 to configure other initiator-to-disk relationships for the other SAS domains found under the entry for the primary host.**

If multiple initiators are seen, access configuration should also be performed at this time. This includes the initiators of other attached hosts.

11. **When done, power cycle the attached hosts. This will perform a full re-scan of the attached storage.**

12. **After all hosts are powered up, do the following:**

   ■ Install and discover the CAM proxy agents on any additional hosts other than the primary CAM host. For installation information, see the *Sun StorageTek Common Array Manager User Guide* for your version of CAM.

   ■ Verify the appropriate Access Configuration is now active (for example, on an array-attached host running Solaris, use the `format` utility to confirm that only disks configured for the initiators of that host are now available).

   ■ Verify operating system multipathing software is installed/enabled and configured for each server. Verify that the disk drives show both paths to the operating system (see Chapter 4).

Note – If your server is running the Windows Server 2008 operating system, and you had previously configured it for multipathing, add back the J4500 array disk drives to the **MPIO-ed Devices** list (through **Control Panel** -> **MPIO properties**).

SAS Multipathing

You can use the Sun Storage J4500 array in a serial-attached SCSI (SAS) multipathing configuration to provide fault tolerant connectivity to storage. Although the J4500 array uses single port SATA drives, the array's IO circuitry provides a redundant data path to each disk port. Using the multipathing feature of the SAS protocol, the J4500 can be configured to provide a redundant data path from host to disk. When used in conjunction with RAID configurations, multipathing can help increase the availability of your J4500 storage.

The J4500 multipathing supports active-active and active-passive operation:

- In active-active operation a host can communicate with a hard disk by two different paths.
- In active-passive operation a host can communicate with a hard disk using only one path. Should that path become unavailable, a failover occurs where the host begins using the path in the other SAS domain (or fabric) to communicate with the hard disk.

Operating system-specific driver software controls the multipathing capability (active-active or active-passive). You enable, disable, and configure multipathing through the server's operating system software.

This chapter includes the following information:

System Requirements

To use multipathing with the J4500 array, your configuration must meet the following requirements.

- Every J4500 must have the latest baseline firmware available from the Sun Common Array Manager (CAM) version 6.4.1. This version provides both multipath and zoning support. See "Supported Sun Storage J4500 Array Firmware and Common Array Manager (CAM) Software" on page 66.
- You can only use multipathing on J4500 array supported LSI-based HBAs that meet the minimum firmware requirements. See "Supported HBAs" on page 67.
- You can only use multipathing on supported operating systems with the required drivers. See "Supported Operating Systems and Drivers" on page 67.
- If you are going to use both zoning (to assign J4500 array disks per host initiator) and multipath failover, you will need to configure zoning first. See Chapter 3.

Supported Sun Storage J4500 Array Firmware and Common Array Manager (CAM) Software

Multipathing the J4500 array is only supported with the following enclosure firmware version and CAM software version.

- The minimum J4500 array enclosure firmware version required is 5.03.73
- The minimum CAM software version required is 6.4.1. This version supports zoning J4500 array storage on a per host, per disk basis. For more on zoning, see Chapter 3.

Note – CAM provides the only method for upgrading J4500 array enclosure firmware.

Initial, basic support for the J4500 array is available starting with CAM version 6.1.2. Support for zoning and multipathing is available starting with CAM version 6.4.1. To obtain the latest CAM software (which includes J4500 array firmware), go to the

Sun software download site
(http://www.sun.com/storagetek/management_software/resource_mana
gement/cam/get_it.html)

.

Supported HBAs

Multipathing for the J4500 array is only supported with the following HBAs.

TABLE 4-1   HBAs That Support J4500 Multipathing

Supported HBA	Minimum Firmware Required for Multipathing
Sun StorageTek PCI Express SAS 8-Channel HBA (SG-XPCIE8SAS-E-Z, LSI-based disk controller)	- Firmware 1.26.03.0-IT - BIOS 6.24.00.00 - Fcode 1.00.49 This HBA must have a Sun manufacturing part number of 375-3487-02 or higher (for example, 375-3487-03 is supported while 375-3487-01 is not supported).
Sun StorageTek ExpressModule SAS 8-Channel HBA (SG-PCIE8SAS-EB-Z, LSI-based disk controller)	- Firmware 1.26.03.0-IT - BIOS 6.24.00.00 - Fcode 1.00.49

The latest firmware for these HBAs may be obtain from the following download site:

http://www.lsi.com/support/sun

Supported Operating Systems and Drivers

Multipathing for the J4500 array is only supported with the following operating systems and drivers.

TABLE 4-2   Operating Systems That Support J4500 Multipathing

Supported Operating System	Required Driver Version for Multipathing
Solaris 10 10/08 OS (SPARC and x86)	MPT 1.80. An earlier version of the MPT driver may be updated with OS patch 138888-03 (SPARC) or 138889-03 (x86)
Red Hat Enterprise Linux (RHEL) 4.6	MPT 3.16.00.00
RHEL 5.1	MPT 4.16.00.00
RHEL 5.2	MPT 4.16.00.00
SUSE Linux Enterprise Server (SLES) 9, SP4	MPT 3.16.00.00
SLES 10, SP1	MPT 4.16.00.00

TABLE 4-2 Operating Systems That Support J4500 Multipathing *(Continued)*

Supported Operating System	Required Driver Version for Multipathing
SLES 10, SP2	MPT 4.16.00.00
Windows Server 2003	Sun DSM driver. Available from the Sun software download site.
Windows Server 2008	Microsoft DSM driver. Included with Windows Server 2008, but must be manually installed.

The latest operating system drivers for the supported HBAs may be obtain from the following download site:

http://www.lsi.com/support/sun

Note – Clustering is not supported for use with the J4500 array.

Supported Drives for Multipath

Your J4500 array's drives are supported for multipath. Each drive has a SAS WWN (World Wide Name) required for multipathing. The WWN does not change even if the drive firmware is upgraded. Only supported drives may be used in your J4500 array. Use of unsupported drives might cause a multipath installation to fail.

At the release of this document, the following Sun-qualified hard disk drives are supported for use in the J4500 array (check the label on the drive if you are unsure):

- HUA7250SBSUN500G A90A Hitachi 500 GB SATA 390-0384-02
- HUA7275SASUN750G A90A Hitachi 750 GB SATA 390-0379-02
- HUA7210SASUN1.0T A90A Hitachi 1.0 TB SATA 390-0381-012
- ST35002NSSUN500G SU0B Seagate 500GB SATA 390-0412-02
- ST37502NSSUN750G SU0B Seagate 750GB SATA 390-0413-02
- ST31000NSSUN1.0T SU0B Seagate 1.0 TB SATA 390-0414-02

Note – Your J4500 array is shipped from the factory with drives of the same capacity. Mixing drives of different capacities in the array is unsupported.

Multipathing Configuration Guidelines

Setting up a dual path connection consumes twice the SAS targets as a single path connection. The HBA must support the total number of targets in the dual path connection.

For example, an HBA that supports 244 targets (122 per port), can be used in a multipath configuration with up to two J4500 arrays, where:

- Two J4500s contain a total of 96 disks.
- In a multipath configuration with two arrays, the number of disk targets seen by the HBA is 192.
- SAS expanders in the array consume three targets each. There are two expanders per SAS fabric (two for SAS A and two for SAS B).
- In a multipath configuration with two arrays, the combined expanders consume 24 targets.

When cascading multiple J4500s using a multipath configuration, Sun recommends cascading the host links in opposite directions from the edge of the SAS fabrics to prevent a single J4500 failure from blocking access to other J4500s in the cascade.

FIGURE 4-1 shows an example of cascading connections. The red arrow indicates the direction of the enclosure cascade, either downstream or upstream (which determines the order in which devices on the SAS link are discovered). The redundant fabrics (SAS A and B) are fully independent; each with access to all of the combined storage. If you zoned the disks so that each host link controls a portion of the storage, additional host links would need to be added to provide path failover for storage in each zone. For more about zoning, see Chapter 3.

FIGURE 4-1 Example Multipath Failover Configuration
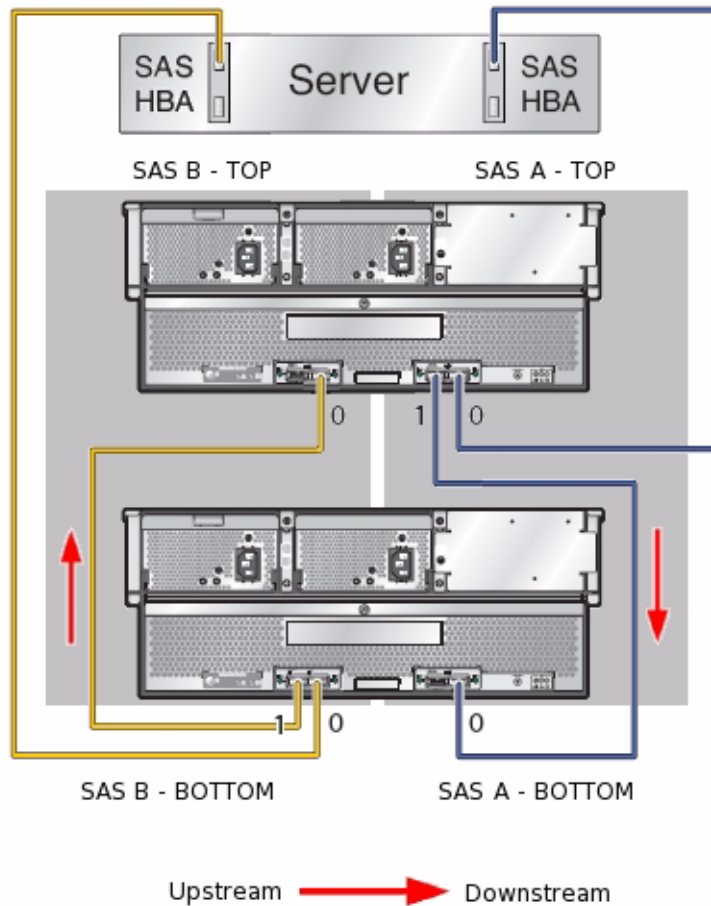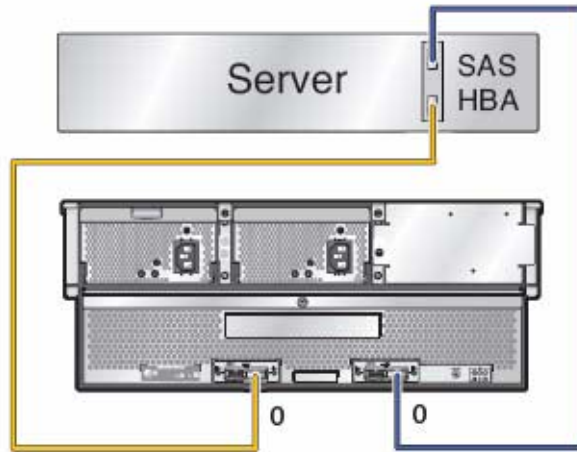

Configuration Examples

This section includes examples of supported multipath configurations for your J4500 array.

Note – In the examples below, the colors are used to indicate a specific host path. However, cascade (array-to-array) connections between arrays might, in some cases, be utilized by more than one host in a failover situation.

Multipathing With One Host, One HBA and One Array

FIGURE 4-2 shows an example of multipath cabling using one host, one HBA and one array. This configuration supports zoned storage and failover.
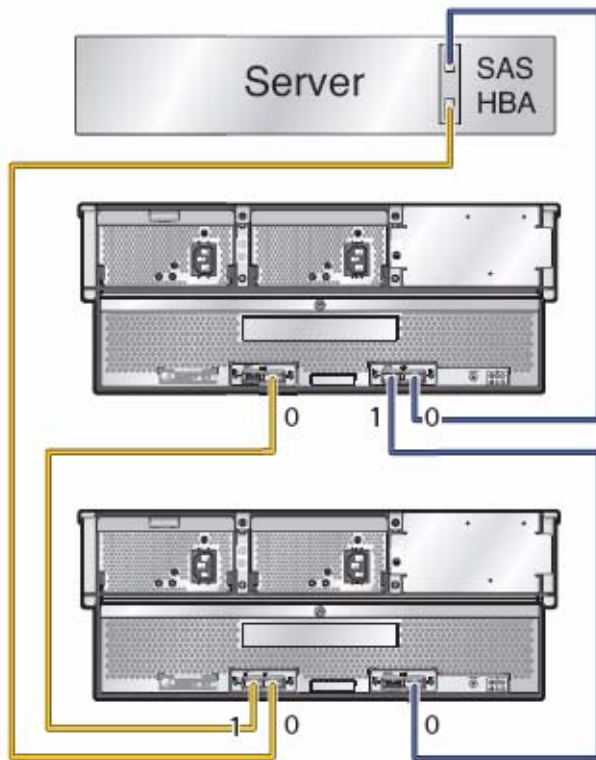
FIGURE 4-2   One Host, One HBA With One Array

Multipathing With One Host, One HBA and Cascaded Arrays

FIGURE 4-3 shows an example of multipath cabling using one host, one HBA and two cascaded arrays. This configuration supports zoned storage and failover.

FIGURE 4-3   One Host, One HBA and Two Arrays

Multipathing With One Host, Two HBAs and Cascaded Arrays

FIGURE 4-4 shows an example of multipath cabling using one host, two HBAs and two cascaded arrays. This configuration supports zoned storage and failover.
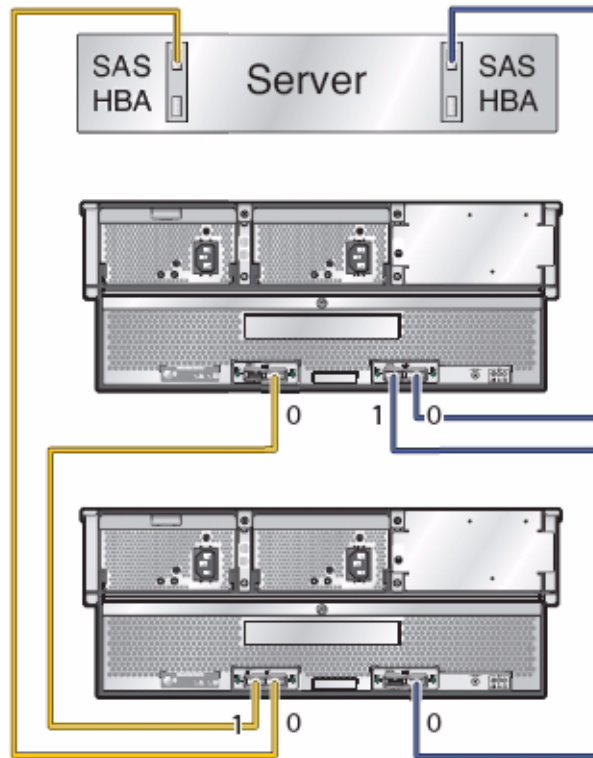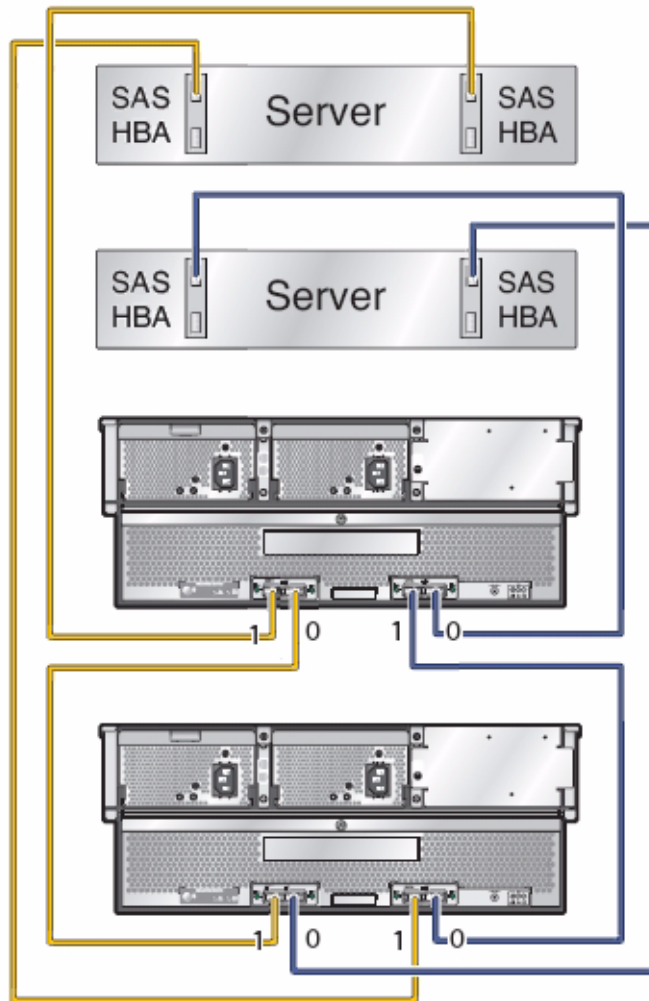
FIGURE 4-4   One Host, Two HBAs and Two Arrays

Multipathing With Two Hosts, Four HBAs and Cascaded Arrays

FIGURE 4-5 shows an example of multipath cabling using two hosts, each with two HBAs and two cascaded arrays. This configuration supports clustering, zoned storage and failover. Each server has dual HBAs and dual paths to the cascaded arrays.

**FIGURE 4-5**   Example Showing Two Hosts, Four HBAs and Cascaded Arrays

Multipathing With Two Hosts, Multiple HBAs and Cascaded Arrays

FIGURE 4-6 shows an example of multipath cabling using two hosts, each with two multipathed HBAs and four arrays. Both hosts have multipath connections to all four J4500's shown. If you follow any single connection, it goes from one host HBA through two cascaded J4500s and then back to the other host. This allows an HBA in

either host to see all 96 drives in one cascaded SAS domain (either SAS A or B). This configuration supports zoned storage and failover. Each server has dual HBAs and dual paths to each cascaded set of arrays.

FIGURE 4-6 Multiple Hosts, Multiple HBAs with Cascaded Arrays
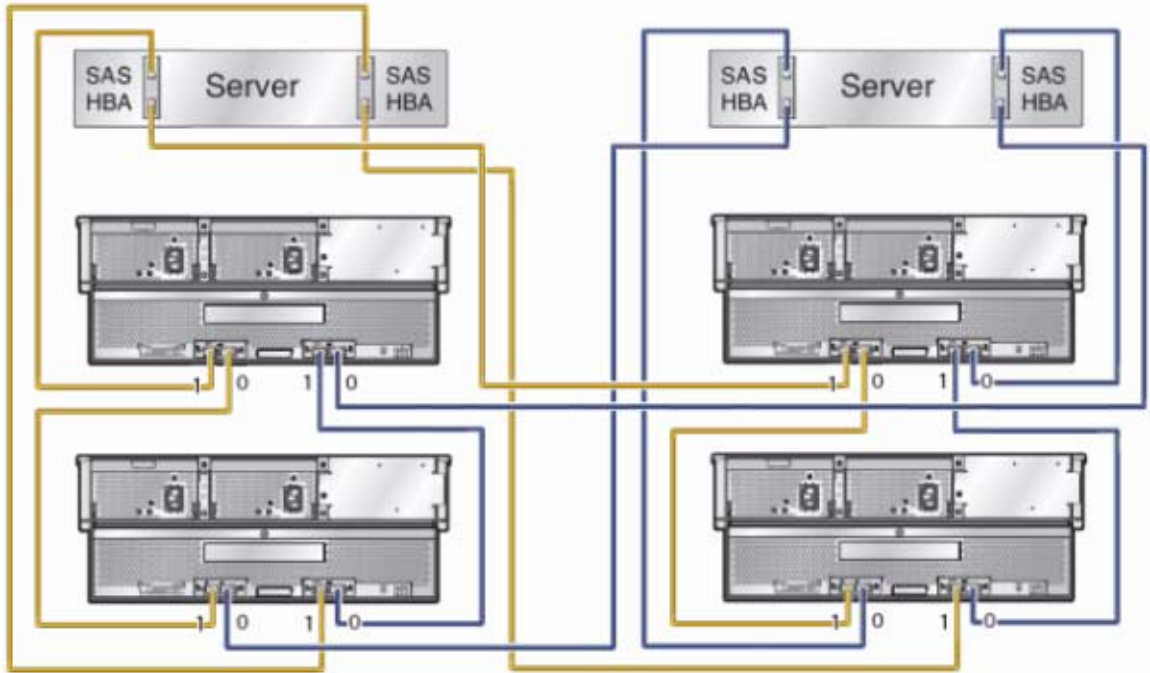
Enabling and Disabling Multipathing in the Solaris Operating System

This section describes how to enable and disable multipathing using the stmsboot(1M) administration program in the Solaris 10 10/08 operating system. The following subsections are included:

- "About Multipathing" on page 76
- "stmsboot Options" on page 78
- "stmsboot Conditions" on page 79
- "To Enable Multipathing on LSI-Based Multipath-Capable Controllers" on page 80

About Multipathing

Use the `stmsboot` command to enable multipathing in the Solaris. `stmsboot` manages enumeration of multipath–capable devices with multipathing and has these characteristics:

- Multipathing-enabled devices are enumerated under `scsi_vhci(7D)`.
- Multipathing-disabled devices are enumerated under the physical controller.

After cabling your server for multipath, you will see two copies of each disk from the OS since you are using two separate array paths (SAS A and B). If you want to have multiple hosts accessing disks in the array, you must first set up zoning per host as described in Chapter 3.

For example, if you have created a zone in each of the array's SAS domains that includes three disks, when entering the `format` command before MPxIO is installed, you will see two of each multipathed disk (zoned out disks that have not been assigned to a host will show as "unknown"). In this example, disk `c1t1d0` is a system disk (not a J4500 array disk).

 # format

```
AVAILABLE DISK SELECTIONS:
0. c1t1d0 <DEFAULT cyl 30397 alt 2 hd 255 sec 63>
 /pci@0,0/pci108e,534c@5/disk@1,0
1. c2t102d0 <DEFAULT cyl 17846 alt 2 hd 255 sec 63>
2. c2t111d0 <DEFAULT cyl 17846 alt 2 hd 255 sec 63>
/pci@0,0/pci10de,376@a/pci1000,3150@0/sd@66,0
4. c2t113d0 <DEFAULT cyl 17846 alt 2 hd 255 sec 63>
/pci@0,0/pci10de,376@a/pci1000,3150@0/sd@6f,0
/pci@0,0/pci10de,376@a/pci1000,3150@0/sd@71,0
3. c2t112d0 <DEFAULT cyl 17846 alt 2 hd 255 sec 63>
5. c2t118d0 <DEFAULT cyl 17846 alt 2 hd 255 sec 63>
/pci@0,0/pci10de,376@a/pci1000,3150@0/sd@70,0
6. c2t119d0 <DEFAULT cyl 17846 alt 2 hd 255 sec 63>
/pci@0,0/pci10de,376@a/pci1000,3150@0/sd@76,0
/pci@0,0/pci10de,376@a/pci1000,3150@0/sd@77,0
```

After installing MPxIO, entering the `format` command will show only three array disks. The J4500 array disks should have "scsi_vhci" in the path.

 # format

```
AVAILABLE DISK SELECTIONS:
0. c1t1d0 <DEFAULT cyl 30397 alt 2 hd 255 sec 63>
 /pci@0,0/pci108e,534c@5/disk@1,0
1. c3t5000C500069E209Fd0 <DEFAULT cyl 17846 alt 2 hd 255 sec 63>
2. c3t5000C500069E1383d0 <DEFAULT cyl 17846 alt 2 hd 255 sec 63>
/scsi_vhci/disk@g5000c500069e209f
/scsi_vhci/disk@g5000c500069e1383
3. c3t5000C500069E2003d0 <DEFAULT cyl 17846 alt 2 hd 255 sec 63>
/scsi_vhci/disk@g5000c500069e2003
```

Details of the multipath disks may be obtained using the `mpathadm` command, as follows:

 # mpathadm list lu

```
/dev/rdsk/c3t5000C500069E209Fd0s2
 Total Path Count: 2
/dev/rdsk/c3t5000C500069E2003d0s2
Operational Path Count: 2
Total Path Count: 2
/dev/rdsk/c3t5000C500069E1383d0s2
Operational Path Count: 2
Total Path Count: 2
Operational Path Count: 2
```

Device Renaming

In the `/dev` and `/devices` trees, multipathing-enabled devices receive new names that indicate that they are under multipathing control.

This means a device has a different name from its original name (after enabling) when it is under multipathing control.

The `stmsboot` command automatically updates /etc/vfstab and dump configuration to reflect the device names changes when enabling or disabling multipathing.

A reboot of the host server is required for changes to take effect.

Dynamic Discovery of SAS Devices

SAS devices, added and removed dynamically with the mpt(7d) driver, enable your system to detect specific targets and LUNs attached, with these conditions:

- If you add or remove a device in your SAS domain, messages are written to the /var/adm/messages file indicating presence or removal.
- If a device has been added, it is visible to, and available by, the format(1m) command.

Note – To clean up the CTD# for your device tables, run the following command: **devfsadm -C**

---

stmsboot Options

The following table describes the options supported by stmsboot(1M).

TABLE 4-3   `stmsboot` Options for SAS Controllers

Option	Description
`-e [-D mpt]`	Enables multipathing on all supported multipath-capable controller ports. • Multipath-capable SAS controller ports (`mpt[7D]`). • Prompts you to reboot. • During reboot, `vfstab` and the dump configuration update to reflect the device-name changes. • Specifying `-D mpt` limits the enabling operation to ports attached using the specified driver.
`-d [-D mpt]`	Disables multipathing on all supported multipath-capable controller ports. • Multipath-capable SAS controller ports (`mpt[7D]`). • Prompts you to reboot. • During reboot, `vfstab` and the dump configuration update to reflect the device-name changes. • Specifying `-D mpt` limits the disabling operation to ports attached using the specified driver.
`-u`	Updates `vfstab` and the dump configuration after manually enabling or disabling multipathing on specific multipath-capable controller ports. • Prompts you to reboot. • During reboot, `vfstab` and the dump configuration update to reflect the device name changes.
`-L`	Displays the device name changes from non-multipathing-device names to multipathing device names on multipath-enabled controller ports. If multipathing is not enabled, no mappings display.
`-l controller_number`	Displays the device-name changes from non-multipathing device names to multipathing device names for the specified controller. If multipathing is not enabled, no mappings display.

`stmsboot` Conditions

`stmsboot` enables and disables multipathing on the host, with these conditions:

■ The utility automatically updates `vfstab(4)` and `dumpadm(1M)` configuration to reflect device-name changes.

Note – The system administrator is responsible for modifying application configuration (for example, backup software, DBMS, and so forth) to reflect updated device names.

- The -L and -l options display the mapping between multipathed and non-multipathed device names, only *after* changes to the multipathing configuration take effect; that is, *following* reboot after invoking stmsboot -e.
- ZFS datasets, including ZFS root datasets, are correctly handled by stmsboot.

▼ To Enable Multipathing on LSI-Based Multipath-Capable Controllers

Note – Multipathing is not supported on all controllers. After enabling multipathing, only supported controllers are placed under multipathing control. Non-supported controllers remain unchanged.

● **From the command prompt, enter the following command:**

   # **stmsboot -D mpt -e**

   The following output is displayed (press **y** when prompted to accept the defaults).

```
# stmsboot -D mpt -e
WARNING: This operation will require a reboot.
Do you want to continue ? [y/n] (default: y) y
updating /platform/i86pc/boot_archive
The changes will come into effect after rebooting the system.
Reboot the system now ? [y/n] (default: y) y
```

Note – stmsboot updates the /etc/vfstab file and dump configuration to reflect device-name changes during reboot.

   The following conditions apply to the stmsboot -e, -d, and -u options:

- Reboot immediately after running stmsboot. If the following error occurs after rebooting, a second reboot is needed:

   ERROR: svc:/system/filesystem/root:default failed to mount /usr (see 'svcs -x' for details)

- Ensure that eeprom(1m) boot device is set to boot from your current boot device; stmsboot reboots the machine to complete the operation.

- stmsboot saves a copy of your original `/kernel/drv/mpt.conf` and `/etc/vfstab` files before modifying them.

▼ To Disable Multipathing on LSI-Based Multipath-Capable Controllers

- **From the command prompt, enter the following command:**

  # **`stmsboot -D mpt -d`**

  The following output is an example of what might be displayed (press **y** when prompted to accept the defaults).

```
# stmsboot -D mpt -d
WARNING: This operation will require a reboot.
Do you want to continue ? [y/n] (default: y) y
The changes will come into effect after rebooting the system.
Reboot the system now ? [y/n] (default: y) y
```

Note – During reboot, `/etc/vfstab` and the dump configuration update to reflect the device-name changes.

Configuring Multipathing on Selected Ports

To enable multipathing on specific ports and disable multipathing on others, edit the `/kernel/drv/mpt.conf` file. To update vfstab(4) and dumpadm(1M) configurations to reflect the changed device names, type:

`stmsboot -u`

Enabling and Disabling Multipathing in the Linux Operating System

This section describes how to enable and disable multipathing in supported versions of the Linux operating system. The following subsections are included:

- "About Multipathing" on page 82
- "To Enable Multipathing in Linux" on page 83

About Multipathing

After cabling your server for multipath, you will see two copies of each disk from the OS since you are using two separate array paths (SAS A and B). If you want to have multiple hosts accessing disks in the array, you must first set up zoning per host as described in Chapter 3.

For example, if you have created a zone in each of the array's SAS domains that includes three disks, when entering the lsscsi command before MPxIO is installed, you will see two of each multipathed disk.

lsscsi

```
[1:0:0:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sda
[1:0:1:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sdb
[1:0:2:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sdc
[1:0:3:0] enclosu SUN Storage J4500 3R21 -
[2:0:0:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sdd
[2:0:1:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sde
[2:0:2:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sdf
[2:0:3:0] enclosu SUN Storage J4500 3R21 -
```

Once the multipath daemon is started on the host, you can see multipath details using the multipath command.

multipath -ll

```
35000c5000357625b dm-2 SEAGATE,ST340008SSUN0.4
[size=373G][features=0][hwhandler=0]
  \_ round-robin 0 [prio=2][active]
  \_ 1:0:1:0  sdb 8:0    [active][ready]
  \_ 2:0:1:0  sde 8:192  [active][ready]
```

To correlate the dm-2 dual path disks with what's displayed in CAM (in the Host details page, see FIGURE 3-2), use the lsscsi command with the -g option.

lsscsi -g

```
[1:0:0:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sda /dev/sg0
[1:0:1:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sdb /dev/sg1
[1:0:2:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sdc /dev/sg2
[1:0:3:0] enclosu SUN Storage J4500 3R21 - /dev/sg3
[2:0:0:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sdd /dev/sg4
```

```
[2:0:1:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sde /dev/sg5
[2:0:2:0] disk SEAGATE ST330055SSUN300G 0B92 /dev/sdf /dev/sg6
[2:0:3:0] enclosu SUN Storage J4500 3R21 - /dev/sg7
```

For each disk, CAM will report the device names from the last column in the
/dev/sg*N* format.

▼ To Enable Multipathing in Linux

1. **Attach a J4500 array to a server with a supported version of Linux installed.**

2. **On the server, edit or create the** /etc/multipath.conf **file.**

3. **Reboot the server.**

4. **After the reboot, make sure that the OS discovers all the disks in the J4500
   array either by using the Linux commands,** fdisk **or** lsscsi.

5. **Partition any disks you want to the desired sizes.**

6. **Use the Linux command modprobe to add the loadable kernel modules dm-
   multipath and dm-round-robin.**

   # **modprobe dm-multipath**

   # **modprobe dm-round-robin**

7. **Start the** multipathd **daemon.**

   For Linux SUSE 9, use the following command:

   # **multipathd -v0**

   For other supported Linux versions, use the following command:

   # **service multipathd start**

8. **Start the multipathing device mapper target autoconfig.**

   # **multipath -v2**

9. **List the multipath devices that have been created.**

   # **multipath -ll**

   The output should list the same number of devices as there are disks in the J4500
   array. The following is an example of output:

```
35000c5000357625b dm-2 SEAGATE,ST340008SSUN0.4
[size=373G][features=0][hwhandler=0]
  \_ round-robin 0 [prio=2][active]
  \_ 0:0:0:0  sda 8:0    [active][ready]
  \_ 1:0:0:0  sdm 8:192  [active][ready]
```

▼ To Disable Multipathing in Linux

1. **If a RAID volume, LVM volume, or volume mount have been placed over the device node of the multipathed disk, quiesce the volume.**

2. **Use the multipath -f command to disable multipathing to a specific device.**

   # `multipath -f mpath1`

3. **Use the multipath -F command to disable multipathing on all multipathed devices.**

   # `multipath -F`

Note – If the message map in use appears for a device when you attempt to disable multipathing, the device is still in use. You must unmount or otherwise quiesce the device before you can disable multipathing. If you cannot quiesce the device, edit the `/etc/multipath.conf` file to exclude the device and then reboot the server.

Enabling and Disabling Multipathing in the Windows Operating System

This section describes how to enable or disable multipathing for your J4500 array with the Windows operating system.

- "About Multipathing" on page 84
- "How a Failover is Handled by Windows" on page 86
- "To Enable Multipathing in Windows Server 2008" on page 86
- "To Disable Multipathing in Windows Server 2008" on page 94

About Multipathing

Multipathing of disks is handled through the Microsoft MPIO architecture in conjunction with a DSM (Device-Specific Module). For Windows Server 2008, use the built-in Microsoft generic DSM.

Note – For the Windows operating system, there is only J4500 array multipath support for Windows Server 2008.

If you want to have multiple hosts accessing disks in the array, you must first set up zoning per host as described in Chapter 3.

When you configure your J4500 array for a multipath support, Windows will initially see two copies of each disk from the OS since you are using two separate array connection paths (one to SAS A and one to SAS B). You will use MPIO to combine the two paths for each type of disk in the array so that the OS sees each multipathed disk as one disk.

After installing the built-in MPIO driver for Windows Server 2008, multipath disks will be combined into a single multipathed disk.

For example, FIGURE 4-7 shows how Windows Server 2008 Device Manager sees a server's four external multipath disks and two internal single path disks before [1] and after [2] MPIO.

FIGURE 4-7 Multipath Disks Seen in Windows Server 2008 Before and After MPIO
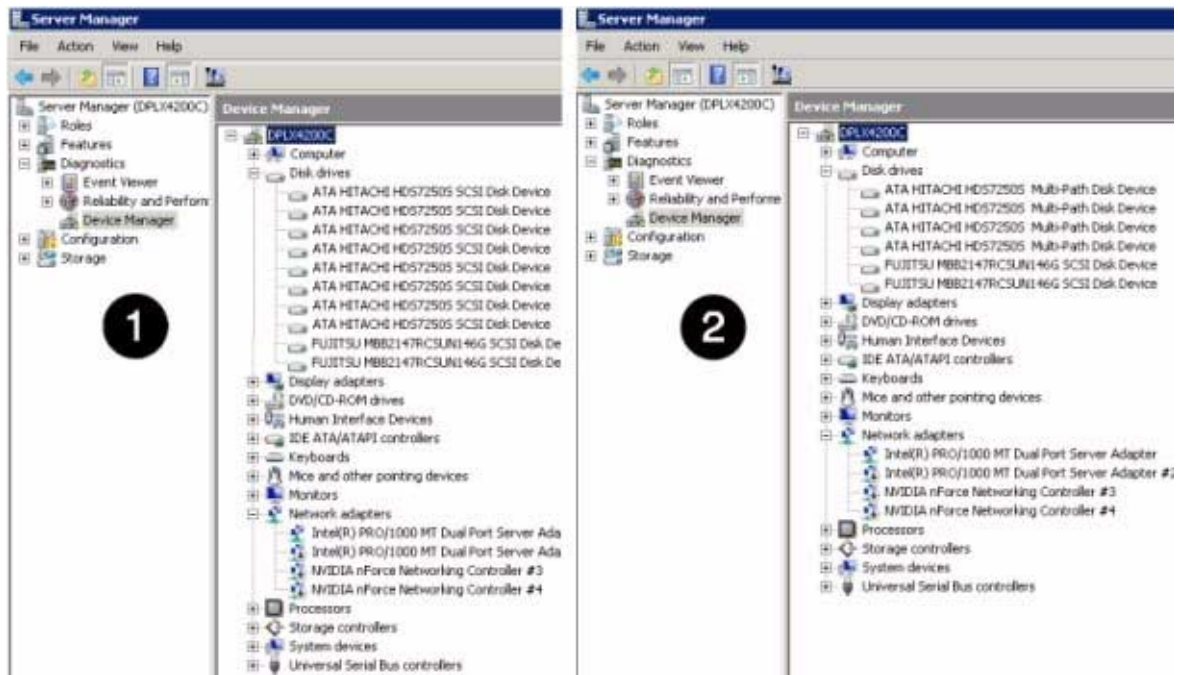
How a Failover is Handled by Windows

If you remove one path to a multipath disk, failover is handled automatically by MPIO. You continue to see the exact same list of disks in the Windows Device Manager and Windows Disk management views. However, you will see MPIO messages in the system event log indicating a failover has occurred.

▼ To Enable Multipathing in Windows Server 2008

An MPIO utility is part of Windows Server 2008, but you must install it manually. For multipath support, you must have already done the following:

- Make sure that the J4500s that you want to setup for multipathing are properly connected to the host system and are up and running.
- You should have already downloaded and installed the Sun Storage J4500 array Windows Device Manager update driver package from the Sun software download site to ensure Windows will properly recognize the array.
- That any zoning of J4500 array storage using the Sun StorageTek Common Array Manager has been successfully completed (see Chapter 3).

1. **From the Windows Start menu, select Server Manager. See** FIGURE 4-8**.**

FIGURE 4-8   Start Menu with Server Manager Selected
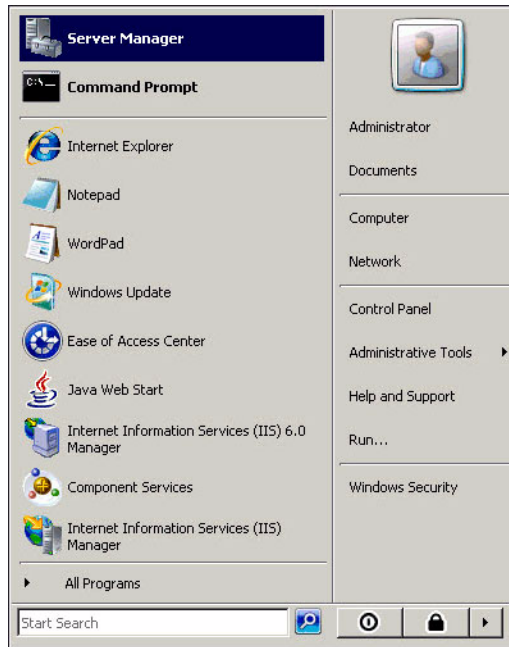
2. **Select Features in the left-hand pane.**

   The features summary page appears. See FIGURE 4-9.

FIGURE 4-9   Server Manager Features Selected

3. Click Add Features (right-side of page) to start the Add Features wizard.

The Add Features wizard begins and presents the default Features selected and a list of optional features available for installation in your system. See FIGURE 4-10.
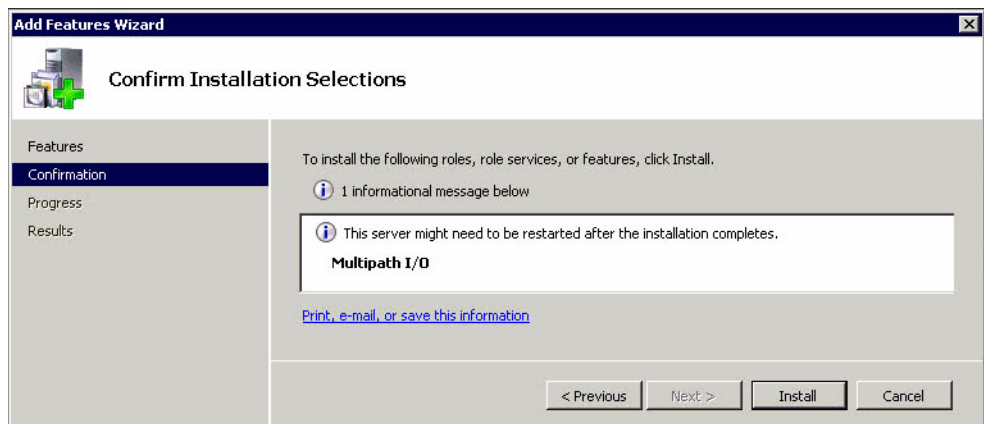
FIGURE 4-10 Add Features Selection Page
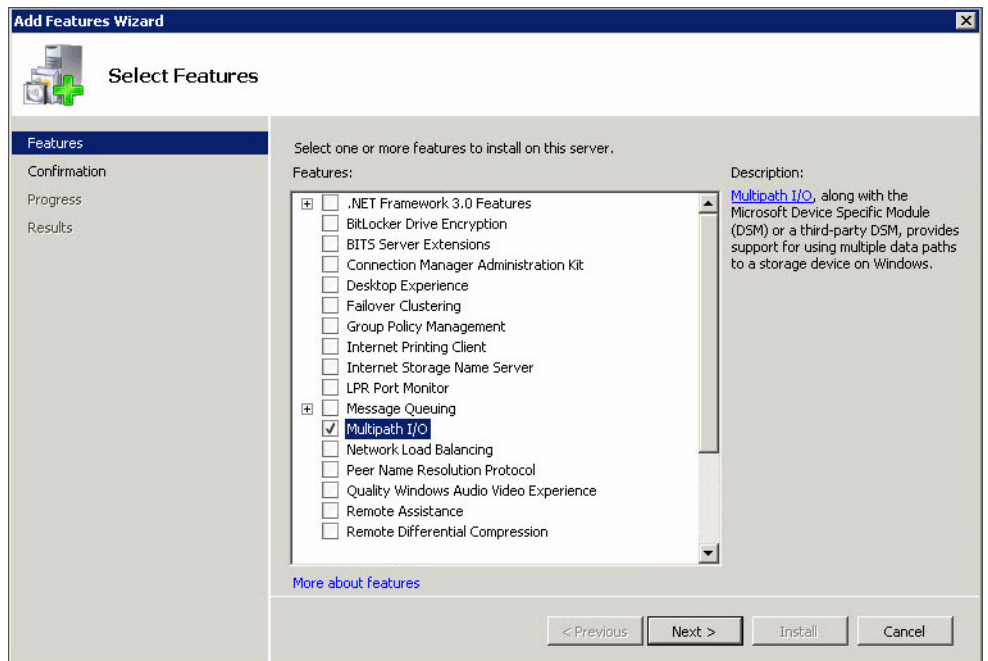
4. **Select the Multipath I/O option from the Message Queuing sublist, and then click Next.**

   The Add Features wizard Confirm Installation Selections page appears. See FIGURE 4-11.

FIGURE 4-11 Confirm Installation Selections Page

5. Click Install.

When the installation is finished, the Add Features wizard Installation Results page appears.

FIGURE 4-12 Installation Results Page
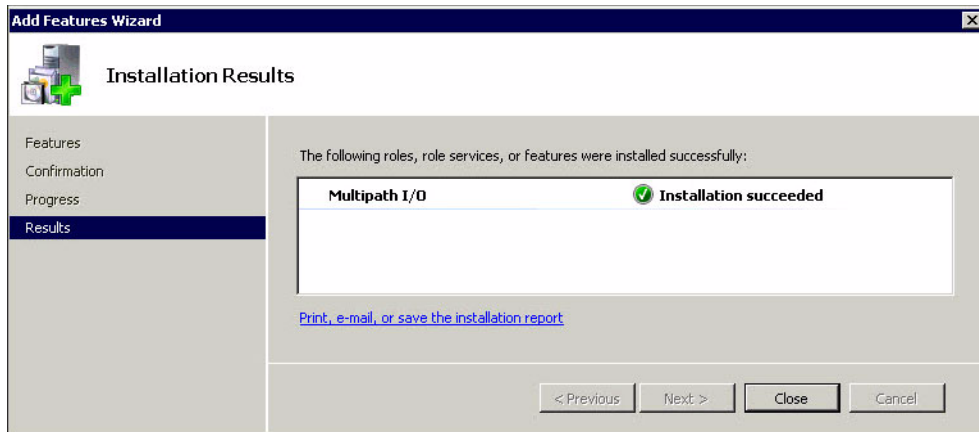
6. Click Close.

7. Close the Server Manager main window.

8. Click Start and select Control Panel.

9. Double-click MPIO properties.

After multipathing is installed, use MPIO properties to select the types of disks that will be multipathed.

FIGURE 4-13 Example MPIO Properties
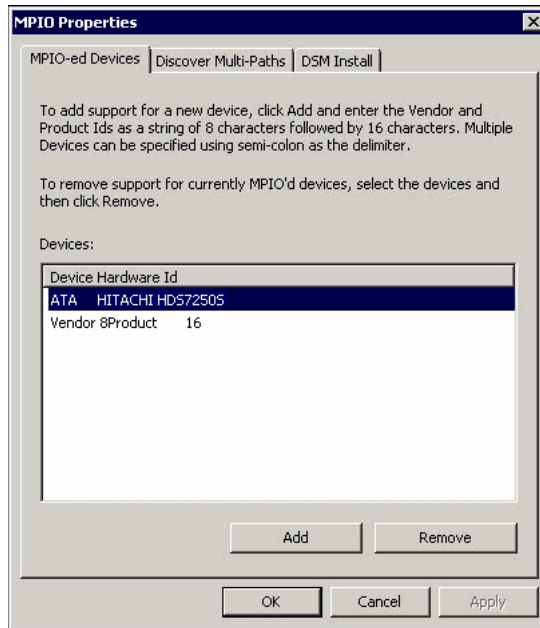
10. **Select the Discover Multi-Paths tab.**

    A list of all the disk drives by manufacturer ID and type are displayed. See
    FIGURE 4-14.

FIGURE 4-14 Example MPIO Properties Discover Multi-Paths Tab
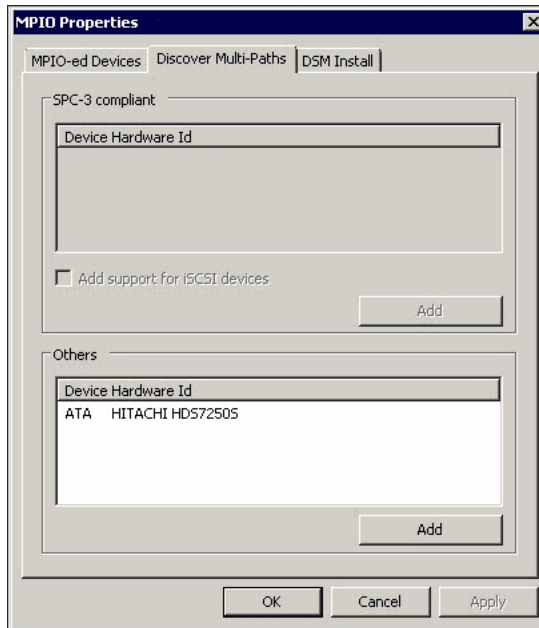
11. **Select the disk drives to multipath, and then click Add.**

12. **Click OK and reboot.**

    At this point, MPIO is installed and configured for dual paths. The second path is hidden by Windows. By default, MPIO is configured for active passive path failover.

13. **After the system reboots, configure MPIO properties for each disk, click Start, and the select Server Manager. See** FIGURE 4-8**.**

14. **Select Device Manager from the Diagnostics sublist.**

    An example view of disks is shown in FIGURE 4-15.

FIGURE 4-15 Example of Dual-Path Disks as Seen in Device Manager
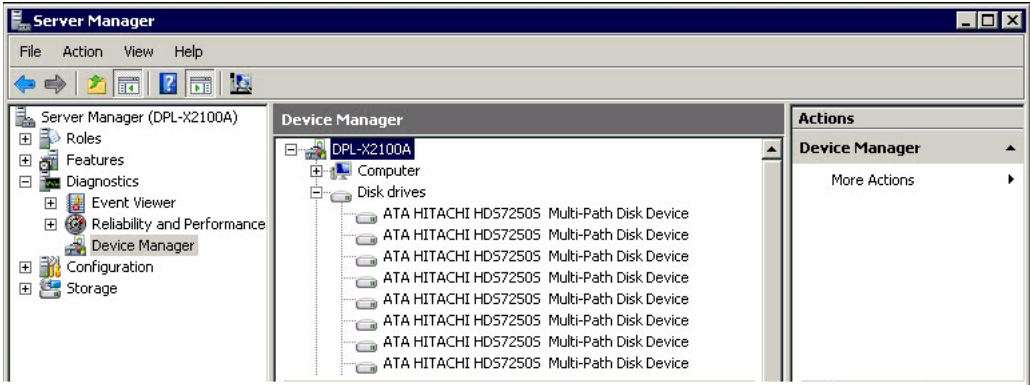
Next, you must make sure that the Load Balancing property for each disk is Failover Only.

15. Right-click a disk drive and select Properties.

The device properties dialog box appears.

FIGURE 4-16 Disk Device Properties Dialog Box with MPIO Tab Selected
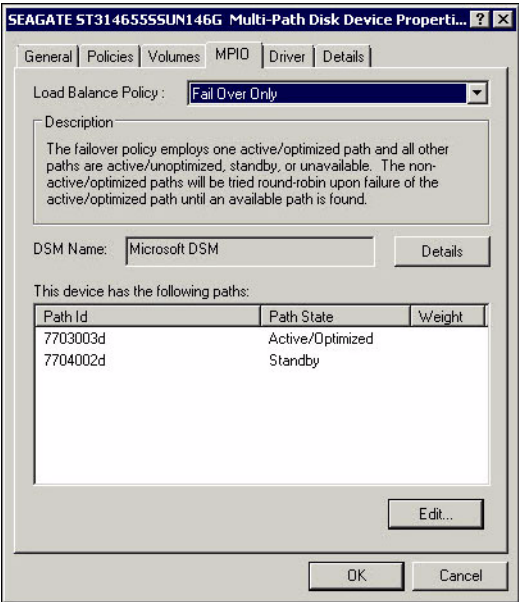
16. Select the MPIO tab.

17. **Choose Failover Only from the Load Balance Policy drop-down list. See**
    FIGURE 4-16**.**

    The J4500 array only supports Failover.

18. **Repeat steps 15 through 17 for each multi-path disk drive in the Device Manager window.**

▼ To Disable Multipathing in Windows Server 2008

Disabling multipathing to drives can be done at two levels:

- Remove drive types from MPIO control, but leave the MPIO feature enabled.
- Disable the MPIO feature.

The steps below describe both methods.

1. **To remove drive types from MPIO control:**

   a. **From the Windows Start menu, select Administrative Tools, and then select MPIO.**

      The MPIO Properties dialog box appears.

FIGURE 4-17 MPIO Properties Dialog Box
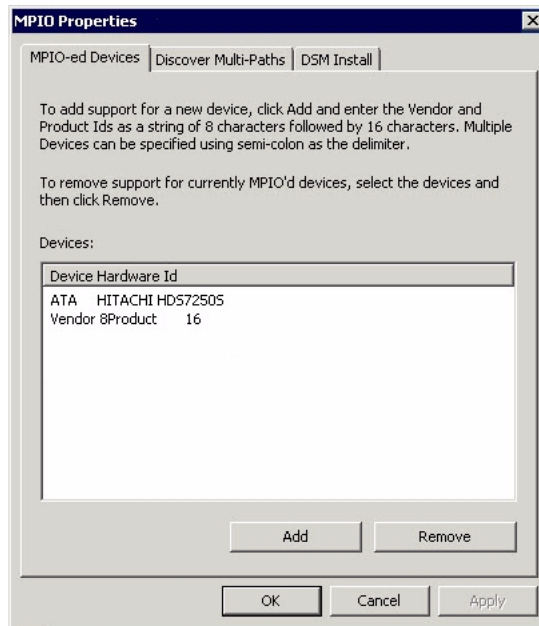
b. **Highlight a device in the list, and then click Remove.**

c. **Reboot the system as prompted.**

d. **After the server has restarted, repeat Steps a through c for each additional device type to be removed.**

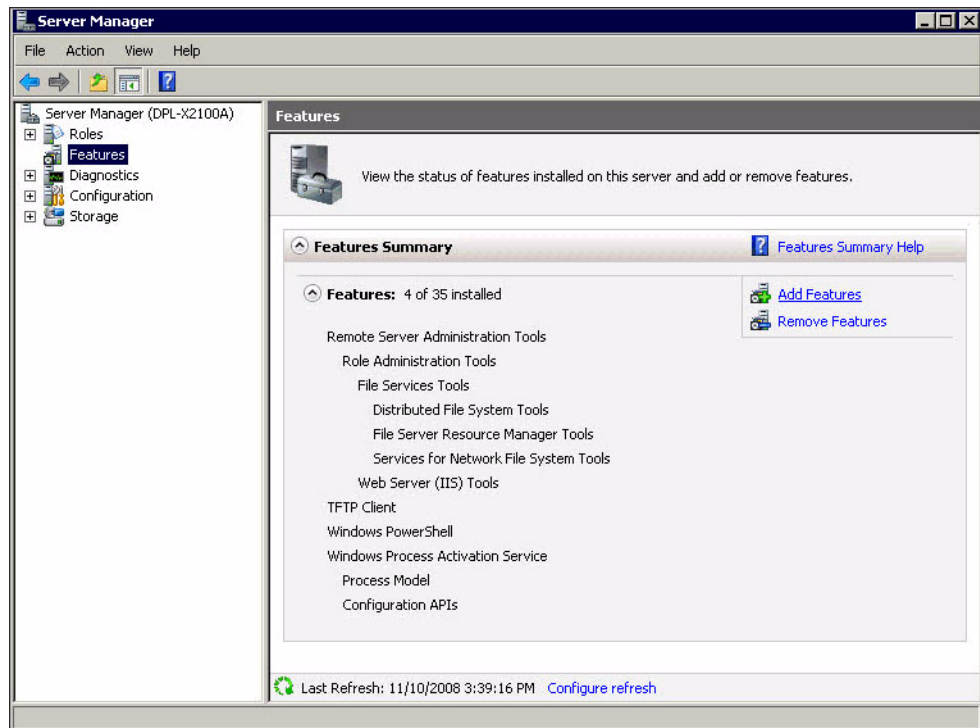   Once all multipath devices have been removed, you will next uninstall the multipath driver.

2. **To disable the and MPIO feature:**

a. **From the Windows Start menu, select Server Manager.**

b. **Select Features from the left-hand pane.**

   The features summary page appears.

FIGURE 4-18 The Features Summary Page

c. **Select Remove Features (right-side of page) to start the Remove Features wizard.**

   The Remove Features wizard begins.

d. **Select Multipath I/O from the Message Queuing sublist.**

FIGURE 4-19 Remove Features Wizard Page
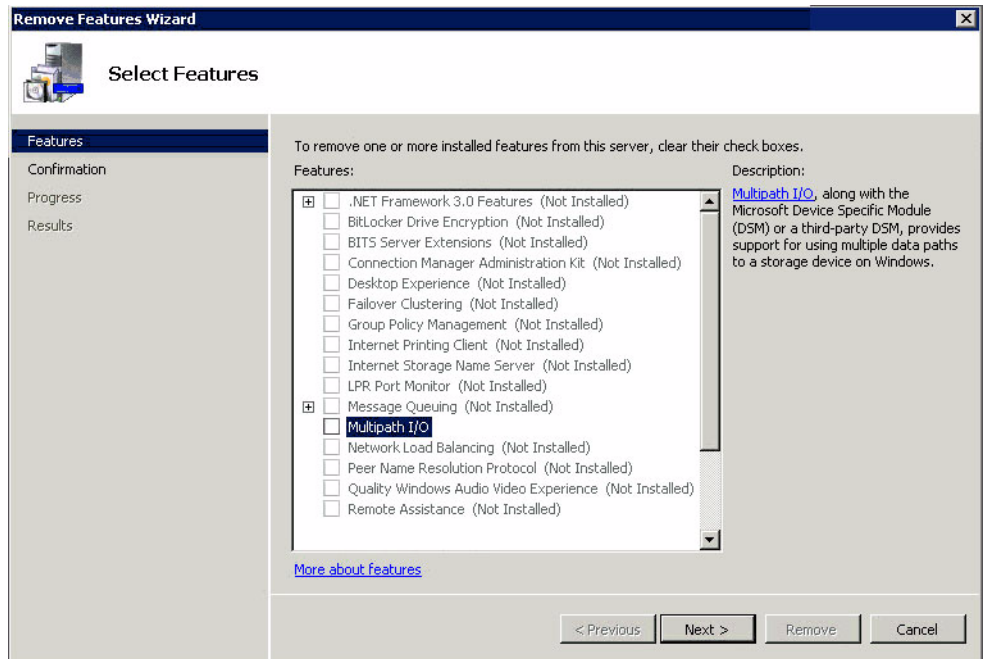
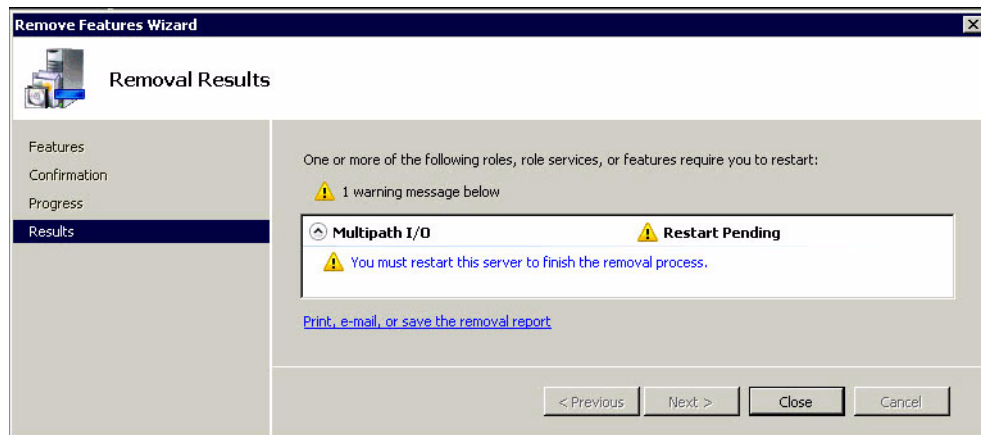The Confirm Removal Selections page appears. See FIGURE 4-20.

FIGURE 4-20 Confirm Removal Selections Page
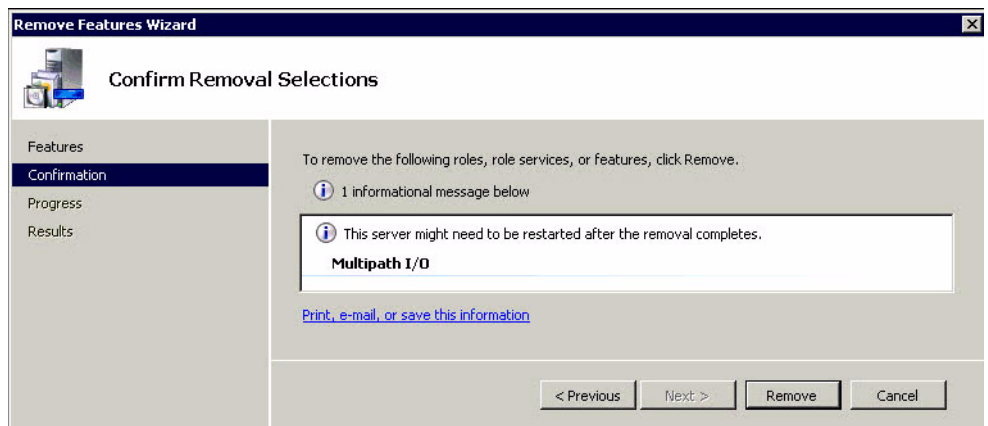
e. **Click Remove.**

The Removal Results page appears.

FIGURE 4-21 Remove Results Page

f. Click Close.

You will be prompted to reboot the system.

g. Click Yes to reboot.

The server will shut down and restart.

h. After the sever has restarted, the Removal Results page appears.

FIGURE 4-22 Removal Results Page
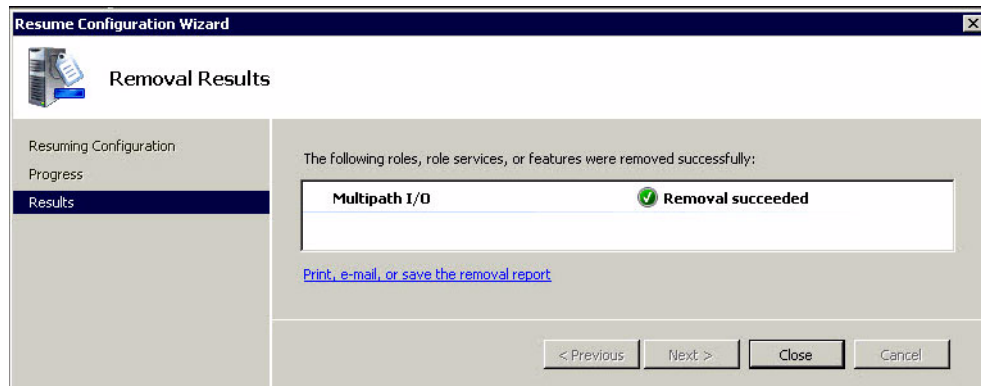
i. Click Close.

Multipath has been disabled.

Troubleshooting

This chapter describes procedures and steps you can take to troubleshoot problems with your Sun Storage J4500 array:

CAM Service Advisor

The Sun StorageTek Common Array Manager (CAM) software includes the Service Advisor application, which provides guided wizards with system feedback for hardware replacement of Customer Replaceable Units (CRUs). In addition, Service Advisor provides troubleshooting procedures for alarms.

Note – All Field Replaceable Units (FRUs) are also CRUs in the J4500 array.

Before you can access Service Advisor procedures, you must have already installed the Common Array Manager software, as described in the *Sun StorageTek Common Array Manager User Guide* for your version of CAM.

Host management, data host management, and remote command line interface (CLI) functions are performed by the Sun StorageTek Common Array Manager software.

The CRU replacement procedures available through the Sun StorageTek Common Array Manager Service Advisor application include (but are not limited to):

- Disks
- Power Supplies
- Fans
- System Controller
- Chassis

▼ To Access Service Advisor Procedures

To launch Service Advisor and access hardware replacement procedures:

1. **Log on to the Sun Java Web Console on the management software host.**

   For example, `https://management_host_address:6789`

2. **In the Storage section of the Sun Java Web Console page, select Sun StorageTek Common Array Manager.**

   The navigation pane and the Storage System Summary page appear.

3. **Select an array under Storage Systems.**

4. **At the top right of the Storage System Summary page, click the Service Advisor button.**

   The Service Advisor application is displayed in a separate window.

5. **In the left pane, select the type of hardware replacement procedure you want to perform:**

   - CRU/FRU Removal/Replacement Procedures
   - Array Utilities

Note – If you see Service-only procedures listed, these are password protected for access by Sun service personnel only. Contact a Sun service representative for further information and assistance with service only procedures.

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6. **To view a procedure, in the right pane either select it or expand its category, and select the hardware component that corresponds to the procedure.**

Taking Electrostatic Discharge (ESD) Precautions

Follow these steps to prevent damaging any CRU during the removal and replacement process:

- Remove all plastic, vinyl, and foam material from the work area.
- Before handling any CRU, discharge any static electricity by touching a grounded surface.
- Wear an anti-static wrist strap at all times when handling any CRU.
- Do not remove a CRU from its anti-static protective bag until you are ready to install it.
- After removing a CRU from the cabinet, immediately place it in an anti-static bag or anti-static packaging.
- Handle any card CRU only by its edges and avoid touching the components or circuitry.
- Do not slide a CRU over any surface.
- Limit body movement (which builds up static electricity) during the removal and replacement of a CRU.

▼ To Reserve the Array for Maintenance

Do the following to reserve the array for maintenance. This action will alert other users that a service action is in progress when they login.

1. **From the Service Advisor, click the link to reserve the array for maintenance.**

2. **Enter a description of the service action.**

3. **Select the estimated duration of the service action in hours from the pull-down.**

4. **Select the Reserve button.**

5. **Use the back arrow to return to the procedure.**

▼ To Release the Array After Maintenance

Once the required maintenance has been performed, release the array for normal operation.

● **From Service Advisor, disable the reserve array function by selecting the Release button.**

Understanding the CAM Event Log

This section provides event IDs, log listings, descriptions, and where applicable, Service action recommendations.

Refer to the *Sun StorageTek Common Array Manager User Guide* for your version of CAM for information on viewing system events and configuring automatic notifications.

In the event list below, note the following designations:

■ Down: Identifies a device or component as not functioning and in need of immediate service.

■ Critical: Identifies a device or component in which a significant error condition is detected that requires immediate service.

■ Major: Identifies a device or component in which a major error condition is detected and service may be required.

■ Minor: Identifies a device or component in which a minor error condition is detected or an event of significance is detected.

Note – Auto Service Request (ASR) monitors the array system health and performance and automatically notifies the Sun Technical Support Center when critical events occur. Critical alarms generate an Auto Service Request case. The notifications enable SunService to respond faster and more accurately to critical on-site issues.

TABLE 5-1   CAM Events for the Sun Storage J4500 Array

Code	Event Name	Severity	Description
xx.5.13	ValueChangeEvent-.disk	Major/ Critical	The Disk has changed state from OK to something else. Action: A disk may have been removed, or failed. Check the alarm log for additional events.
xx.5.19	ValueChangeEvent-.fan	Major/ Critical	A fan has changed state from OK to something else. Action: Check fan LEDs to locate the fault and replace the faulty fan to ensure nominal system operating temperature.
xx.5.227	ValueChangeEvent-.ps	Major/ Critical	A power supply has changed state from OK to something else. Action: check the event log and chassis fault LEDs to find the trouble. Replace the faulty power supply.
xx.5.586	ValueChangeEvent-.chassis	Major/ Critical	Chassis has had a negative state change. Action: Look for other events that can help identify the problem, check chassis fault LEDs. Replace any failed components.
xx.5.590	ValueChangeEvent-.overTemperatureFailure	Major	The system has detected a critical over-temperature. Action: This event should have shut down the array. Look for other events that can help identify the problem. Check the array's cooling vents and environment. You will need to press the array's power button to re-apply main power to the array, Check chassis fault LEDs and replace any failed components.
xx.5.591	ValueChangeEvent-.overTemperatureWarning	Major	The system has detected a warning temperature. Action: Look for other events that can help identify the problem. Check the array's cooling vents and environment. Check chassis fault LEDs and replace any failed components.
xx.11.21	CommunicationEstablishedEvent.ib	Minor	Indicates that communication has been re-gained to the storage array via the in-band path.
xx.12.21	CommunicationLostEvent.ib	Major/ Critical	Indicates that communication has been lost to the array, and that the last path successfully used was the in-band communication path.
xx.12.31	CommunicationLostEvent.oob	Major/ Critical	Indicates that communication has been lost to the proxy host connected to the storage array.
xx.14.16	DiscoveryEvent	Minor	Indicates that the discovery of an array or proxy host containing one or more arrays has occurred.

TABLE 5-1 CAM Events for the Sun Storage J4500 Array *(Continued)*

Code	Event Name	Severity	Description
xx.41.13	ComponentRemoveEvent.disk	Major/ Critical	A disk has changed state from OK to a removed state. Action: Check the alarm log to determine whether the disk has failed or has been removed for maintenance.
xx.41.19	ComponentRemoveEvent.fan	Minor	A fan has changed state from OK to a removed state. Action: Check the alarm log to determine whether the fan has failed or has been removed for maintenance.
xx.41.227	ComponentRemoveEvent.ps	Minor	A power supply has changed state from OK to a removed state. Action: Check the alarm log to determine whether the power supply has failed or has been removed for maintenance.
xx.75.42	RevisionDeltaEvent.revision	Minor	The firmware revision of the enclosure is not at baseline. Action: upgrade firmware to baseline.

Troubleshooting Problems with the Array

The following sections describe how to troubleshoot problems you may experience with the J4500 array.

- "Initial Start-up" on page 104
- "Check the Event and Performance Logs" on page 105
- "Using the Array Management Software to Monitor Enclosure Health" on page 106
- "Array Link Problems" on page 106
- "Disks Problems" on page 108
- "Array Environment Problems" on page 109
- "Power Problems" on page 110

Initial Start-up

If you are unable to see the array drives after powering on the array, check the following:

- Ensure all cables are properly connected (power and SAS).

- Be sure you are using SAS cables supported for use with the array. Using longer, or non-certified cables is not supported. For a list of supported cables, see the *Sun Storage J4500 Array Service Manual*, 820-3160.
- You should carefully follow the configuration rules listed in Chapter 1. Not following these rules could result in an unsupported configuration.
- Check the array indicator LEDs to make sure all components are operating normally and the link LEDs are green.
- The proper startup sequence for the array is to power-on the array first, wait one minute, then power-up the server.

Check the Event and Performance Logs

The operating system event log is a good first place to start in identifying problems or potential issues with the array enclosure or its disks. If you experience disk problems, such as disk errors or invalid read/writes, the system event log can help identify the problem disk.

Note – By default, errors for the enclosure (temperature, voltage, device status), may not be logged in the system event log, but only in the array management software event log. If you want errors to be forwarded to the system event log, refer to the HBA documentation to see if it supports this feature.

You may have problems with the array listed in multiple log files (system and HBA). If this is the case, concentrate on recent errors that best relate to the problem. Try to pinpoint the time when problems began to appear. Search through the log files as soon as possible for when the problems first appeared—log files can quickly fill up with errors and some information may be lost.

Identifying Disks in the Array Enclosure

Disks in the array enclosure are typically identified by the operating system in sequential order in a list of 51 devices; the first 4 addresses (0-3) represent the array's four SAS expanders, the other 48 addresses (4-51) represent the 48 hard disks. Drives are mapped in numerical order as shown on the drive map label on the top of the array enclosure. Device names and address information depends on other mass storage devices attached to the server and where the array's HBA is located in the PCI bus boot order.

Using the Array Management Software to Monitor Enclosure Health

Your J4500 array supports a powerful set of SMP (Serial Management Protocol) and SES-2 (SCSI Enclosure Services) enclosure management features. Some or all of these features are available through supported management software (for example, the Sun Common Array Manager (CAM), or the Sun StorageTek RAID Manager software) to provide a system administrator at the array-connected server or network-connected management console the following capabilities:

■ Monitor the enclosure status (on/off line status, component health)

■ Monitor the enclosure environment (voltage and temperature)

■ Remotely identify and locate enclosure components

■ Obtain FRU identification and status (expanders, hard disks, fans, power supplies)

■ Remove and install FRU components

■ Remotely reset the enclosure hardware

■ Remotely upgrade the enclosure's firmware (expanders and hard disk—must use CAM)

■ View the enclosure event log to aid in troubleshooting

Refer to Chapter 2 for more information on array management software.

Array Link Problems

You may encounter a problem where the server is unable to communicate with the array. Complete the following troubleshooting tasks to reestablish communications with the array.

■ Check the SAS link LEDs at the rear of the array enclosure (see "Sun Storage J4500 Array Front Panel Controls and Indicators" on page 6) to ensure the ports are communicating with the HBA. Each SAS port has a SAS Link Activity LED. The following LED states will be viewable:

   ■ On – 1 to 4 links are ready.

   ■ Blink – Read/Write port activity.

   ■ Off – Link is lost.

■ If the link LED is off, check the SAS cables for proper connection. Ensure that the cables are supported for the J4500 array (refer to the *Sun Storage J4500 Array Service Manual,* 820-3160).

- If you can not reestablish communication with the server, you can try resetting the enclosure hardware. The enclosure hardware may be reset with the power on. See "Resetting the Enclosure Hardware" on page 110. You may also remotely reset the enclosure through the Sun Common Array Manager.

- There may be a problem with SAS fabric you are using. Try using the redundant fabric. If you have daisy-chained J4500 arrays, be sure to move all cable connections to the redundant fabric—only one SAS fabric (SAS A or SAS B) may be used per HBA port connection. Cross fabric connections on an array enclosure (SAS A to SAS B) are not supported.

- There may be a problem with the SAS cable. The cable might be damaged and either prevents communication, or it may allow only degraded communication (which can manifest itself in poor array performance). The array comes with two cables, try attaching a new SAS cable.

- Review the Sun and operating system vendor knowledge bases to see if the problem is a known issue with a solution, also see the Sun support site http://www.sun.com/support. The J4500 array SAS expanders have firmware that may be upgraded as fixes and new features become available from Sun. For more about upgrading the enclosure firmware, see "Upgrading Sun Storage J4500 Array Firmware Using CAM" on page 37.

Switching SAS Cables or Making New Connections

In a single path environment: If your J4500 array is connected to the StorageTek SAS RAID External HBA, and you switch a cable from one port of the HBA to the other port on the HBA, you should wait long enough after the initial cable pull for all the physical hard drives shown in the GUI or through the CLI to be removed from the display. This prevents the problem of the controller attempting to remove drives at the same time it is reading the same drives on another port. If no display is available, you should wait at least 2 minutes between pull and reconnect.

In a multipath environment: Since the J4500 array uses SATA drives, the potential for SATA affiliation conflicts exists. Conflict can occur when more than one initiator tries to access the drive via the same path (for example, two hosts attached to SAS A on a J4500 array), or if you move an established connection from one domain port to another (for example, from port 0 to port 1). Possible symptoms of SATA affiliation conflicts are: operating system hangs, zoning operations take longer than 10 minutes to complete, and/or disk utilities like "format" will not return device lists in a timely fashion. For more about SATA affiliations, see "Access Configuration (Zoning) Guidelines" on page 46.

Disks Problems

Issues with array disks might be identified by viewing the system event log, being alerted by your array management software, or by viewing the J4500 array's LEDs. In the event of a disk failure, the disk may be replaced with the array online.

▼ To Replace a Disk

If the disk must be replaced, complete the following tasks:

1. **Slide the J4500 array out of the rack far enough to remove the disk top cover panel. For step-by-step procedures, refer to the *Sun Storage J4500 Array Service Manual* (820-3160).**

2. **To replace a disk, use the operating system, or enclosure management software command to unmount the disk and prepare it for removal. This is required to isolate the disk and stop all read/write activity.**

3. **Identify the physical disk to be removed by looking for the blue ready-to-remove LED, or the amber failed LED, on the disk. Then, remove the disk. For step-by-step procedures for removing disks from the enclosure, refer to the *Sun Storage J4500 Array Service Manual* (820-3160).**

4. **Replace the disk, then use the operating system or enclosure management software commands to remount the disk. If the disk is part of a RAID volume, it will automatically rebuild with the required data after replacement.**

Guidelines for Removal and Replacement of RAID Storage

When removing and replacing RAID disks in the J4500 array, use the following guidelines:

- Perform RAID disk removal and replacement procedures with the system powered on. That way, the HBA can update its RAID configuration information.
- When removing and replacing disks, allow enough time between each operation for the HBA to update the RAID configuration information. When hot-plugging non-failed drives for test purposes, you should wait a full minute after removal before reinserting the drive.

Persistent Affiliation When Changing HBAs

When connecting your array to an HBA, it is possible that the SAS "affiliation" feature may cause problems if the array was previously connected to another HBA. An affiliation is used by the SAS protocol to prevent multiple SAS initiators (HBAs) from interfering with each other when communicating with SATA drives. If you encounter such a problem, affiliations may be removed by power cycling the array enclosure prior to connecting it to a different HBA.

If You Do Not See All of the 48 Disks

If you see only some of the available disks (for example, if you see only 20 or 28 of the total 48 disks), try the following:

- Look through the vents at the back of the System Controller module to see if the 4 green expander heartbeat LEDs are blinking. If not, try power cycling the array.

- If the problem occurs repeatedly, there might be a problem with the System Controller module. Check in the Sun Common Array Manager (CAM) to see if the array is at firmware baseline, if not, you should upgrade the array firmware.

- If updating the array firmware does not solve the problem, the System Controller module may need to be replaced. For step-by-step procedures for replacing the System Controller module, refer to the *Sun Storage J4500 Array Service Manual* (820-3160).

- If you have moved SAS cables from one port to another, you may have SATA affiliation conflicts. Conflict can occur when more than one initiator tries to access the drive via the same path (for example, two hosts attached to SAS A on a J4500 array), or if you move an established connection from one domain port to another (for example, from port 0 to port 1). Possible symptoms of SATA affiliation conflicts are: operating system hangs, zoning operations take longer than 10 minutes to complete, and/or disk utilities like "format" will not return device lists in a timely fashion. For more about SATA affiliations, see "Access Configuration (Zoning) Guidelines" on page 46.

Array Environment Problems

The array enclosure needs to operate within a specific temperature range (below 35 °C or 95 °F). If the internal temperature is above that, the fans automatically increase in speed when a thermal threshold is reached. This could be a reaction to higher external ambient temperatures in the local environment. If the fan noise level and tone seem high, check to ensure there is no airflow restriction raising the enclosure's internal temperature.

If an excessive temperature threshold is reached that could damage components in the enclosure, the J4500 array Over Temperature LED will light. If this happens do the following:

- Use your array management software to check for a faulty fan. An enclosure fan is a hot-swappable and may be replaced with the power on. The fans include status LEDs to identify a faulty fan. For step-by-step procedures for replacing enclosure fans, refer to the *Sun Storage J4500 Array Service Manual* (820-3160).
- Check that there is clear, uninterrupted airflow at the front and rear of the array enclosure.
- Check for enclosure intake restrictions due to dust buildup and clear them.
- Check for excessive recirculation of heated air from the rear of the array enclosure to the front.
- Reduce the ambient temperature in the room where the array enclosure is racked.

Power Problems

The J4500 array includes redundant, hot-swappable power supplies. If a power supply fails, you may be alerted by the array management software or the array power supply status LEDs (an alert LED will light amber both at the front and rear of the array enclosure when service is required). For step-by-step procedures for replacing an enclosure power supply, refer to the *Sun Storage J4500 Array Service Manual* (820-3160).

Resetting the Enclosure Hardware

In the event the array becomes non-responsive to host commands or you cannot see its disks, you may need to reset the array enclosure hardware. You can reset the array with the power on. The array takes about 1 minute to reset before relinking to the host.

Note – The enclosure may be reset remotely using the Common Array Manager (CAM) software.

▼ To Reset the Enclosure Hardware Using the Reset Button

Resetting the array is done by pressing a recessed button at the rear of the array (see). The array may also be reset remotely using the Sun Common Array Manager.

Note – This procedure should only be performed after you've checked of other problems at the server and have shut down all server processes that are actively accessing the J4500 array.

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1. **At the back of the J4500 array, locate the enclosure Reset button (see** **).**

2. **Using a paper clip or stylus, press and release the recessed button on the back panel.**

   The reset process takes about 1 minute. After that, the server should again see the array disks.

FIGURE 5-1   Enclosure Reset Button
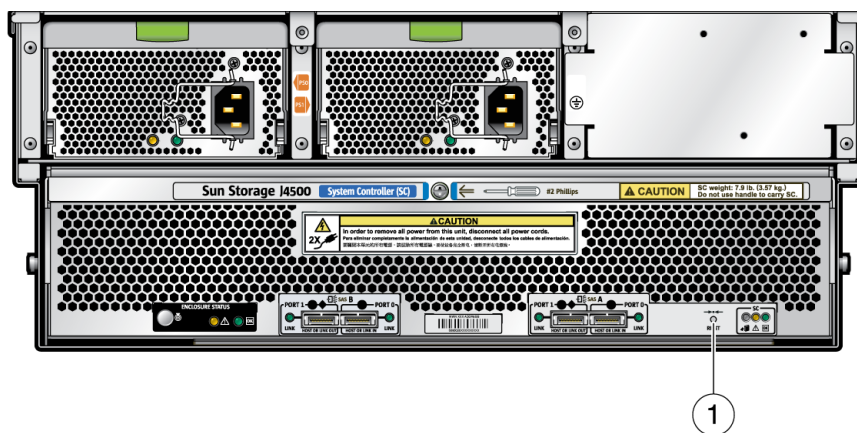
Figure Legend

1	Enclosure Reset button

Clearing the Enclosure Zoning Password

When creating storage zones on your J4500 array, use the Common Array Manager (CAM). CAM allows you to set a zoning password for each of the array's SAS domains (each domain equates to one of the array's SAS fabrics: A or B). The zoning passwords are stored in the array expanders and in CAM, and are used to prevent unauthorized changes to storage zones. If the array's zoning password is ever forgotten, or becomes corrupt, it can be cleared using the enclosure zoning password clear button on the back of the J4500 array.

Note – Using the enclosure zoning password clear button clears the zoning password for both of the J4500 array's SAS domains. It does not clear zoning configurations.

After clearing the zoning password on the array enclosure, you will also need to clear the zoning password for each of the array's SAS domains stored in CAM. This can be done from the CAM management host. Once the password is cleared in both places, you can use CAM to assign a new password to each of the array's SAS domains.

Note – Clearing the password in both places is important to ensure the passwords stored in the array and in CAM match. Some CAM array maintenance operations use the enclosure zone password during execution to ensure the action is authorized.

▼ To Clear the Enclosure Zoning Password

Clearing the enclosure zoning password is done by pressing a recessed button at the rear of the array. This operation may be performed with the enclosure running.

1. **At the back of the J4500 array, locate the Enclosure Zoning Password Clear button access hole (see** FIGURE 5-2**).**

2. **Using a paper clip, press and hold the recessed button on the back panel for five seconds and then release.**

   The enclosure zoning password for both SAS fabrics (A and B) is cleared.

FIGURE 5-2 Enclosure Zoning Password Clear Button
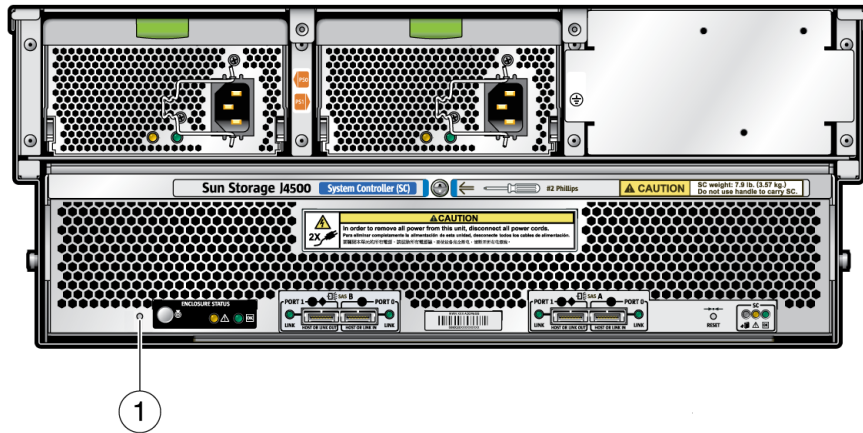
Figure Legend

1	Enclosure Zoning Password Clear button

3. From the CAM management host, select Clear password from the Administration page and save the setting for both of the array's SAS domains.

Once that is done, you can assign new zoning passwords using CAM.

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