IBM System Storage DS3500 and EXP3500 Storage Subsystem

Installation, User's, and Maintenance Guide

Note: Before using this information and the product it supports, read the general information in "Notices" on page C-1 and see the *Warranty Information* document that comes with the storage subsystem.

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Safety

Before installing this product, read the Safety Information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الآمنية

Antes de instalar este produto, leia as Informações de Segurança.

在安装本产品之前，请仔细阅读 Safety Information
（安全信息）。

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtete příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

Ennen kuin asennat tämän tuotteen, lue turvaohjeet kohdasta Safety Information.

Avant d'installer ce produit, lisez les consignes de sécurité.

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

Πριν εγκαταστήσετε το προϊόν αυτό, διαβάστε τις πληροφορίες ασφάλειας
(safety information).

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

Prima di installare questo prodotto, leggere le Informazioni sulla Sicurezza.

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

Пред да се инсталира овој продукт, прочитајте информацијата за безбедност.

Les sikkerhetsinformasjonen (Safety Information) før du installerer dette produktet.

Przed zainstalowaniem tego produktu, należy zapoznać się
z książką "Informacje dotyczące bezpieczeństwa" (Safety Information).

Antes de instalar este produto, leia as Informações sobre Segurança.

Перед установкой продукта прочтите инструкции по
технике безопасности.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

Antes de instalar este producto, lea la información de seguridad.

Läs säkerhetsinformationen innan du installerar den här produkten.

Safety statements

These statements provide the caution and danger information used in this documentation.

Important:

Each caution and danger statement in this documentation is labeled with a number. This number is used to cross reference an English-language caution or danger statement with translated versions of the caution or danger statement in the *Safety Information* document.

For example, if a caution statement is labeled "Statement 1," translations for that caution statement are in the *Safety Information* document under "Statement 1."

Be sure to read all caution and danger statements in this documentation before you perform the procedures. Read any additional safety information that comes with your system or optional device before you install the device.

Statement 1

DANGER

Electrical current from power, telephone, and communication cables is hazardous.

To avoid a shock hazard:
- Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.
- Connect all power cords to a properly wired and grounded electrical outlet.
- Connect to properly wired outlets any equipment that will be attached to this product.
- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.
- Connect and disconnect cables as described in the following table when installing, moving, or opening covers on this product or attached devices.

To Connect:	To Disconnect:
1. Turn everything OFF.	1. Turn everything OFF.
2. First, attach all cables to devices.	2. First, remove power cords from outlet.
3. Attach signal cables to connectors.	3. Remove signal cables from connectors.
4. Attach power cords to outlet.	4. Remove all cables from devices.
5. Turn device ON.	

Statement 2

CAUTION:
When replacing the lithium battery, use only IBM® Part Number 33F8354 or an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:
- Throw or immerse into water
- Heat to more than 100°C (212°F)
- Repair or disassemble

Dispose of the battery as required by local ordinances or regulations.

Statement 3

CAUTION:
When laser products (such as CD-ROMs, DVD drives, fiber optic devices, or transmitters) are installed, note the following:

- **Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.**

- **Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.**

DANGER

> **Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.**
>
> **Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.**

Class 1 Laser Product
Laser Klasse 1
Laser Klass 1
Luokan 1 Laserlaite
Appareil À Laser de Classe 1

Statement 4

| ≥ 18 kg (39.7 lb) | ≥ 32 kg (70.5 lb) | ≥ 55 kg (121.2 lb) |

CAUTION:
Use safe practices when lifting.

Statement 5

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.
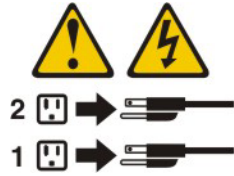
Statement 8

CAUTION:
Never remove the cover on a power supply or any part that has the following label attached.

Hazardous voltage, current, and energy levels are present inside any component that has this label attached. There are no serviceable parts inside these components. If you suspect a problem with one of these parts, contact a service technician.

Statement 11

CAUTION:
The following label indicates sharp edges, corners, or joints nearby.

Statement 12

CAUTION:
The following label indicates a hot surface nearby.

Statement 13

DANGER

> **Overloading a branch circuit is potentially a fire hazard and a shock hazard under certain conditions. To avoid these hazards, ensure that your system electrical requirements do not exceed branch circuit protection requirements. Refer to the information that is provided with your device for electrical specifications.**

Statement 15

CAUTION:
Make sure that the rack is secured properly to avoid tipping when the server unit is extended.

Statement 17

CAUTION:
The following label indicates moving parts nearby.

Statement 26

CAUTION:
Do not place any object on top of rack-mounted devices.

Statement 29

CAUTION:
This equipment is designed to permit the connection of the earthed conductor of the dc supply circuit to the earthing conductor at the equipment. If this connection is made, all of the following conditions must be met:

- This equipment shall be connected directly to the dc supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the dc supply system earthing electrode conductor is connected.
- This equipment shall be located in the same immediate area (such as, adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same dc supply circuit and the earthing conductor, and also the point of earthing of the dc system. The dc system shall not be earthed elsewhere.
- The dc supply source shall be located within the same premises as this equipment.
- Switching or disconnecting devices shall not be in the earthed circuit conductor between the dc source and the point of connection of the earthing electrode conductor.

Statement 34

CAUTION:

To reduce the risk of electric shock or energy hazards:

- **This equipment must be installed by trained service personnel in a restricted-access location, as defined by the NEC and IEC 60950-1, First Edition, The Standard for Safety of Information Technology Equipment.**
- **Connect the equipment to a reliably grounded safety extra low voltage (SELV) source. An SELV source is a secondary circuit that is designed so that normal and single fault conditions do not cause the voltages to exceed a safe level (60 V direct current).**
- **Incorporate a readily available approved and rated disconnect device in the field wiring.**
- **See the specifications in the product documentation for the required circuit-breaker rating for branch circuit overcurrent protection.**
- **Use copper wire conductors only. See the specifications in the product documentation for the required wire size.**
- **See the specifications in the product documentation for the required torque values for the wiring-terminal nuts.**

Statement 37

DANGER

> **When you populate a rack cabinet, adhere to the following guidelines:**
>
> - **Always lower the leveling pads on the rack cabinet.**
> - **Always install the stabilizer brackets on the rack cabinet.**
> - **Always install the heaviest devices in the bottom of the rack cabinet.**
> - **Do not extend multiple devices from the rack cabinet simultaneously, unless the rack-mounting instructions direct you to do so. Multiple devices extended into the service position can cause your rack cabinet to tip.**
> - **If you are not using the IBM 9308 rack cabinet, securely anchor the rack cabinet to ensure its stability.**

Attention: This product is suitable for use on an IT power distribution system whose maximum phase to phase voltage is 240 V under any distribution fault condition.

Chapter 1. Introduction

This chapter contains information about the operating specifications, features, and components of the IBM System Storage® DS3500 storage subsystem and the IBM System Storage EXP3500 storage enclosure.

Note: For Ethernet Interfaces: DS3500 storage subsystem is not intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunication networks.

The DS3500 storage subsystem and EXP3500 storage enclosure consist of the following models:
- DS3512 storage subsystem
- DS3524 storage subsystem
- EXP3512 storage enclosure
- EXP3524 storage enclosure

This chapter also includes an inventory checklist and information about best practices and product updates for your DS3500 storage subsystem and EXP3500 storage enclosure.

If firmware and documentation updates are available, you can download them from the IBM Web site. The DS3500 storage subsystem and EXP3500 storage enclosure might have features that are not described in the documents that are shipped with the device. Documents might be updated occasionally to include information about those features, or technical updates might be available, which are not included in the DS3500 storage subsystem and EXP3500 storage enclosure documents.

To check for updates, complete the following steps:
1. Go to http://www.ibm.com/servers/storage/support/.
2. On the "Support for System Storage and TotalStorage products" page, under **Select your product**, in the **Product family** field, select **Disk systems**.
3. In the **Product** field, select **DS3500** or **EXP3500**.
4. Click **Go**.
5. Select the following options:
   - For firmware updates, click the **Download** tab.
   - For documentation updates, click the **Install and use** tab.

Note: Changes are made periodically to the IBM Web site. Procedures for locating firmware and documentation might vary slightly from what is described in this document.

The DS3500 storage subsystem and EXP3500 storage enclosure have limited warranty. For more information about the terms of warranty, see the *Warranty Information* document that comes with the device.

Record information about the DS3500 storage subsystem and EXP3500 storage enclosure in "Storage subsystem and controller information record" on page A-2. You will need this information if you have to call for service.

Figure 1-1 on page 1-2 shows the location of the serial number label, product name, machine type, model, and serial number label.

Note: The illustrations in this document might differ slightly from your hardware.
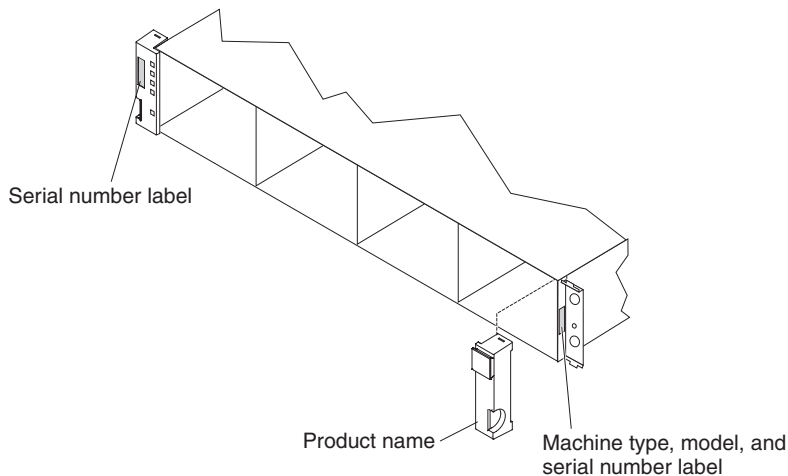
Figure 1-1. Serial number label, and product name, machine type, and model number label locations

Use "Hard disk drive locations" on page A-1 to keep a record of the drives that are installed in or attached to the DS3500 storage subsystem and EXP3500 storage enclosure. This information can be helpful when you install additional drives or if you have to report a hardware problem. Make a copy of this table before you record information in it, in case you need extra space to write new values later, or when you update the DS3500 storage subsystem and EXP3500 storage enclosure configuration.

DS3500 storage subsystem overview

With direct-attached Serial Attached SCSI (SAS) connectivity and support for RAID levels 0, 1, 3, 5, and 6, the DS3500 storage subsystem provides an internal physical storage capacity that is scalable up to 36 TB (terabytes) for the DS3512 and 24 TB for the DS3524 storage subsystem.

Note: RAID 6 implements a P+Q design. If RAID level 1 is implemented and the number of drives increases to more than two, RAID level 10 gets implemented automatically.

The DS3500 is a 2U rack-mountable storage subsystem that supports up to two redundant, dual-active RAID storage controllers. The DS3500 storage subsystem ships with two 6 Gbps x4 SAS host ports and a single 6 Gbps x4 SAS expansion port per controller. Each controller contains 1 GB of cache memory that can be upgraded to 2 GB. Each controller supports installation of the following host port adapters:
- 6 Gbps SAS
- 8 Gbps FC
- 1 Gbps iSCSI
- 10 Gbps iSCSI

When attached to EXP3500 storage enclosures, the DS3500 storage subsystem can be expanded to support 96 drives. This can be expanded to 192 drives when using the 96-192 drive expansion upgrade. The DS3500 storage subsystem and EXP3500 storage enclosures support configurations of 6 Gbps SAS, Near Line (NL) SAS, Solid State Disk (SSD), 6 Gbps SAS Full Disk Encryption (FDE) disk drives, or a mix of disk drives. You must purchase the Full Disk Encryption (FDE) option so that you can use FDE.

Advanced DS3500 storage management, copy service options, and optional advanced disaster recovery functions are available for the DS3500, including FlashCopy®, VolumeCopy, and Enhanced Remote Mirroring.

Note: Enhanced Remote Mirroring is supported on the dual-controller DS3500 models only.

Depending on the model, the DS3524 storage subsystems are shipped with either ac or dc (-48V dc) power supply and fan units.

DS3524 storage subsystems that are equipped with dc power supply and fan units (1746 model C4T) supports both NEBS level 3/Telco operating environments and standard Information Technology (IT) and office environments.

DS3512 and DS3524 storage subsystems that are equipped with ac power supply and fan units support both NEBS level 3/Telco operating environments and standard IT and office environments.

The IBM System Storage DS Storage Manager version 10 software is also available for the DS3500 storage subsystem. This storage-management software is designed to help centralize storage management, simplify partitioning of the DS3500 series storage into as many as 128 virtual servers, and strategically allocate storage capacity to maximize storage space.

Using the hot-swap features, you can remove and replace SAS drives, power supplies, and controllers (in a dual-controller storage subsystem).

EXP3500 storage enclosure overview

The EXP3500 is a 2U rack-mountable storage enclosure equipped with a single environmental services module (ESM), which can be expanded to dual redundant ESM when you install the optional ESM kit. The EXP3512 storage enclosure supports up to 12 drives and the EXP3524 storage enclosure supports up to 24 drives.

Depending on the model, the EXP3500 storage enclosures are shipped with either ac or dc (-48V dc) power supply and fan units.

EXP3500 storage enclosures that are equipped with ac power supply and fan units (1746 models E2A and E4A) support both NEBS level 3/Telco operating environments, and standard IT and office environments. EXP3524 storage enclosures that are equipped with dc power supply and fan units (1746 model E4T only) also support both NEBS level 3/Telco operating environments, and standard Information Technology (IT) and office environments.

Notices and statements in this document

The caution and danger statements in this document are also in the multilingual *IBM Systems Safety Notices* document, which is in the Documentation folder on the IBM *System Storage DS3500 Support* DVD. Each statement is followed by a reference number that you can use to locate the corresponding statement in your language in the *IBM Systems Safety Notices* document.

The following notices and statements are used in this document:
- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information or advice that might help you avoid inconvenient or problem situations.
- **Attention:** These notices indicate potential damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage might occur.
- **Caution:** These statements indicate situations that can be potentially hazardous to you. A caution statement is placed just before the description of a potentially hazardous procedure step or situation.
- **Danger:** These statements indicate situations that can be potentially lethal or extremely hazardous to you. A danger statement is placed just before the description of a potentially lethal or extremely hazardous procedure step or situation.

Features and operating specifications

Table 1-1 contains a summary of the features and operating specifications of the DS3500 storage subsystem and EXP3500 storage enclosure. Depending on the model, some features might not be available, or some specifications might not apply.

Table 1-1. Features and operating specifications

General:	Power supply with built-in fans:	Environment:

• Modular components
  – High-capacity disk drives
  – (DS3500) RAID storage controller modules
  – (EXP3500) environmental services modules (ESMs)
  – Power supplies with built-in fans
• Technology
  – Supports disk array technology
  – Redundant data storage, power and cooling system, (DS3500) SAS disk controllers, and (EXP3500) ESMs
  – Hot-swap technology for drives, power supplies, (EXP3500) ESMs, and (DS3500) controllers
  – (DS3500) Host port adapter. Each controller supports one host port adapter. Support for:
    - 6 Gbps SAS
    - 8 Gbps FC
    - 1 Gbps iSCSI
    - 10 Gbps iSCSI
• User interface
  – Built-in power, activity, and fault LEDs, identification labeling on components, rear LEDs, and connectors
  – Easy-to-replace drives, power supplies with built-in fans, and controllers
	• Two hot-swap 585-watt (100 - 240 V ac) standard
	• Provides redundant power
	
	Size:
	• DS3512 and EXP3512:
	  – Height: 8.6 cm (3.4 in.)
	  – Depth: 54.0 cm (21.3 in.)
	  – Width: 44.9 cm (17.7 in.)
	  – (DS3512) Weight: Single controller: 17.2 kg (38.0 lb) Dual controller: 18.5 kg (40.7 lb)
	  – (EXP3512) Weight: 16.9 kg (37.3 lb)
	• DS3524 and EXP3524:
	  – Height: 8.8 cm (3.5 in.)
	  – Depth: 48.7 cm (19.2 in.)
	  – Width: 44.9 cm (17.7 in.)
	  – (DS3524) Weight: Single controller: 20.2 kg (44.5 lb) Dual controller: 21.4 kg (47.2 lb)
	  – (EXP3524) Weight: 19.9 kg (43.8 lb)
		• Air temperature:
		  – On: 10° to 35°C (50.0° to 95°F); altitude: 30.5 (100 ft) below to 3000 m (9840 ft) above sea level; temperature change: 10°C (18°F) per hour
		  – Off: -10° to 50°C (14.0° to 120.0°F); maximum altitude: 3000 m (9840 ft); temperature change: 15°C (27.0°F) per hour
		• Humidity:
		  – On: 20% to 80%
		  – Off: 10% to 90%
		  – Maximum dew point: 26°C (79°F)
		  – Maximum humidity gradient: 10% per hour
		
		Heat output:
		
		Approximate heat output in British thermal units (Btu) per hour:
		• Minimum configuration: 205 Btu (60 watts)
		• Maximum configuration 1235 Btu (361 watts)

Table 1-1. Features and operating specifications (continued)

Hard disk drives:
- DS3512 and EXP3512: 12 LFF 3.5–inch 6 Gbps
- DS3524 and EXP3524: 24 SFF 2.5–inch 6 Gbps

Drive type: SAS, NL SAS, and SSD

Storage controllers:

(DS3500) SAS interface: Three 26-pin, mini-SAS connectors per controller

ESMs:

(EXP3500) SAS interface: Three 26-pin, mini-SAS connectors per ESM

Acoustical noise emissions:
- DS3512 and EXP3512 fully populated with 12 drives
    - Sound power (idling): 6.2 bels
    - Sound power (operating): 6.2 bels
    - Sound pressure (idling): 62 dBA
    - Sound pressure (operating): 62 dBA
- DS3524 and EXP3524 fully populated with 24 drives
    - Sound power (idling): 6.4 bels
    - Sound power (operating): 6.4 bels
    - Sound pressure (idling): 64 dBA
    - Sound pressure (operating): 64 dBA

Electrical input (ac models):
- Sine-wave input (50 - 60 Hz) required
- Input voltage low range:
    - Minimum: 90 V ac
    - Maximum: 140 V ac
- Input voltage high range:
    - Minimum: 200 V ac
    - Maximum: 264 V ac
- Approximate input kilovolt-amperes (kVA):
    - Minimum: 0.06 kVA
    - Maximum: 0.38 kVA

Electrical input (dc models):
- Input voltage range:
    - Minimum: -42 V dc
    - Nominal: -48 V dc
    - Maximum: -60 V dc
- Operating current: 16 A to 11.2 A

Notes:

1. Power consumption and heat output vary depending on the number and type of optional features that are installed and the optional power-management features that are in use.

2. These levels are measured in controlled acoustical environments according to the procedures specified by the American National Standards Institute (ANSI) S12.10 and ISO 7779, and are reported in accordance with ISO 9296. Actual sound-pressure levels in a given location might exceed the average stated values because of room reflections and other nearby noise sources. The declared sound-power levels indicate an upper limit, below which a large number of computers will operate.

Models and optional devices

The DS3500 storage subsystem controller cache size, partitions, and other features vary depending on the model and optional devices. Table 1-2 shows the DS3500 models and options available at the time of publication. Contact your IBM marketing representative or authorized reseller for more information about models and options.

Table 1-2. DS3500 models and optional devices

Base configurations	Optional features (for all base configurations as appropriate)
DS3512 Single Controller: • One controller with 1 GB cache • Two 6 GB SAS ports • Supports one host interface card	Host Interface Cards: • 6 Gbps SAS 2-port daughter card • 8 Gbps FC 4-port daughter card (includes two 8 GB SFP transceivers) • 1 Gbps iSCSI 4-port daughter card • 10 Gbps iSCSI 2-port daughter card with RJ-45 port connectors
DS3512 Dual Controller: • Two controllers each with 1 GB cache (2 GB total) • Four 6 GB SAS ports • Supports two host interface cards (must be of same type)	Additional Hardware Options: • Second controller (for single-controller base system) • 8 GB FC SFP transceiver pair • 2 GB cache upgrade (quantity one for single controller, two for dual controller)

Table 1-2. DS3500 models and optional devices (continued)

Base configurations	Optional features (for all base configurations as appropriate)
DS3524 Single Controller: • One controller with 1 GB cache • Two 6 GB SAS ports • Supports one host interface card	Licensed functions: • Turbo performance (requires dual controllers) • Full Disk Encryption (FDE)
DS3524 Dual Controller: • Two controllers each with 1 GB cache (2 GB total) • Four 6 GB SAS ports • Supports two host interface cards (must be of same type)	
DS3524 Dual Controller - DC power: • Two controllers each with 1 GB cache (2 GB total) • Four 6 GB SAS ports • Supports two host interface cards (must be of same type)	

Operating-system support

The following operating systems are supported for host servers that have mapped LUNs created in the DS3500 storage subsystem with storage enclosures:

- IBM AIX®
- IBM Linux on POWER® (LoP)
- Microsoft Windows Server 2003
- Microsoft Windows Server 2008
- Red Hat® Enterprise Linux
- SuSE Linux Enterprise Server
- VMware ESX Server

For additional host operating-system support, see the latest Storage Manager software readme file and the IBM DS3000 series products interoperability matrix at http://www.ibm.com/systems/storage/disk/.

Product updates

Important: To keep your storage subsystem up-to-date with the latest firmware and other product updates, register the storage subsystem for technical support notifications. Go to http://www.ibm.com/servers/storage/support/disk/. From the menu at the top of the page, click **My IBM** and select **My Technical Support**. On the next page, click **register now**.

Download the latest version of the Storage Manager software, DS3500 storage subsystem controller firmware, DS3500 series storage enclosure firmware, and drive firmware when you initially install the storage subsystem and when product updates become available.

To receive product updates, complete the following steps:

1. After you have registered, type your user ID and password to log in to the site. The "My notifications for technical support" page opens.
2. From the **Subscribe** tab, click **Storage disk systems**.
3. Click the box next to the product you want to receive information about.

4. Click **Continue**.
5. Under **Notify me by**, click **e-mail**.
6. Click the **Submit** button to complete the notifications process.

Best practices guidelines

To ensure optimal operation of your system, follow these best practices:

- Ensure that the storage subsystem is in an optimal state before you shut it down. Never turn off the power if any amber LED is lit; be sure to resolve any error conditions before you shut down the storage subsystem.
- Back up the data on your storage drives periodically.
- To maintain power redundancy, connect the DS3500 storage subsystem and EXP3500 storage enclosure right and left power supplies to two independent external power circuits through ac power distribution units (PDUs) inside a rack or directly into external receptacles. This ensures that all devices in the configuration have power when only one power circuit is available. In addition, having all the right or all the left power cables connected to the same power circuit enables the devices in the configuration to power-on simultaneously during an unattended restoration of power.

  Note: Do not overload the circuits that power your storage subsystem and storage enclosures. Use additional pairs of ac PDUs. See Table 1-1 on page 1-4 for information about storage subsystem power requirements. Contact the technical-support representative for additional information.

- Save the storage subsystem profile before any planned system shutdown or after any system additions, removals, or modifications (including firmware updates, logical drive creations, storage partitioning definitions, hardware changes, and so on). For instructions to save the storage subsystem profile for DS Storage Manager V10.77 or earlier, see the *IBM System Storage DS® Storage Manager Version 10 Installation and Host Support Guide*. For DS Storage Manager V10.83 or later, see *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide*. Save the profile in a location other than in the logical drives that are created for the DS3500 storage subsystem and EXP3500 storage enclosure.
- During any maintenance or attended power-on procedure, carefully follow the power-on sequence that is described in "Turning on the storage subsystem" on page 4-2. Make sure that each component of the storage subsystem is powered-on in the correct order during this entire power-on procedure to ensure that the controller will be able to optimally access all of the storage subsystems.
- The storage subsystem supports simultaneous power-on to the system components. However, you must always follow the power-on sequence that is described in "Turning on the storage subsystem" on page 4-2 during any attended power-on procedure.
- A storage subsystem in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, call your IBM technical-support representative if any of the following conditions occur:
  - The storage subsystem logical drives and subsystems do not display in the Storage Manager graphical user interface.
  - The storage subsystem logical drives and subsystems are not online.
  - The storage subsystem logical drives and subsystems seem to be degraded.
- When using dc models equipped with dc power supply and fan units, install the dc disconnect/breaker device as described in "Cabling the DS3500 and EXP3500 dc power supplies" on page 3-45.

Attention:

– The disconnect device (circuit breaker) must be rated at 20 A.

– Ensure that only 12 AWG or larger copper conductor wires are used for all of the wiring between the DS3500 or EXP3500 dc power connectors and the dc power source.

DS3500 storage subsystem and EXP3500 storage enclosure components

The DS3500 storage subsystem and EXP3500 storage enclosure have the following removable components. These components, called customer replaceable units (CRUs), are accessible from the front or rear of the storage subsystem.

- (DS3512 and EXP3512) Up to 12 LFF 3.5–inch 6 Gbps SAS or NL SAS drives and drive filler panels.
- (DS3524 and EXP3524) Up to 24 SFF 2.5–inch 6 Gbps SAS, NL SAS, or SSD drives and drive filler panels.
- (DS3512 and DS3524) Up to two controllers. Each controller supports the installation one of the following optional host port adapters:
  - 6 Gbps SAS
  - 8 Gbps FC
  - 1 Gbps iSCSI
  - 10 Gbps iSCSI
- (EXP3512 and EXP3524) Up to two ESM modules.
- Two ac power supply and fan units (machine type 1746 models C2A, E2A, C4A, and E4A).
- Two dc power supply and fan units (machine type 1746 models C4T and E4T).

Disk drives and bezels

The hot-swap drive bays that are accessible from the front of the DS3512 storage subsystem and EXP3512 storage enclosure are shown in Figure 1-2. The hot-swap drive bays that are accessible from the front of the DS3524 storage subsystem and EXP3524 storage enclosure are shown in Figure 1-3 on page 1-9.
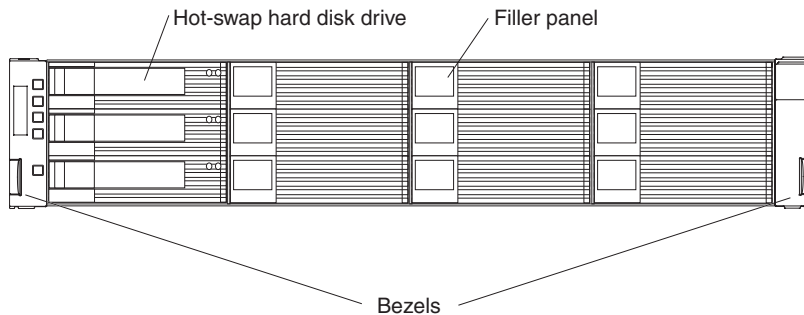
Figure 1-2. DS3512 storage subsystem and EXP3512 storage enclosure hot-swap drive bays and bezels
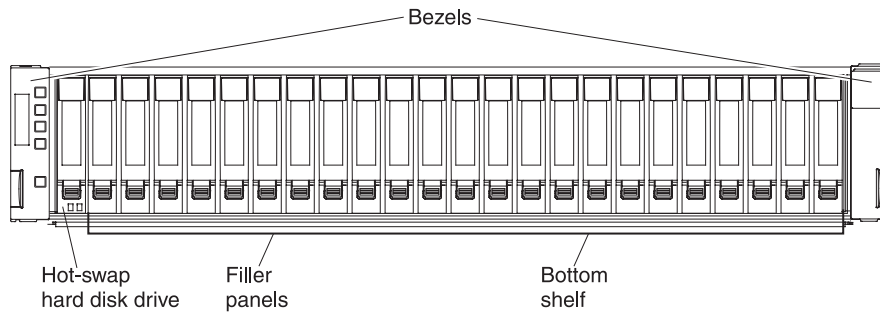
Figure 1-3. DS3524 storage subsystem and EXP3524 storage enclosure hot-swap drive bays and bezels

Hot-swap drive

You can install up to 12 hot-swap SAS or NL SAS drives in the DS3512 storage subsystem and EXP3512 storage enclosure. You can install up to 24 hot-swap SAS or NL SAS drives in the DS3524 storage subsystem and EXP3524 storage enclosure.

Filler panel

The DS3500 storage enclosure and EXP3500 storage enclosure have filler panels in the empty drive bays. Before you install a disk drive, remove the filler panel and save it for future use. Each of the drive bays must contain either a filler panel or a drive.

Left-side bezel

The left-side bezel contains the LEDs, as shown in the following illustration. For a description of the LEDs, see "Front LEDs" on page 4-8.
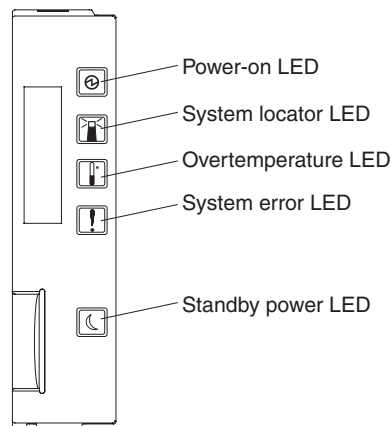
Figure 1-4. Left-side bezel

Right-side bezel and bottom shelf

The right-side bezel and bottom shelf contain the drive identification information. Figure 1-5 on page 1-10 shows the right-side bezel of the DS3512 storage subsystem and EXP3512 storage enclosure. Figure 1-6 on page 1-10 shows the bottom shelf of the DS3524 storage subsystem and EXP3524 storage enclosure.
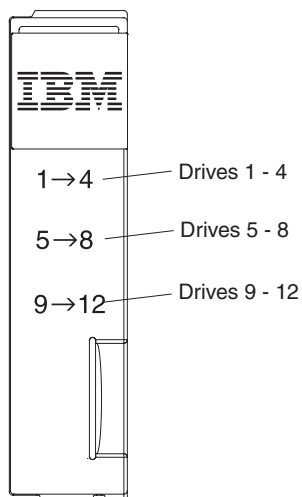
Figure 1-5. Right-side bezel (DS3512 and EXP3512)

Drives 1 - 24
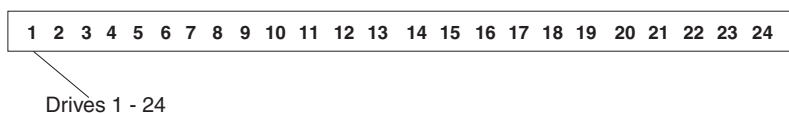
Figure 1-6. Bottom shelf (DS3524 and EXP3524)

The drives are preinstalled in drive trays. Install drives in the drive bays on the front of the storage subsystem or storage enclosure. When a drive is installed, the drive and tray bay designation is set automatically. The hardware addresses are based on the enclosure ID setting on the controller and on the physical locations of the drives.

There are no serviceable parts in a drive assembly. If it fails, the whole drive assembly, along with the drive, bezel, and tray, must be replaced. When you replace a drive, ensure that you order the correct drive. Using an unsupported drive can cause the drive to be locked out by the controller firmware.

Attention:
1. After you remove a drive from a bay, wait for 70 seconds to allow the drive to spin down before you replace or reseat the drive. Failure to do so might cause unpredictable results.
2. Never hot-swap a drive when its associated green activity LED or amber fault LED is flashing. Hot-swap a drive only when its associated amber fault LED is lit continuously or when the drive is inactive and its associated green activity LED is not flashing.

Note: If the drive that you want to remove is not in a failed or bypass state, use the Storage Manager software either to place the drive in a failed state or to place the array that is associated with the drive (or drives) in an offline state, before you remove the drive from the enclosure.

Controllers

The DS3500 storage subsystem comprises one or two controllers. When the DS3500 storage subsystem has two controllers, the controllers are redundant and can be hot-swapped. The controllers contain the storage subsystem control logic, interface ports, and LEDs. Each controller contains the following ports:

- Two 6 Gbps SAS host ports
- One SAS drive port to connect EXP3500 storage enclosures
- Two Ethernet ports for subsystem management
- Support for one optional host port adapter:

- Two-port 6 Gbps SAS
- Four-port 8 Gbps FC
- Four-port 1 Gbps iSCSI
- Two-port 10 Gbps iSCSI

The Ethernet ports consist of the following default IP addresses:
  Port 1 on controller A is 192.168.128.101
  Port 2 on controller A is 192.168.129.101
  Port 1 on controller B is 192.168.128.102
  Port 2 on controller B is 192.168.129.102

The subnet mask for both Ethernet ports is 255.255.255.0.

Attention: When a DS3500 storage subsystem has two controllers, the controllers must be identical to each other in hardware (host port adapter and cache size) and firmware. If you install a host port adapter in one controller, you must install an identical host port adapter in the other controller.

The storage management software automatically sets the enclosure ID for the controllers. You can change the enclosure ID through the Storage Manager software only. There are no switches on the DS3500 chassis to manually set the enclosure ID. Both controller enclosure IDs are identical under normal operating conditions.

Figure 1-7 shows a single-controller storage subsystem without an optional host port adapter installed. See "Cabling the DS3500 storage subsystem" on page 3-1 for illustrations of the storage subsystem with optional host port adapters installed in the controllers.
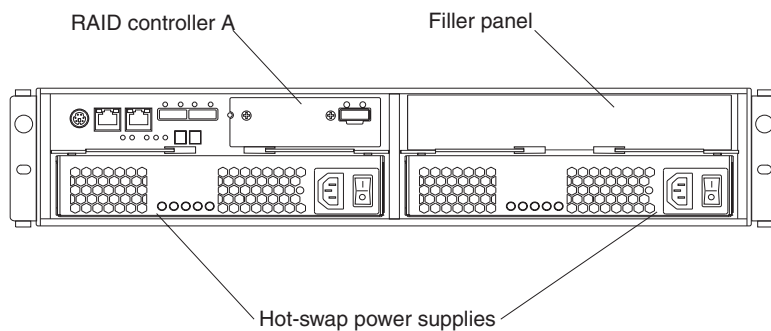
Figure 1-7. Rear view, single-controller model (shown without an optional host port adapter)

Environmental service modules

The EXP3500 storage enclosure comprises a single environmental service module (ESM). An optional ESM is available for redundant configurations. If the controller connected to the ESM supports more than one EXP3500 storage enclosure per physical port, you can connect two or more EXP3500 storage enclosures by chaining them together. For information about connecting an EXP3500 storage enclosure to a DS3500 storage subsystem, see "Connecting storage enclosures to the DS3500" on page 3-17.

Figure 1-8 on page 1-12 shows an EXP3512 storage enclosure containing one ESM and a filler panel over the blank ESM bay.

ESM   Filler panel

Hot-swap power supplies
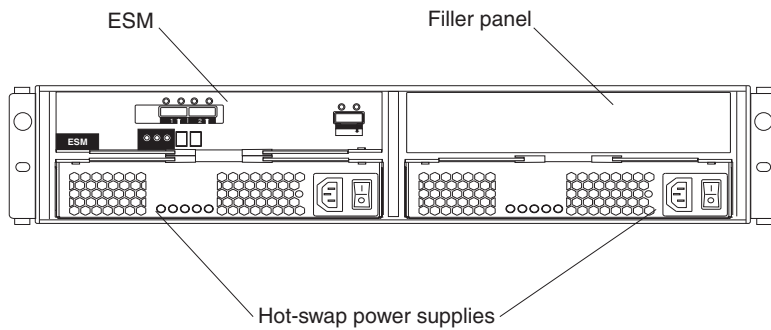
Figure 1-8. Rear view, single ESM model storage enclosure

AC power supply and fan units

The DS3500 storage subsystem (models DS3512-C2A and DS3524-C4A) and EXP3500 storage enclosure (models EXP3512-E2A and EXP3524-E4A) each have two removable ac power supplies. Each ac power supply has two fans. The four fans pull air through the drives from front to back across the drives.

The fans provide redundant cooling, which means that if one fan fails, the remaining fans continue to provide sufficient cooling to operate the storage subsystem or storage enclosure. If one power supply is turned off or malfunctions, the other power supply maintains electrical power to the storage subsystem or storage enclosure. To preserve the optimal airflow, do not remove a failed power supply from the chassis until you are ready to replace it with a new power supply.

Figure 1-9 shows the ac power supply components.

Power   Power   Power   Power
connector   switch   connector   switch
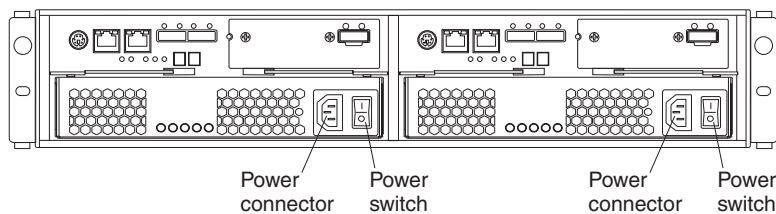
Figure 1-9. AC power supply components

DC power supply and fan units

The DS3524 storage subsystem (model C4T) and EXP3524 storage enclosure (model E4T) each have two removable dc power supplies. Each dc power supply has two fans. The four fans pull air through the drives from front to back across the drives.

The fans provide redundant cooling, which means that if one fan fails, the remaining fans continue to provide sufficient cooling to operate the storage subsystem or storage enclosure. If one power supply is turned off or malfunctions, the other power supply maintains electrical power to the storage subsystem or storage enclosure. To preserve the optimal airflow, do not remove a failed power supply from the chassis until you are ready to replace it with a new power supply.

Figure 1-10 on page 1-13 shows the dc power supply components.
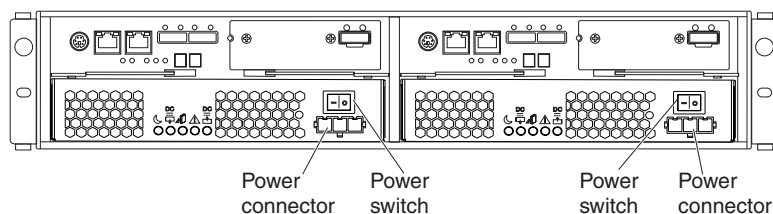
Figure 1-10. DC power supply components

Figure 1-11 and Table 1-3 below show the location and describe the function of the dc power supply connector pins.
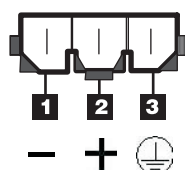
Figure 1-11. DC power supply connector - pin positions

Table 1-3. DC power supply connector - pin descriptions

Number	Description
1	Pin 1: - 48 V dc
2	Pin 2: POS RTN
3	Pin 3: GND

Battery units

Each controller contains 1024 MB of cache memory (minimum). It also contains a sealed, rechargeable lithium ion battery that maintains data in the cache so that it can be transferred to flash memory if power fails.

Figure 1-12 shows the locations of the battery and memory cache DIMM in the controller.
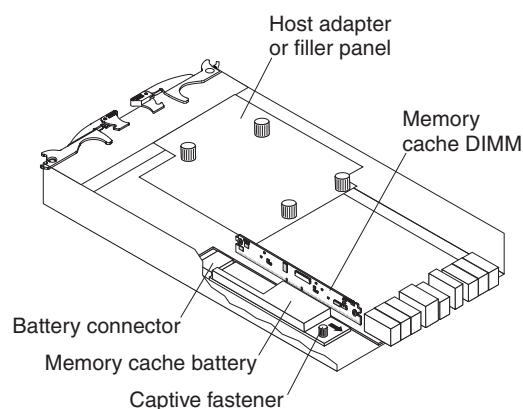
Figure 1-12. Battery unit

The battery chargers in the power supplies perform a battery learn test when the storage subsystem is started for the first time and at a scheduled interval thereafter. Data caching starts after the battery tests are completed.

The condition of the battery is indicated by an LED on the rear of the controller (see "Controller LEDs" on page 4-9 for the location of the battery fault LED and conditions that the LED indicates). You can also check the status of the battery using the Storage Manager client software.

Software and hardware compatibility and upgrades

The latest controller firmware, NVSRAM firmware, ESM firmware, and drive firmware must be installed to ensure optimal functionality, manageability, and reliability.

Software and firmware support code upgrades

To enable support for the DS3500, you must ensure that the system software and firmware are of the latest versions. To find the latest Storage Manager software, controller firmware, NVSRAM, ESM firmware, and drive firmware, check the firmware readme files.

The DS3500 was initially shipped with controller firmware version 7.70.16.01. With controller firmware version 7.77.xx.xx, the following capabilities and support are available:

- Standard feature extended capabilities added with controller firmware version 7.77.xx.xx:
  - The number of supported logical drives per subsystem is increased to 512 from 256.
  - The number of logical drives that can be assigned to a host partition is increased to 256 from 32.
- Premium feature extended capabilities added with controller firmware version 7.77.xx.xx:
  - The number of drives per subsystem can be increased to 192 from 96. To obtain this optional capability, you must purchase a 96 to 192 drive expansion premium feature.
  - The number of host partitions supported per subsystem can be increased to 128 from 64. To obtain this optional support, you must purchase the appropriate host partition upgrade premium feature for the currently enabled 4, 8, 16, 32 or 64 host partitions.
  - The number of FlashCopy logical drives per subsystem is increased to 256 from 64. To obtain this capability, you must purchase a FlashCopy premium feature. No additional purchase is required.
  - The number of VolumeCopy logical drives per subsystem is increased to 256. To obtain this optional capability, you must purchase a VolumeCopy premium feature. No additional purchase is required.
  - The number of remote mirroring logical drives can be increased to 16 from 8. To obtain this optional support, you must purchase an 8 to 16 mirrors upgrade premium feature in addition to the standard remote mirroring premium feature.
- Hardware support added with controller firmware version 7.77.xx.xx:
  - 10 Gbps iSCSI host card
  - DS3524 model with DC power supplies
- The controller firmware version 7.83.xx.xx supports the following features:
  - Dynamic disk pooling
  - Thin provisioning
  - Enhanced FlashCopy
  - ALUA fail-over method

For instructions to install the DS Storage Manager V10.77 or earlier, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide*. For instructions to install the DS Storage Manager V10.83 or later, see the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide*.

Determining firmware levels

To determine the firmware levels of the DS3500 storage subsystem, the connected storage enclosures, and the installed drives, use the Storage Manager software that is used to manage the DS3500 storage subsystem.

1. In the Subsystem Management window, click the **Summary** tab.
2. In the Status section, click **Storage Subsystem Profile**. The Storage Subsystem Profile window opens.
3. Click the **All** tab and scroll through the **Profile For Storage Subsystem** to locate the following information:

Note: The **Profile For Storage Subsystem** contains profile information for the entire subsystem. Therefore, you might have to scroll through a large amount of information to locate the firmware version numbers.

DS3500 Storage Server
- Firmware version
- NVSRAM version

Hard Disk Drives
- Firmware version

Drive Enclosure
- ESM firmware version

Specifications

The specifications of the DS3500 storage subsystem and EXP3500 storage enclosure are listed in Table 1-1 on page 1-4. This section provides additional site specifications for the DS3500 storage subsystem and EXP3500 storage enclosure. Before you install the storage subsystem, you must either check that the planned installation site meets these requirements, or prepare the site so that it meet these requirements. Preparations might include area, environmental, and electrical requirements for DS3500 storage subsystem and EXP3500 storage enclosure installation, service, and operation.

Area requirements

The floor space at the installation site must support the weight of the storage subsystem and associated equipment; provide sufficient space to install, operate, and service the storage subsystem; and provide sufficient ventilation to provide free flow of air to the unit.

Dimensions

Figure 1-13 shows the dimensions of the DS3512 storage subsystem and EXP3512 storage enclosure, which conforms to the 19-inch rack standard.

44.9 cm (17.7 in.)

8.6 cm (3.4 in.)

54.0 cm (21.3 in.)

48.2 cm (19 in.)
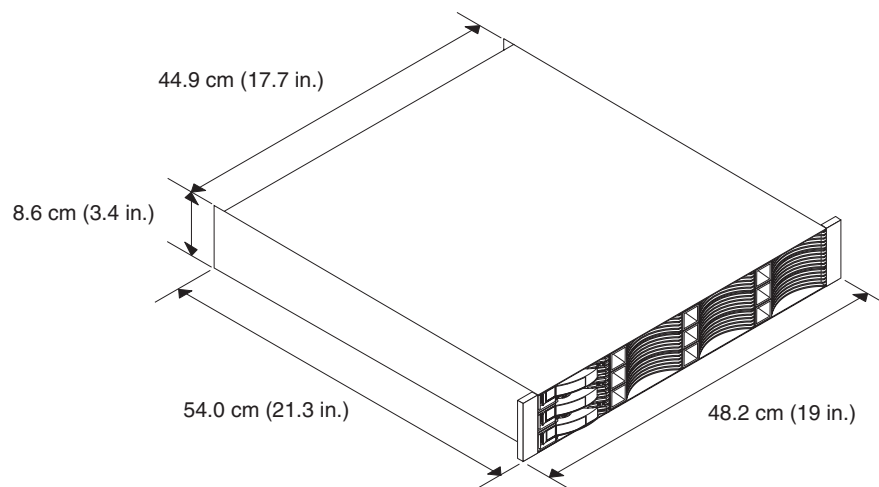
Figure 1-13. DS3512 storage subsystem and EXP3512 storage enclosure dimensions

Figure 1-14 shows the dimensions of the DS3524 storage subsystem and EXP3524 storage enclosure, which conforms to the 19-inch rack standard.

44.9 cm (17.7 in.)

8.8 cm (3.5 in.)

48.7 cm (19.2 in.)

48.2 cm (19 in.)
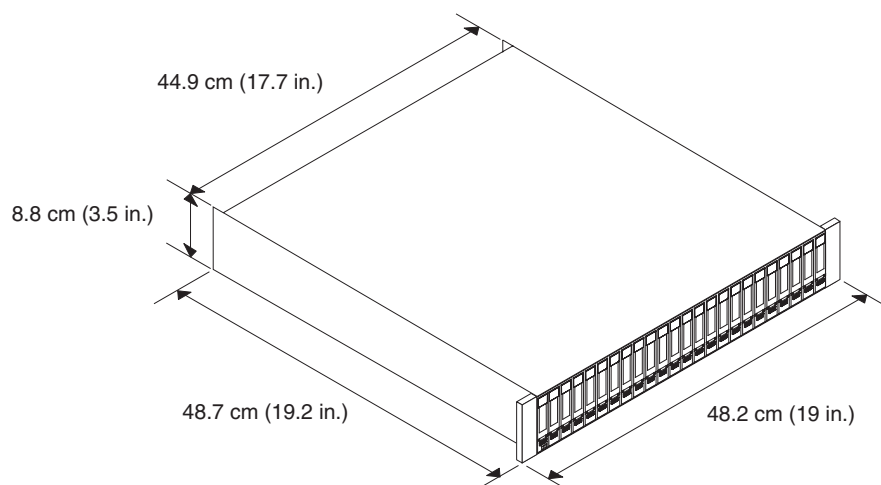
Figure 1-14. DS3524 storage subsystem and EXP3524 storage enclosure dimensions

Weight

The total weight of the storage subsystem and storage enclosure depends on the number of installed components. Table 1-4 lists the maximum and empty weights for the DS3512 storage subsystem and EXP3512 storage enclosure in different configurations. Table 1-5 lists the maximum and empty weights for the DS3524 storage subsystem and EXP3524 storage enclosure in different configurations. Table 1-6 on page 1-17 lists the weight of each component.

Table 1-4. DS3512 storage subsystem and EXP3512 storage enclosure weights

Model	Maximum [1]	Empty [2]
DS3512	27.0 kg (59.6 lb)	8.4 kg (18.5 lb)
EXP3512	26.3 kg (57.9 lb)	

[1] Chassis with dual controller or ESMs and 12 drives.

[2] Chassis without power supplies, controllers or ESMs, and drive filler panels.

Table 1-5. DS3524 storage subsystem and EXP3524 storage enclosure weights

Model	Maximum [1]	Empty [2]
DS3524 with ac power supply and fan units	25.9 kg (57.1 lb)	10.7 kg (23.6 lb)
DS3524 with dc power supply and fan units	25.85 kg (56.99 lb)	
EXP3524 with ac power supply and fan units	25.2 kg (55.5 lb)	
EXP3524 with dc power supply and fan units	25.15 kg (55.45 lb)	

[1] Chassis with dual controller or ESMs and 24 drives.

[2] Chassis without power supplies, controllers or ESMs, and drive filler panels.

Table 1-6. DS3500 component weights

Unit	Weight
2.5–inch drive	0.25 kg (0.55 lb)
3.5–inch drive	0.78 kg (1.72 lb)
AC power supply with fan	2.50 kg (5.31 lb)
DC power supply with fan	2.36 kg (5.21 lb)
Controller (including cache battery backup and no host port adapter)	2.05 kg (4.52 lb)
Fibre channel host daughter card	.08 kg (.18 lb)
iSCSI host daughter card	.05 kg (.11 lb)
SAS host daughter card	.07 kg (.15 lb)
Battery	.15 kg (.33 lb)
ESM	1.75 kg (3.86 lb)

Temperature and humidity

Table 1-7 lists the acceptable temperature and humidity ranges for the storage subsystem in typical Information Technology (IT) or office environments.

Table 1-7. Temperature and humidity requirements for storage subsystems in an Information Technology (IT) or office environment

Condition	Parameter	Requirement
Temperature (storage subsystem On)	Operating range	10° to 35°C (50.0° to 95°F)
	Altitude	30.5 (100 ft) below to 3000 m (9840 ft) above sea level
	Maximum rate of change	10°C (18°F) per hour
Relative humidity (storage subsystem On)	Operating range	20% to 80%
	Maximum dew point	26°C (79°F)
	Maximum humidity gradient	10% per hour
Temperature (storage subsystem Off)	Operating range	-10° to 50°C (14.0° to 120.0°F)
	Maximum altitude	3000 m (9840 ft)
	Maximum rate of change	15°C (27.0°F) per hour
Relative humidity (storage subsystem Off)	Operating range	10% to 90%
	Maximum dew point	26°C (79°F)
	Maximum humidity gradient	10% per hour

Note:

1. The non-operating environment must not exceed the environment limits for more than 60 days.

2. The storage environment must not exceed the environment limits for more than one year.

3. Substantial deviations from the suggested operating range, in either direction, if sustained for extended periods of time, will expose the unit to greater risk of failure from external causes.

Table 1-8 on page 1-18 lists temperature and humidity ranges for the storage subsystem in a NEBS/ETSI compliant environment.

Table 1-8. Temperature and humidity requirements for storage subsystems in a NEBS/ETSI compliant environment

Condition	Parameter	Requirement
Temperature[1]	Operating range	5° - 40° C (41° - 104° F)
	Short-term[2]	-5° - 50° C (23° - 122° F)
	Maximum rate of change	30° C (54° F) per hour
Relative humidity[1] (no condensation)	Operating range	5% to 85%
	Short-term[2]	5% to 90% (not to exceed 0.024 kg water/kg of dry air)

Note:

1. In a NEBS/ETSI compliant environment, conditions are measured at a location 1.5 m (59 in.) above the floor and 400 mm (15.8 in.) in front of the equipment.

2. Short-term refers to a period of not more than 96 consecutive hours and a total of not more than 15 days in one year. (This refers to a total of 360 hours in any given year, but no more than 15 occurrences during that one-year period.)

Electrical requirements

Consider the following information when you prepare the installation site:

- **Protective ground:** Site wiring must include a protective ground connection to the ac power source.

  Note: Protective ground is also known as safety ground or chassis ground.

- **Circuit overloading:** Power circuits and associated circuit breakers must provide sufficient power and overload protection. To prevent possible damage to the unit, isolate its power source from large switching loads (such as air conditioning motors, elevator motors, and factory loads).

- **Power failures:** If a total power failure occurs, the unit automatically performs a power-on recovery sequence without operator intervention after power is restored.

Site wiring and power

The DS3500 storage subsystem (models DS3512-C2A and DS3524-C4A) and EXP3500 storage enclosure (models EXP3512-E2A and EXP3524-E4A) are equipped with redundant ac power supply and fan units. The storage subsystem ac power supplies are wide-ranging units that automatically accommodate voltages to the ac power source. The power supplies operate within the range of 90 V ac to 264 V ac, at a minimum frequency of 50 Hz and a maximum frequency of 60 Hz. The power supplies meet standard voltage requirements for operation both inside the U.S.A. and outside the U.S.A. They use standard industrial wiring with line-to-neutral or line-to-line power connections. The ac power supplies have C14 power inlets.

Power requirements for models equipped with ac power supplies are shown in Table 1-9.

Table 1-9. DS3500 ac power requirements

	Low range	High range
Nominal voltage	90 V ac to 140 V ac	200 V ac to 264 V ac
Frequency (Hz)	50 to 60 Hz	50 to 60 Hz
Approximate input kilovolt-amperes (kVA)	Minimum 0.06 kVA to maximum 0.38 kVA	

The DS3524 model C4T storage subsystem and EXP3524 model E4T storage enclosure are equipped with redundant dc power supply and fan units. The storage subsystem dc power supplies are wide-ranging units that automatically accommodate voltages to the dc power source. The dc power supplies operate within the range of -42 V dc to -60 V dc. The dc power supplies require a reliably grounded safety extra-low voltage SELV source and an approved and rated 20 A disconnect device for the -48 V line.

Power requirements for models equipped with dc power supplies are shown in Table 1-10.

Table 1-10. DS3500 dc power requirements

	Requirement
Operating voltage	-42 V to -60 V
Nominal voltage	-48 V
Operating current	16 A to 11.2 A
Rated disconnect device (circuit-breaker)	20 A

Power recovery

After normal power is restored after a total ac or dc power failure, the storage subsystem performs power-on recovery procedures automatically without operator intervention.

Power cords and receptacles

Storage subsystems equipped with ac power supply and fan units come with two ac jumper cords that are used to connect to the rack PDU. You must purchase the power cords that are applicable for use in a typical receptacle in your country. See "Power cords" on page 7-5 for more information.

Storage subsystems equipped with dc power supply and fan units come with two dc jumper cables that are used to connect to the site -48 V dc power source. The supplied dc jumper cables have 10 AWG copper conductor wires. 12 AWG or larger copper conductor wires must be used for all of the wiring between the DS3500 or EXP3500 dc power connectors and the dc power source. See the "DS3524 storage subsystem and EXP3524 storage enclosure parts listing" on page 7-3 for more information.

Heat output, airflow, and cooling

Air enters at the front of the DS3500 storage subsystem and EXP3500 storage enclosure and leaves at the back. Allow at least 30 inches in front of the DS3500 storage subsystem and EXP3500 storage enclosure and at least 24 inches at the rear for service clearance, proper ventilation, and heat dissipation.

When racks that contain many DS3500 storage subsystems and EXP3500 storage enclosures are to be installed together, the following requirements must be met to ensure that the devices are adequately cooled:

- Air enters at the front of the rack and leaves at the back. To prevent the air that is leaving the rack from entering the intake of another piece of equipment, you must position the racks in alternate rows, back-to-back and front-to-front. This arrangement is known as "cold aisle/hot aisle" and is shown in Figure 1-15 on page 1-20.
- Where racks are in rows, each rack must touch the rack that is next to it to reduce the amount of hot air that can flow around from the back of the rack into the intakes of the storage enclosures that are in that rack. Use Suite Attach Kits to completely seal any gaps that remain between the racks. For details about Suite Attach Kits, contact your IBM marketing representative or authorized reseller.
- Where racks are in rows front-to-front or back-to-back, gaps of at least 122 cm (48 in.) must separate the rows across the cold aisle (see Figure 1-15 on page 1-20).
- To correct airflow in each rack, the rack filler plates must be installed in unused positions. Also, all the gaps in the front of the racks must be sealed, including the gaps between the storage subsystems.
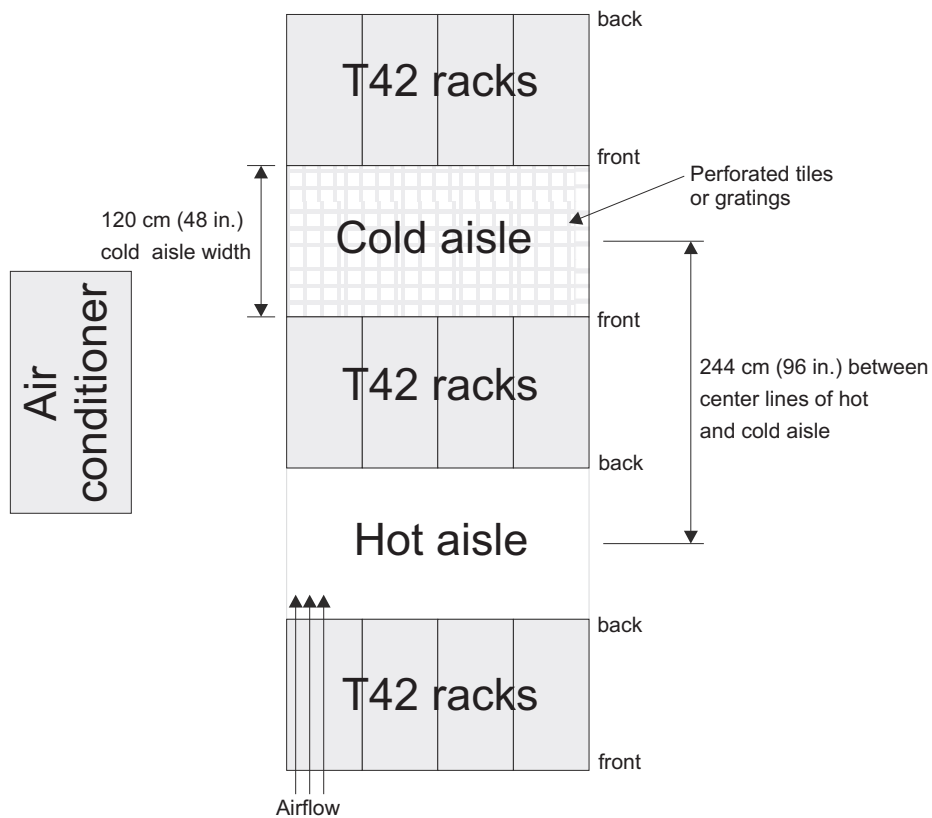
Figure 1-15. Example of cold aisle/hot aisle rack configuration

Chapter 2. Installing the storage subsystem and storage enclosure

This chapter provides instructions for installing the DS3500 storage subsystem and the EXP3500 storage enclosure in a rack. To install the DS3500 storage subsystem in a rack, see Chapter 2, "Installing the storage subsystem and storage enclosure." To install the EXP3500 storage enclosure in a rack, see "Installing the EXP3500 storage enclosure" on page 2-4.

Before you begin the installation, review the safety information in "Safety" on page xi and "Handling static-sensitive devices" on page 2-3.

Installing the DS3500 storage subsystem

This section provides instructions for installing the DS3500 storage subsystem in a rack.

Inventory checklist

After you unpack the DS3500 storage subsystem, ensure that you have the following items. Depending on your order, your shipping box might contain additional items that are not on the list.

- **Hardware**
  - Hard disk drives or drive filler panels:
    - DS3512 (12)
    - DS3524 (24)
  - Storage controllers (up to 2)
  - AC power supply and fan units (2) (models C2A, E2A, C4A, and E4A)
  - DC power supply and fan units (2) (models C4T and E4T)
  - AC power cables (2 jumper line cords) (models C2A, E2A, C4A, and E4A)
  - DC power jumper cables (2) (models C4T and E4T)
  - Rack installation hardware kit:
    - Support rails (2) (right and left assembly)
    - M5 black hex-head slotted screws (8)
    - M5 Washers (6)
    - Small diameter spacers (8) (these come installed, four in each rail)
    - Large diameter spacers (8)
    - M4 pan-head screws (2)

  Attention: The DS3500 storage subsystem ac power models do not have region-specific power cords. You must obtain the IBM-approved ac power cords for your region. The DS3500 and EXP3500 dc power models do not have the 20 A rated disconnect device (circuit-breaker) that is required for the -48V DC power connection. See "Power cords" on page 7-5 for the IBM-approved ac power cords for your region.

- **Software and documentation**
  - IBM *System Storage DS3500 Support* DVD

    The support DVD contains the IBM Storage Manager host software. The DVD also includes online help, and the following documentation in Adobe Acrobat Portable Document Format (PDF):
    - *IBM System Storage DS3500 and EXP3500 Storage Subsystem Installation, User's, and Maintenance Guide* (this document)

- *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) and *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later)
  - *IBM Systems Safety Notices*
- *IBM System Storage DS3500 and EXP3500 Rack Installation and Quick Start Guide*

The box will contain Premium features activation or entitlement kits if you ordered for them.

If an item is missing or damaged, contact your IBM marketing representative or authorized reseller.

DS3500 installation overview

CAUTION:

>18 kg (39.7 lb)

or

18-32 kg (39.7-70.5 lb)

or
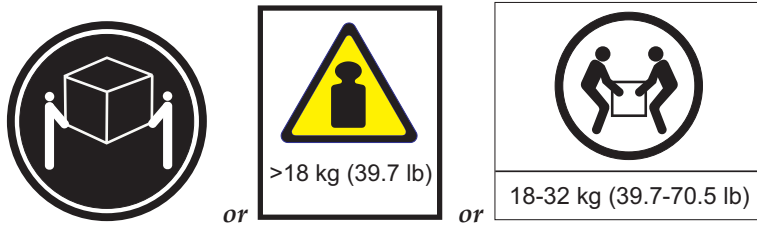
The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). At least two people should lift this component (C009).

Attention: A fully configured DS3500 storage subsystem weighs up to 27 kg (60 lb). At least two people should lift the DS3500 storage subsystem from the shipping box. Before you lift it out of the box, you might want to open the sides of the shipping box and remove the components from the DS3500 storage subsystem, so that the storage subsystem is lighter and easier to remove.

Complete the following steps to install the storage subsystem:

1. Review the preparation recommendations. See "Preparing for installation" on page 2-3.
2. Prepare the installation site. See "Preparing the site" on page 2-4.
3. Prepare the rack. See the *DS3500 and EXP3500 Rack Installation and Quick Start Guide*.
4. Record the serial number, machine type and model number, and controller MAC addresses for your DS3500 storage subsystem in "Storage subsystem and controller information record" on page A-2. See Figure 1-1 on page 1-2 for the location of the serial number.

   The MAC addresses are labeled near the Ethernet port on each controller.
5. Install and secure the DS3500 chassis and components in the rack. See the *DS3500 and EXP3500 Rack Installation and Quick Start Guide*.
6. Install the storage enclosure in the rack, if you are installing one or more storage enclosures. Follow the instructions in the *DS3500 and EXP3500 Rack Installation and Quick Start Guide*.
7. Cable the DS3500 storage subsystem to the storage enclosures. See "Connecting storage enclosures to the DS3500" on page 3-17.
8. Complete one of the following cabling tasks to enable management of the DS3500 configuration:
   - If you are using out-of-band management, cable the DS3500 Ethernet ports to either the management workstation or the host.
   - If you are using in-band management, cable the DS3500 hosts to the host bus adapters (HBAs) in the hosts. See "Connecting iSCSI hosts to the DS3500" on page 3-38.
9. Connect the power cables. See "Cabling the DS3500 and EXP3500 ac power supplies" on page 3-45 for models equipped with ac power supply and fan units or "Cabling the DS3500 and EXP3500 dc power supplies" on page 3-45 for models equipped with dc power supply and fan units.
10. Power on the storage enclosure and the DS3500 storage subsystem, using the procedure in "Turning on the storage subsystem" on page 4-2.

11. Install the DS Storage Manager host software on the management workstation (for out-of-band management) or on the host (for in-band management).

    For instructions to install the DS Storage Manager V10.77 or earlier, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide*. For instructions to install the DS Storage Manager V10.83 or later, see the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide*.

12. Check configuration using the Storage Manager host software.

13. Review and complete the procedures in "Performing the health check process" on page 4-1.

Handling static-sensitive devices

Attention: Static electricity can damage the storage subsystem and other electronic devices. To avoid damage, keep static-sensitive devices in their static-protective packages until you are ready to install them.

To reduce the possibility of electrostatic discharge, observe the following precautions:

- Limit movement, so that static electricity does not build up around you.
- Handle the device carefully, holding it by its edges or its frame.
- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the device in a place where other devices can cause damage.
- While the device is still in its static-protective package, touch it to an unpainted metal part of the system unit for at least 2 seconds. This drains static electricity from the package and from your body.
- Remove the device from its package and install it directly into the system unit without setting it down. If it is necessary to set down the device, put it back into its static-protective package. Do not place the device on the system unit cover or on a metal surface.
- Take additional care when you handle devices during cold weather. Heating reduces indoor humidity and increases static electricity.

Preparing for installation

Before you install the DS3500 storage subsystem, create a detailed plan of how the device will be used in the storage configuration. The plan should include RAID levels, failover requirements, operating systems that are to be used, and total storage capacity requirements.

To prepare the DS3500 storage subsystem for installation in a rack, complete the following steps:

1. Prepare the site for installation. For more information, see "Specifications" on page 1-15.

2. Move the shipping box that contains the DS3500 to the site.

CAUTION:

or >18 kg (39.7 lb) *or* 18-32 kg (39.7-70.5 lb)
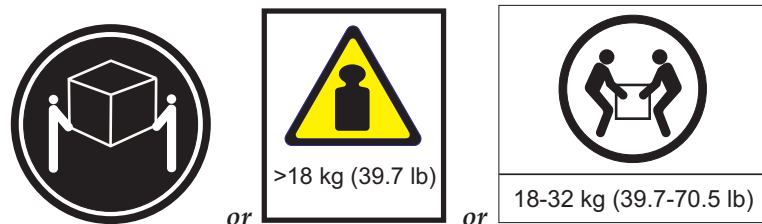
The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). At least two individuals are required to safely lift this part or unit. (C009)

3. Ensure that you have the correct host software for your operating system.

The support DVD that is shipped with the DS3500 has the correct Storage Manager host software. The DVD also includes the storage subsystem controller firmware. For the latest controller firmware, see http://www.ibm.com/servers/storage/support/disk/.

4. Read the applicable readme files that are included in the Storage Manager host software or DS3500 controller firmware packages for any updated information about hardware, software, or firmware products.

5. Continue with "Required tools and hardware."

Required tools and hardware

Keep the following tools and equipment ready:

- Region-specific power cords
- 5/16 (8 mm) hex nut driver
- #0 and #1 Phillips screwdrivers
- Electrostatic-discharge protection (such as a grounding wrist strap)
- Rack power jumper cords
- Rack-mounting hardware
- Ethernet interface cables and cable straps (depending on configuration)
- SAS cables (depending on configuration)
- Fibre Channel cables, interface cables, and cable straps (depending on configuration)
- SFP modules (depending on configuration)

Preparing the site

This section lists the floor space requirements and weight information for the DS3500. For information about interface cables and connections, see Chapter 3, "Cabling the storage subsystem and storage enclosure," on page 3-1.

The floor area at the installation site must have:

- Sufficient space to install the DS3500 storage subsystem
- Enough stability to support the weight of the fully configured DS3500 storage subsystem and associated devices (see "Weight" on page 1-16).

Ensure that all requirements, such as floor space, air conditioning, and electrical service, are met. Other site preparation activities include:

- Ensuring that there is enough room to move around the rack and install the modules.
- Installing uninterruptible-power-supply devices.
- Installing, if applicable, host servers with host bus adapters (HBAs), switches, or other devices.
- Routing interface cables from the HBA ports in the hosts or switches to the installation area.
- Routing main power cords to the installation area.

Continue with "Installing the DS3500 storage subsystem in a rack."

Installing the DS3500 storage subsystem in a rack

To install the DS3500 in a rack, follow the instructions in the *DS3500 and EXP3500 Rack Installation and Quick Start Guide*. Then, continue with Chapter 3, "Cabling the storage subsystem and storage enclosure," on page 3-1.

Installing the EXP3500 storage enclosure

This section provides instructions for installing the EXP3500 storage enclosure in a rack. The EXP3500 connects to a DS3500 storage subsystem.

Inventory checklist

After you unpack the EXP3500 storage enclosure, ensure that you have the following items. Depending on your order, the shipping box might contain additional materials that are not in the following list.

- **Hardware:**
  - Hard disk drives or drive filler panels:
    - EXP3512 (12)
    - EXP3524 (24)
  - ESMs (up to 2)
  - Power supplies (2)
  - Power cables (2 jumper line cords)
  - Rack installation hardware kit:
    - Support rails (2) (right and left assembly)
    - M5 black hex-head slotted screws (8)
    - M5 Washers (6)
    - Small diameter spacers (8) (these come installed, four in each rail)
    - Large diameter spacers (8)
    - M4 pan-head screws (2)
- **Printed documents:**
  - *IBM System Storage DS3500 and EXP3500 Rack Installation and Quick Start Guide*
- **Online documents:**
  - *IBM System Storage DS3500 and EXP3500 Storage Subsystem Installation, User's, and Maintenance Guide* (this document)
  - *IBM Systems Safety Notices*

All documents are available on the IBM *Documentation* CD or from the IBM support Web site at http://www.ibm.com/servers/storage/support/.

Installing the EXP3500 storage enclosure in a rack

You can install the EXP3500 storage subsystem in an Electronic Industries Association (EIA) 310 standard rack. For complete rack installation instructions, see *IBM System Storage DS3500 and EXP3500 Rack Installation and Quick Start Guide*.

Chapter 3. Cabling the storage subsystem and storage enclosure

This chapter provides information and instructions for cabling the DS3500 storage subsystem and the EXP3500 storage enclosure. To cable the DS3500 storage subsystem, see "Cabling the DS3500 storage subsystem." To cable the EXP3500 storage enclosure, see "Cabling the EXP3500 storage enclosure" on page 3-14.

Cabling the DS3500 storage subsystem

The section provides information and instructions for cabling the DS3500 storage subsystem. After the storage subsystem is installed in its permanent location, you must cable it to hosts, drives, and other external devices, depending on the hardware configuration.

Controller connectors (with Fibre Channel host port adapters)

Figure 3-1 shows the optional Fibre Channel host port adapter installed in both controllers on the rear panel of the DS3500 storage subsystem.
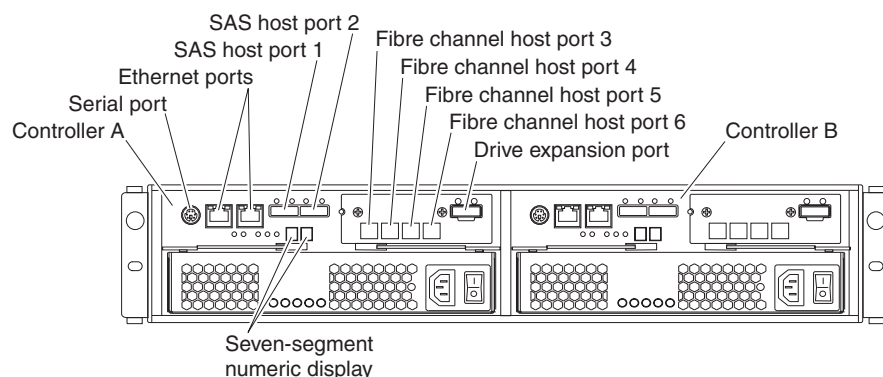
Figure 3-1. Dual-controller DS3500 storage subsystem ports and controllers (with optional Fibre Channel host port adapter)

Fibre Channel host ports
> Each Fibre Channel host port supports a small-form-factor pluggable (SFP) transceiver and is capable of operating at 8 Gbps, 4 Gbps, or 2 Gbps.

Drive expansion port
> The drive expansion port is an x4 multilane SAS port. Connect a SAS cable to this port and to a drive storage enclosure.

Controller connectors (with 1 Gbps iSCSI host port adapters)

Figure 3-2 on page 3-2 shows the optional 1 Gbps iSCSI host port adapter installed in both controllers on the rear panel of the DS3500 storage subsystem.
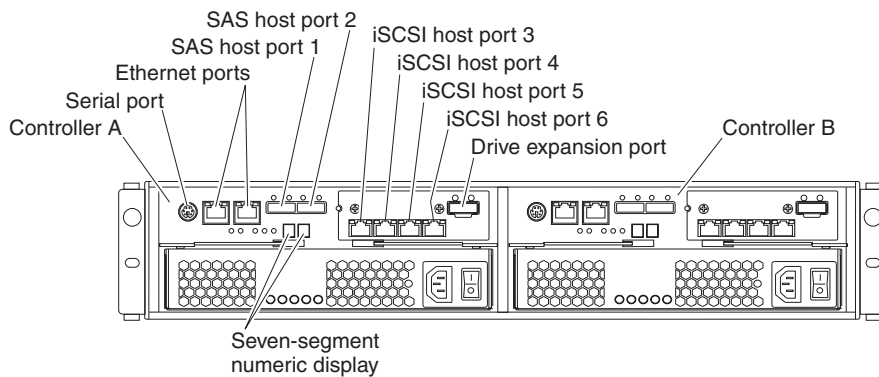
Figure 3-2. Dual-controller DS3500 storage subsystem ports and controllers (with optional iSCSI host port adapter)

1 Gbps iSCSI host ports
> The 1 Gbps iSCSI host ports are auto-negotiated 100/1000 Mbps Ethernet ports that support iSCSI offload. The host ports also provide support for both Internet Protocol version 4 (IPv4) and IPv6, and have the advanced networking functions of jumbo frames, IEEE 802.1p, and virtual local area network (VLAN) support.

Drive expansion port
> The drive expansion port is an x4 multilane SAS port. Connect a SAS cable to this port and to a drive storage enclosure.

Controller connectors (with 10 Gbps iSCSI host port adapters)

Figure 3-3 shows the optional 10 Gbps iSCSI host port adapter installed in both controllers on the rear panel of the DS3500 storage subsystem.
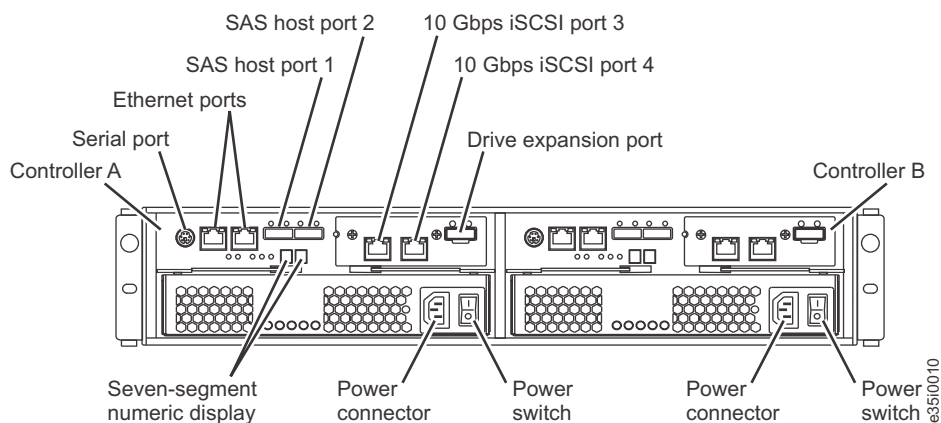
Figure 3-3. Dual-controller DS3500 storage subsystem ports and controllers (with optional 10 iSCSI host port adapter)

10 Gbps iSCSI host ports
> The 10 Gbps iSCSI host ports are auto-negotiated 1/10Gbps Ethernet ports that support iSCSI offload. The host ports also provide support for both Internet Protocol version 4 (IPv4) and IPv6, and have the advanced networking functions of jumbo frames, IEEE 802.1p, and virtual local area network (VLAN) support.

Drive expansion port
> The drive expansion port is an x4 multilane SAS port. Connect a SAS cable to this port and to a drive storage enclosure.

Controller connectors (with SAS host port adapters)

Figure 3-4 shows the optional SAS host port adapter installed in both controllers on the rear panel of the DS3500 storage subsystem.
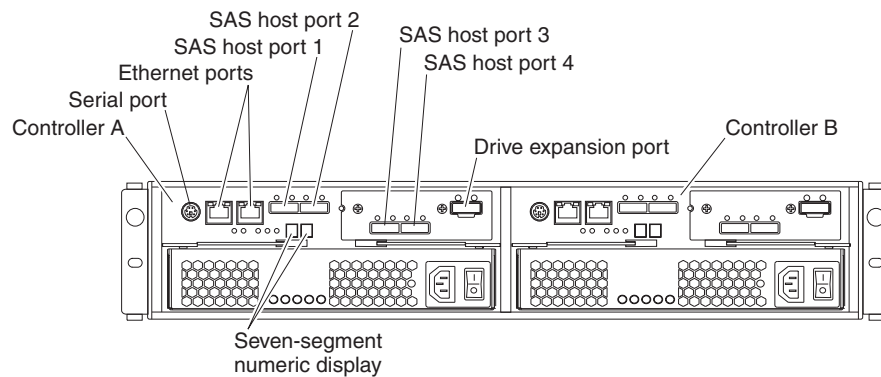
Figure 3-4. Dual-controller DS3500 storage subsystem ports and controllers (with an optional SAS host port adapter)

SAS host ports

> The DS3500 SAS host ports are each a x4 multilane, 6 Gbps universal mini-SAS port. Connect a SAS cable from your host system SAS host bus adapter to a host port on each controller.

Drive expansion port

> The drive expansion port is an x4 multilane SAS port. Connect a SAS cable to this port and to a drive storage enclosure.

Enclosure ID settings

The enclosure ID is a unique two-digit identifier for each enclosure in the storage subsystem configuration. In a dual controller or ESM configuration, both enclosure IDs are identical under normal operating conditions. Each EXP3500 storage storage enclosure and DS3500 storage subsystem in the storage subsystem configuration must have a unique storage enclosure ID.

The controller automatically sets the enclosure ID. You can change the setting through the Storage Manager software, if necessary. The range of supported enclosure ID settings is 0 through 99. The enclosure ID is normally set to a value of 00 at the factory.

The enclosure ID is displayed on the seven-segment numeric display located on the back of each controller and ESM.

Working with SAS cables

Each DS3500 storage controller has up to four x4 multilane SAS host ports and a single x4 multilane SAS port for drive channel connections.

Use a 1M or 3M (1-meter or 3-meter) SAS cable with a mini-SAS 4x multilane SAS connector on each end to connect a controller host port to a host HBA and to connect the drive expansion port to a storage enclosure.

The following illustration shows the 1M and 3M mini-SAS cable.

Mini-SAS
connectors
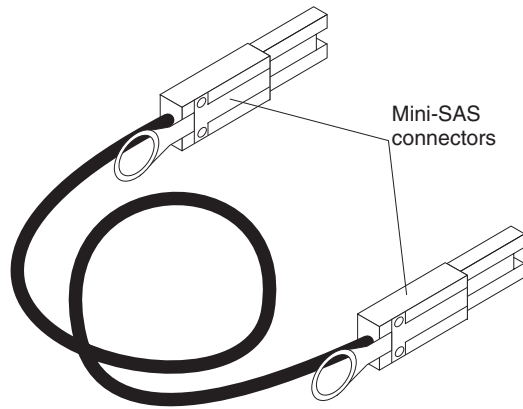
Figure 3-5. Mini-SAS cable

The 1M and 3M SAS cables have a universal key connector that enables the cable to be used in all mini-SAS ports.

Attention: To avoid damage to the SAS cables:
- Leave enough slack in the cable when you route the cable along a folding cable-management arm.
- Route the cable away from places where it can be damaged by other devices in the rack.
- Do not put excess weight on the cable at the connection point. Ensure that the cable is well supported.

To connect a mini-SAS cable, insert the mini-SAS connector into a mini-SAS port. Ensure that it locks into place.
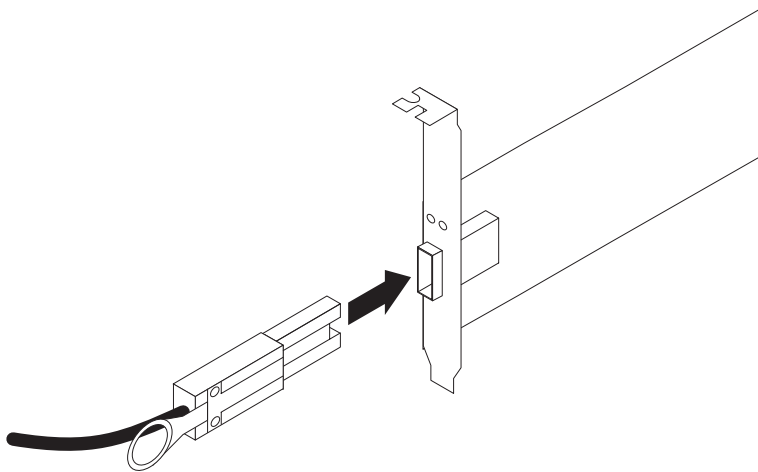
Figure 3-6. Connecting a mini-SAS cable

To remove a mini-SAS cable, complete the following steps:
1. Hold the blue plastic tab on the mini-SAS connector and gently pull the tab to release the locking mechanism.

Blue plastic tab
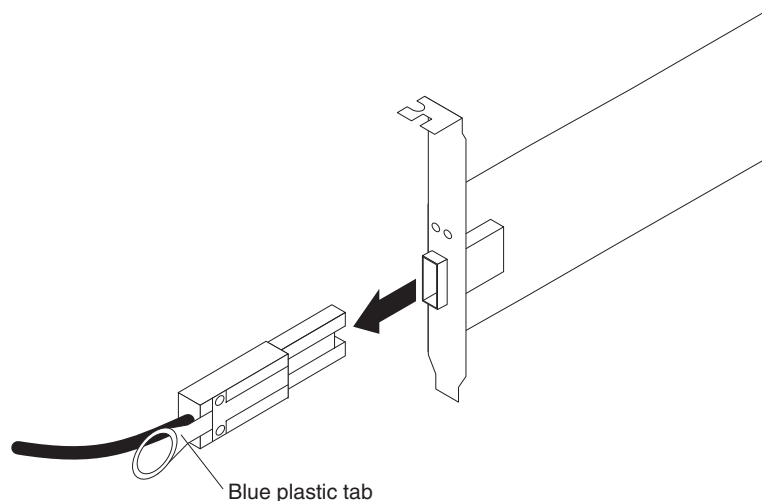
Figure 3-7. Removing a mini-SAS cable

2. As you pull the tab, pull out the connector to remove it from the port.

Working with SFP modules and fiber optic cables

Each storage controller can have up to four Fibre Channel host ports. Use a small-form-factor pluggable (SFP) module to connect a host port to a host. Insert the SFP module into the port and a fiber optic cable into the SFP module. Connect the other end of the fiber optic cable to an optical interface connector in a Fibre Channel HBA on a host. SFP modules are laser products.

CAUTION:
This product might contain one or more of the following devices: CD-ROM drive, DVD-ROM drive, DVD-RAM drive, or laser module, which are Class 1 laser products. To avoid exposure to hazardous laser radiation, do not remove the covers of the laser product, or use the controls, or adjust procedures other than the specifications in this guide. There are no serviceable parts inside the device (C026).

CAUTION:
Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fiber cable or open receptacle (C027).

Handling fiber optic cables

Attention: To avoid damage to the fiber optic cables:

- Do not route the cable along a folding cable-management arm.
- For devices on slide rails, leave enough slack in the cables so that they do **not** bend to a diameter of less than 76 mm (3 in), or a radius less than 38 mm (1.5 in) when extended, or become pinched when retracted.
- Route the cable away from places where it can be damaged by other devices in the rack cabinet.
- Do not use plastic cable ties instead of the provided cable straps.

- Do not overtighten the cable straps or bend the cables to a diameter of less than 76 mm (3 in) or a radius less than 38 mm (1.5 in).
- Do not put excess weight on the cable at the connection point. Ensure that the cable is well supported.
- The recommended maximum cable lengths are as follows:
  - 2 Gbps: 300 m (984 ft.) of 50/125 um fiber, 150 m (492 ft.) of 62.5/125 um fiber
  - 4 Gbps: 150 m (492 ft.) of 50/125 um fiber, 70 m (230 ft.) of 62.5/125 um fiber
  - 8 Gbps: 50 m (164 ft.) of 50/125 um fiber, 35 m (115 ft.) of 62.5/125 um fiber
- Recommended maximum lengths of OM2 category Fibre Channel cable are as follows:
  - 4 Gbps: 150 m (492 ft.) of 50/125 um fiber, 300 m (984 ft.) of 62.5/125 um fiber
  - 8 Gbps: 50 m (164 ft.) of 50/125 um fiber, 150 m (492 ft.) of 62.5/125 um fiber

Installing SFP modules

The storage subsystem requires SFP modules. SFP modules convert electrical signals to optical signals that are required for Fibre Channel transmission to and from controllers. After you install the SFP modules, you use fiber optic cables to connect the storage subsystem to other Fibre Channel devices.

Review the following information before installing SFP modules and fiber optic cables:

- Use only short-wave SFP modules. Do not mix long-wave and short-wave SFP modules on a single storage subsystem. Use the Storage Manager Client to view the Storage Subsystem Profile to ensure that you are not mixing long-wave and short-wave SFP modules.

  Attention: Do not use long-wave SFP modules or Gigabit Interface Converters (GBICs) in any of the Fibre Channel ports in the storage subsystem controllers. (Long-wave SFP modules and GBICs are not supported in the storage subsystem or any of the attached storage enclosures. Long-wave SFP modules and GBICs are supported only in the Fibre Channel switch ports to which the storage subsystem connects.)

- The SFP module housing has an integral guide key that is designed to prevent you from inserting the SFP module incorrectly.

- Use minimal pressure when inserting an SFP module into a Fibre Channel port. Forcing the SFP module into a port could cause damage to the SFP module or to the port.

- You can insert or remove the SFP module while the port is powered on.

- The operational or redundant loop performance is not affected when you install or remove an SFP module.

- You must insert the SFP module into a port before you connect the fiber optic cable.

- You must remove the fiber optic cable from the SFP module before you remove the SFP module from the port. See "Removing SFP modules" on page 3-8 for more information.

- The speed of the SFP module determines the maximum operating speed of the Fibre Channel port in which the SFP module is installed. For example, a 2-Gbps SFP module that is connected to a 4-Gbps-capable port will limit the speed of that port to a maximum of 2 Gbps.

  Attention: Check the IBM part number, option number, and FRU part number of the SFP module to identify its speed. There are no physical features that distinguish an 8 Gbps, 4 Gbps, or 2 Gbps SFP module from each other.

CAUTION:
This product might contain one or more of the following devices: CD-ROM drive, DVD-ROM drive, DVD-RAM drive, or laser module, which are Class 1 laser products. To avoid exposure to hazardous laser radiation, do not remove the covers of the laser product, or use the controls, or adjust procedures other than the specifications in this guide. There are no serviceable parts inside the device (C026).

⚠️

CAUTION:

Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fiber cable or open receptacle (C027).

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see "Handling static-sensitive devices" on page 2-3.

To install an SFP module, complete the following steps:

1. Remove the SFP module from its static-protective package.
2. Remove the protective cap from the SFP module, as shown in Figure 3-8. Save the protective cap for future use.
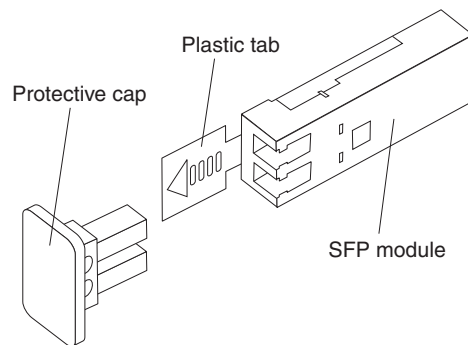
Figure 3-8. SFP module and protective cap

3. Remove the protective cap from the SFP port. Save the protective cap for future use.
4. Insert the SFP module into the host port until it clicks into place. See Figure 3-9.
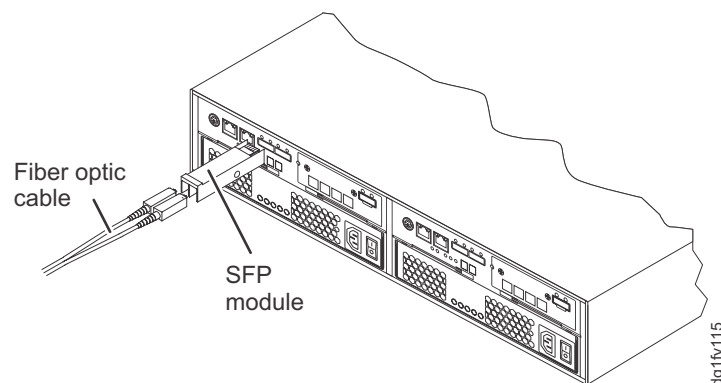
Figure 3-9. Installing an SFP module into the host port

5. Connect an LC-LC Fibre Channel cable. For information about the LC-LC cable, see "Using LC-LC Fibre Channel cables" on page 3-8.

Removing SFP modules

To remove the SFP module from the host port, complete the following steps:

Attention: To avoid damage to the cable or to the SFP module, ensure that you disconnect the LC-LC Fibre Channel cable *before* you remove the SFP module.

1. Remove the LC-LC Fibre Channel cable from the SFP module. For more information, see "Removing an LC-LC Fibre Channel cable" on page 3-10.
2. Unlock the SFP module latch:
   - For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab as shown in Figure 3-10.
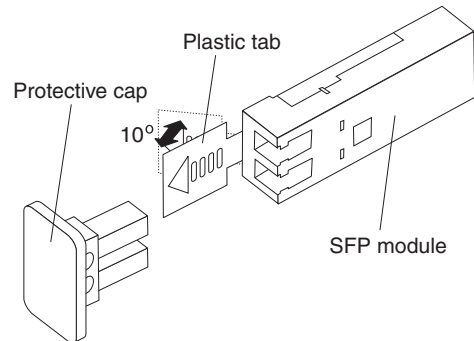
Figure 3-10. Unlocking the SFP module latch - plastic variety

   - For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch as shown in Figure 3-11.
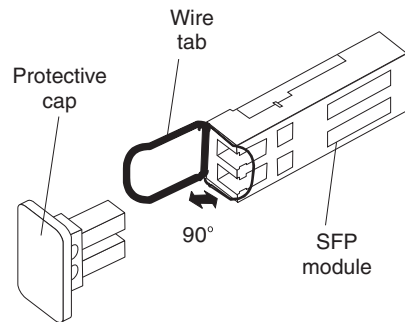
Figure 3-11. Unlocking the SFP module latch - wire variety

3. With the SFP module latch in the unlocked position, remove the SFP module.
   - For SFP modules that contain plastic tabs, slide the SFP module out of the port.
   - For SFP modules that contain wire tabs, grasp the wire latch and pull the SFP module out of the port.
4. Replace the protective cap on the SFP module.
5. Place the SFP module into a static-protective package.
6. Replace the protective cap on the host port.

Using LC-LC Fibre Channel cables

The LC-LC Fibre Channel cable is a fibre optic cable that you use to connect Fibre Channel ports to one of the following devices:
- An SFP module installed in a Fibre Channel switch port

- A Fibre Channel host bus adapter port (optical interface connector)

See Figure 3-12 for an illustration of the LC-LC Fibre Channel cable.

For more information, see the documentation that was shipped with the LC-LC Fibre Channel cable.
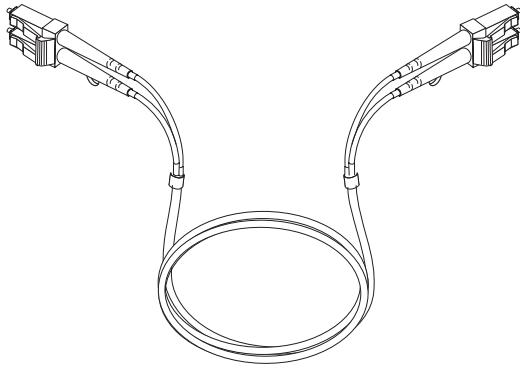
Figure 3-12. LC-LC Fibre Channel cable

Connecting an LC-LC cable to an SFP module:
To connect an LC-LC Fibre Channel cable to an SFP module, complete the following steps.

CAUTION:
This product might contain one or more of the following devices: CD-ROM drive, DVD-ROM drive, DVD-RAM drive, or laser module, which are Class 1 laser products. To avoid exposure to hazardous laser radiation, do not remove the covers of the laser product, or use the controls, or adjust procedures other than the specifications in this guide. There are no serviceable parts inside the device (C026).

CAUTION:
Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fiber cable or open receptacle (C027).

1. Read the information in "Handling fiber optic cables" on page 3-5.
2. If necessary, remove the protective cap from the SFP module, as shown in Figure 3-8 on page 3-7. Save the protective cap for future use.
3. Remove the two protective caps from one end of the LC-LC cable, as shown in Figure 3-13 on page 3-10. Save the protective caps for future use.
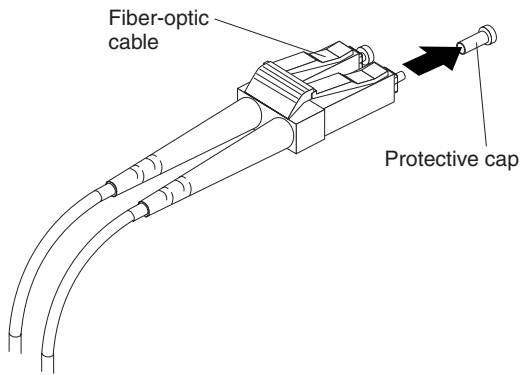
Figure 3-13. Removing fiber optic cable protective caps

4. Carefully insert the open end of the LC-LC cable into an SFP module that is installed in the storage subsystem. The cable connector is keyed for correct installation. Holding the connector, push in the cable until it clicks into place, as shown in Figure 3-14.
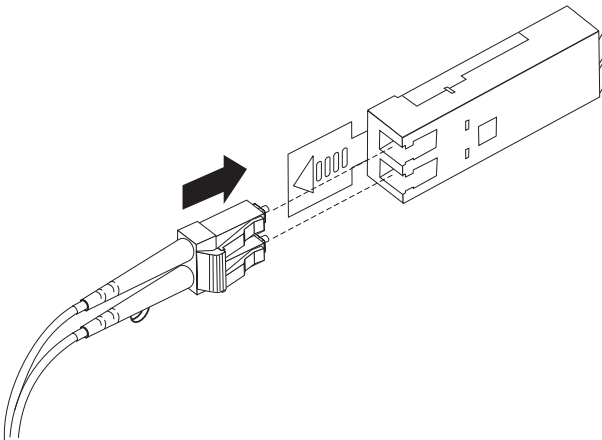
Figure 3-14. Inserting an LC-LC Fibre Channel cable into an SFP module

5. Remove the two protective caps from the other end of the LC-LC cable. Save the protective caps for future use.
6. Connect this end of the LC-LC cable to one of the following devices:
   - An SFP module that is installed in a Fibre Channel switch port
   - A Fibre Channel host bus adapter port

Removing an LC-LC Fibre Channel cable:
To remove an LC-LC Fibre Channel cable, complete the following steps.

Attention: To avoid damaging the LC-LC cable or SFP module, make sure that you observe the following precautions:

- Press and hold the lever to release the latches before you remove the cable from the SFP module.
- Ensure that the levers are in the released position when you remove the cable.
- Do NOT grasp the SFP module plastic tab when you remove the cable.

1. At the end of the LC-LC cable that connects into the SFP module or host bus adapter, press down and hold the lever to release the latches, as shown in Figure 3-15 on page 3-11.
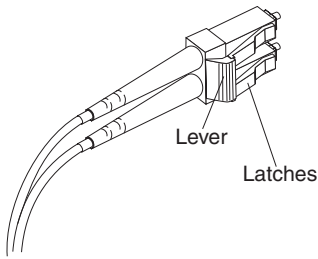
Figure 3-15. LC-LC Fibre Channel cable lever and latches

2. While pressing down the cable lever, carefully pull the connector to remove the cable from the SFP module, as shown in Figure 3-16.
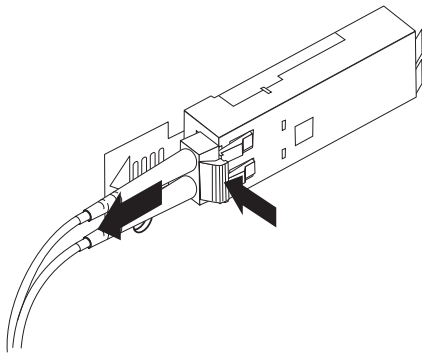
Figure 3-16. Removing the LC-LC Fibre Channel cable

3. Replace the protective caps on the cable ends.
4. Replace the protective cap on the SFP module.

Using LC-SC Fibre Channel cable adapters

The LC-SC Fibre Channel cable adapter is a fiber optic cable that is used to connect an LC connector to one of the following devices that require SC connectors:

- 1-Gbps Fibre Channel switch
- Fibre Channel host bus adapter

For more information, see the documentation that is shipped with the LC-SC Fibre Channel cable adapter.

LC connector

SC connector
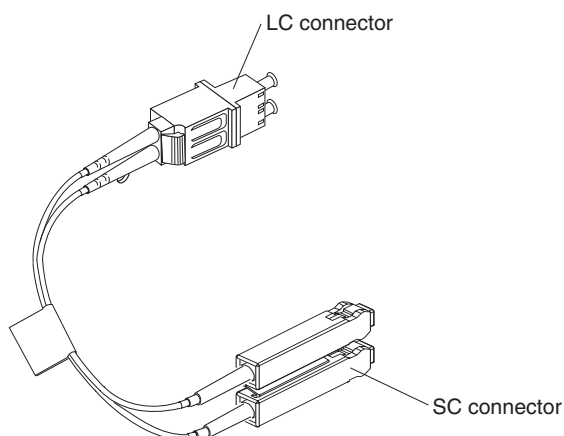
Figure 3-17. LC-SC Fibre Channel cable adapter

The following sections include the procedures for correctly connecting and removing an LC-SC Fibre Channel cable.

CAUTION:
This product might contain one or more of the following devices: CD-ROM drive, DVD-ROM drive, DVD-RAM drive, or laser module, which are Class 1 laser products. To avoid exposure to hazardous laser radiation, do not remove the covers of the laser product, or use the controls, or adjust procedures other than the specifications in this guide. There are no serviceable parts inside the device (C026).

CAUTION:
Data processing environments can contain equipment transmitting on system links with laser modules that operate at greater than Class 1 power levels. For this reason, never look into the end of an optical fibre cable or open receptacle (C027).

Connecting an LC-SC cable adapter to a device:
To connect an LC-SC Fibre Channel cable adapter to a device, complete the following steps:

1. Read the information in "Handling fiber optic cables" on page 3-5.
2. Connect one end of an LC-LC cable to an SFP module in the DS3500. For instructions, see "Using LC-LC Fibre Channel cables" on page 3-8.
3. Remove the two protective caps from the LC connector end of the LC-SC cable adapter as shown in Figure 3-18 on page 3-13. Save the protective caps for future use.
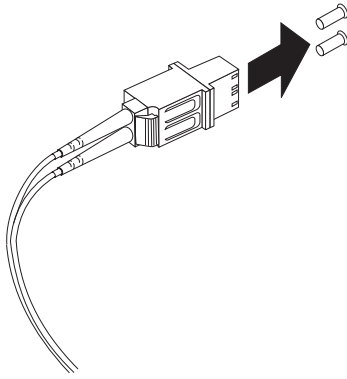
Figure 3-18. Removing the LC-SC cable adapter protective caps

4. Carefully insert the other end of the LC-LC cable into the LC connector end of the LC-SC cable adapter as shown in Figure 3-19. Push in the connector until it clicks into place.
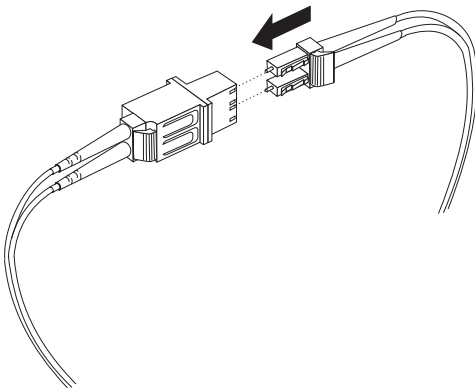
Figure 3-19. Connecting an LC-LC cable into the LC-SC cable adapter

5. If you are connecting the storage subsystem to a 1-Gbps Fibre Channel switch or Fibre Channel host bus adapter, connect the SC connector end of the LC-SC cable adapter to a Gigabit Interface Converter (GBIC) that is installed in the 1-Gbps Fibre Channel switch or Fibre Channel host bus adapter. For more information about connecting to these devices, see the documentation that is shipped with the device.

Removing an LC-LC cable from an LC-SC cable adapter:
To remove an LC-LC cable from an LC-SC cable adapter, complete the following steps.

Attention: To avoid damaging the LC-LC cable, ensure that you press and hold the lever to release the latches before you remove the cable from an LC-SC cable adapter. When removing the cable from the SFP module, ensure that you do not grasp the SFP module plastic tab.

1. At the end of the cable that connects into the LC connector end of the LC-SC cable adapter, press down and hold the lever to release the latches. Figure 3-20 on page 3-14 shows the location of the lever and latches.
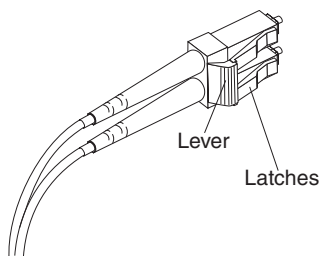
Figure 3-20. LC-LC Fibre Channel cable lever and latches

2. Carefully pull the connector to remove it. Ensure that you grasp the connector and not the cable when removing the LC-LC cable from the LC-SC cable adapter as shown in Figure 3-21.
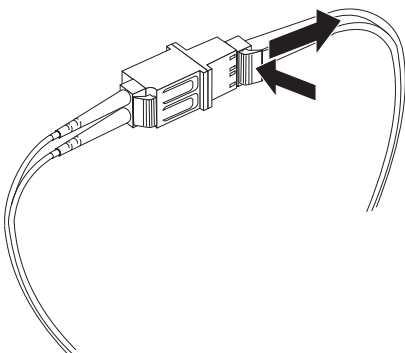
Figure 3-21. Removing the LC-LC Fibre Channel cable from an LC-SC Fibre Channel cable adapter

3. Replace the protective caps on the cable ends.

Cabling the EXP3500 storage enclosure

The EXP3500 storage enclosure contains an ESM that enables you to connect the EXP3500 storage enclosure to a DS3500 storage subsystem. If you are attaching the EXP3500 to a dual controller DS3500 storage subsystem, you must add a second ESM to the EXP3500 storage enclosure to provide a redundant drive path.

ESM connectors

Figure 3-22 shows the connectors on the ESM.
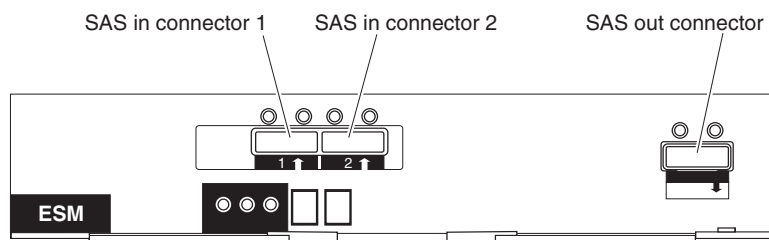
Figure 3-22. ESM connectors

SAS In 1

Connect a SAS cable to this connector and to either an IBM SAS controller or the SAS Out ($\downarrow$) connector of another EXP3500.

SAS In 2

Connect a SAS cable to this connector and to either an IBM SAS controller or the SAS Out (↓) connector of another EXP3500.

SAS Out

Connect a SAS cable to this connector and to the SAS In (↑) connector of another EXP3500.

Note: Each ESM contains two SAS In connectors. You can use either SAS In connector, but only one SAS In connector can be used at a time.

Single-ESM configuration

The DS3500 storage controller supports more than one EXP3500 storage enclosure per drive expansion port. You can connect two or more EXP3500 storage enclosures by chaining them together. To connect a controller to one or more EXP3500 storage enclosures that have one ESM each, complete the following steps:

1. Connect one EXP3500 storage enclosure to the controller:

   a. Connect one end of a SAS cable to the drive expansion port on the controller.

   b. Connect the other end to one of the In (↑) SAS connectors on the ESM in the EXP3500 storage enclosure.
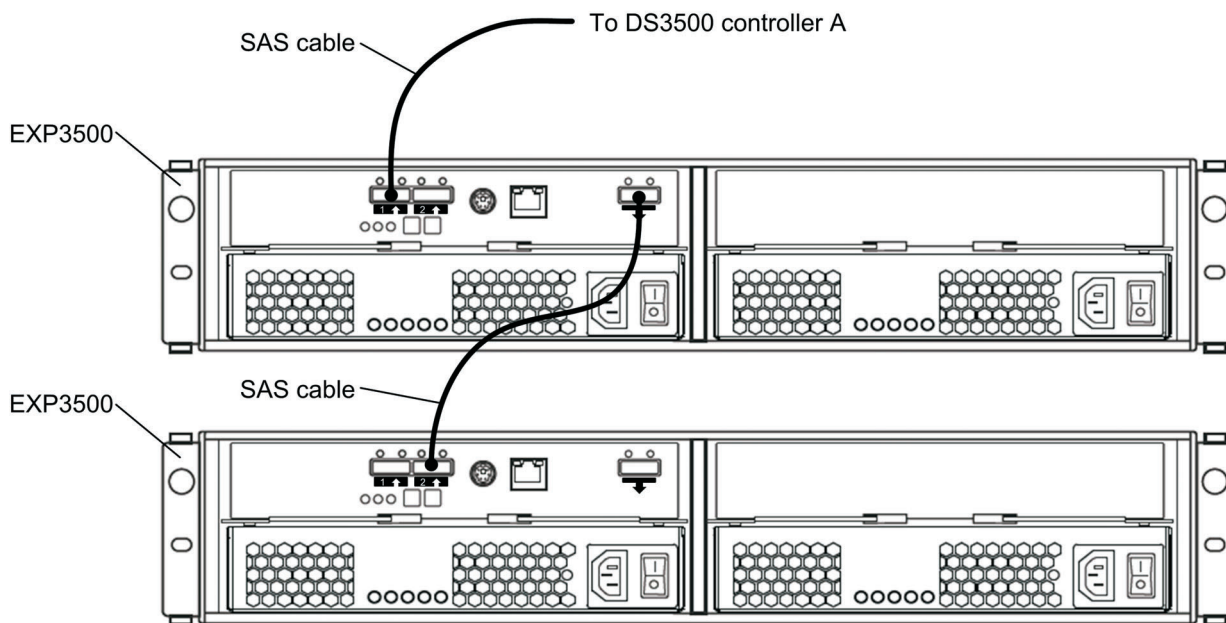
2. Connect a second EXP3500 storage enclosure to the first EXP3500 storage enclosure:

   a. Connect one end of a SAS cable to the Out (↓) SAS connector on the ESM of the EXP3500 storage enclosure that you just connected.

   b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the ESM on the next EXP3500 storage enclosure.

   c. Repeat steps 2a and 2b for each EXP3500 storage enclosure that you add.

Dual-ESM configuration

The EXP3500 storage enclosure comes with one ESM. If your DS3500 storage subsystem is a dual controller configuration, it supports redundant drive paths. You must install a second ESM. See "Installing an additional ESM" on page 5-39 before attaching any EXP3500 storage enclosures.

Dual-ESM configuration with a single EXP3500 storage enclosure:
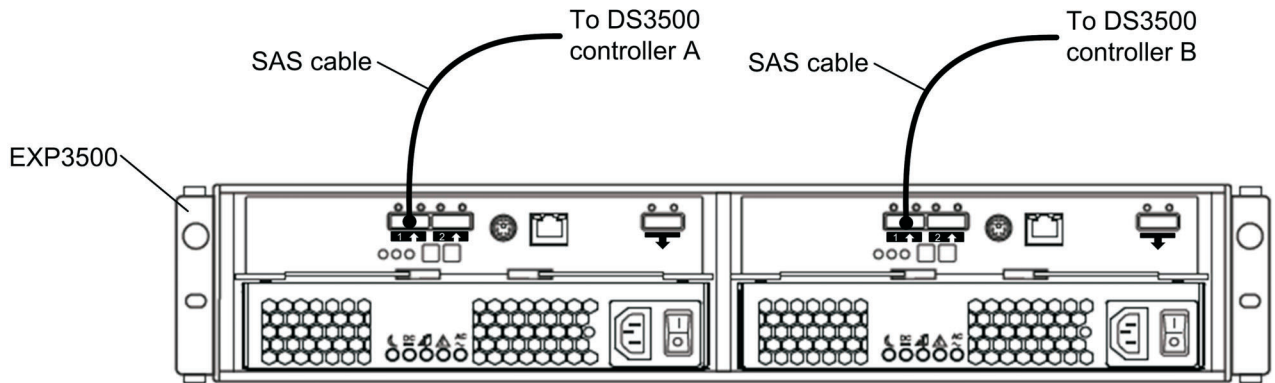
To connect controllers A and B to one EXP3500 storage enclosure that has two ESMs, complete the following steps:

1. Connect the EXP3500 storage enclosure to controller A:

    a. Connect one end of a SAS cable to controller A.

    b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the left ESM in the EXP3500 storage enclosure.

2. Connect the EXP3500 storage enclosure to controller B:

    a. Connect one end of a SAS cable to controller B.

    b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the right ESM in the EXP3500 storage enclosure.

Dual-ESM configuration with two or more EXP3500 storage enclosures:
The DS3500 controllers support more than one EXP3500 storage enclosure per physical port, so multiple EXP3500 storage enclosures can be connected by chaining them together.
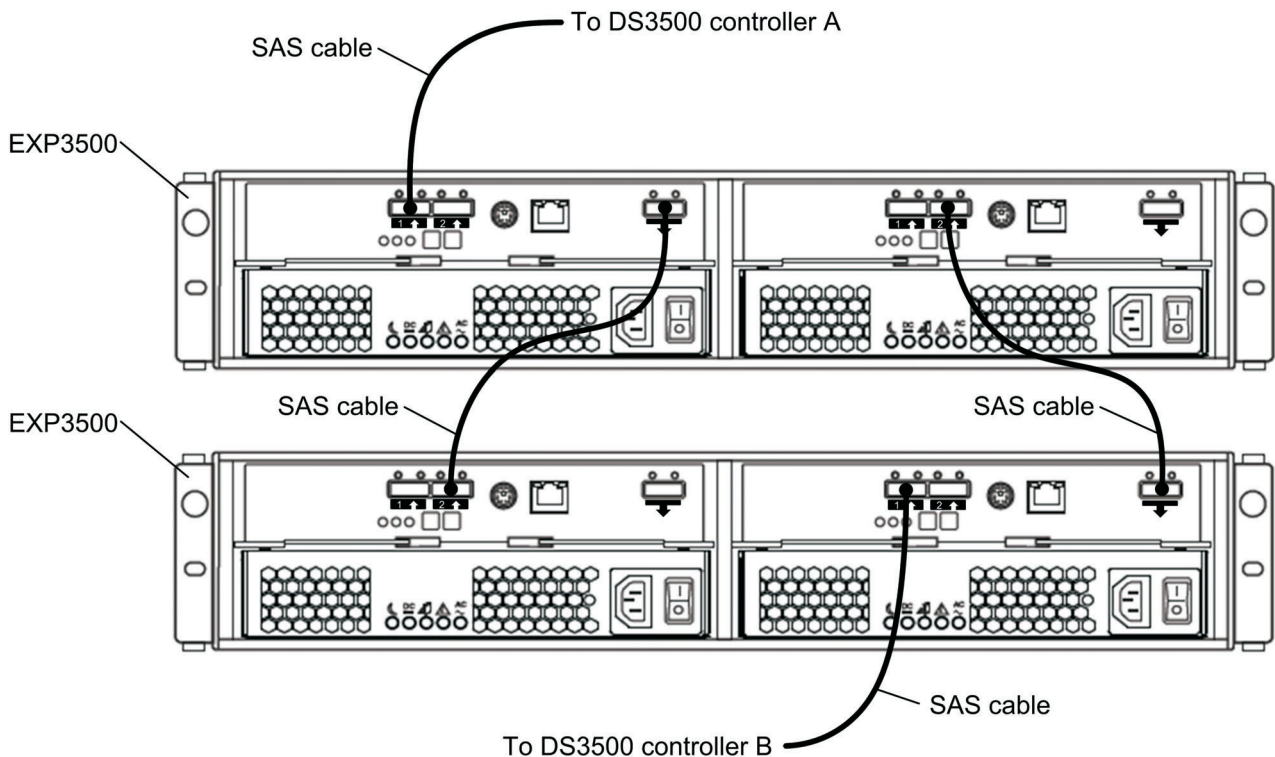
To connect DS3500 controllers A and B to multiple EXP3500 storage enclosures that have two ESMs each, complete the following steps:

1. Connect one EXP3500 storage enclosure to controller A:
   a. Connect one end of a SAS cable to the drive expansion port on the DS3500 controller A.
   b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the left ESM in the EXP3500 storage enclosure.
2. Connect the left ESM of the EXP3500 storage enclosure to the next EXP3500 storage enclosure in the chain:
   a. Connect one end of a SAS cable to the Out (↓) SAS connector on the left ESM of the EXP3500 storage enclosure that you just connected.
   b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the left ESM in the next EXP3500 storage enclosure in the chain.
   c. Repeat steps 2a and 2b for each EXP3500 storage enclosure that you add.
3. Connect the last EXP3500 storage enclosure in the chain to controller B:
   a. Connect one end of a SAS cable to the drive expansion port on the DS3500 controller B.
   b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the right ESM in the last EXP3500 storage enclosure of the chain that you created.
4. In reverse order (last in chain to first in chain), connect the right ESMs in the EXP3500 storage enclosures in the chain:
   a. Connect one end of a SAS cable to the Out (↓) SAS connector on the right ESM of the EXP3500 storage enclosure that you just connected.
   b. Connect the other end of the SAS cable to one of the In (↑) SAS connectors on the right ESM of the previous EXP3500 storage enclosure in the chain.
   c. Repeat steps 2a and 2b until you connect the right ESM of the first EXP3500 storage enclosure in step 2 to the right ESM of the EXP3500 storage enclosure in step 1.

Connecting storage enclosures to the DS3500

The DS3500 supports either the EXP3512 or the EXP3524 storage enclosure. The DS3500 supports up to 192 drives (with controller firmware 7.77.xx.xx and later) or 96 drives (with controller firmware 7.75.xx.xx and earlier), with the purchase of an optional Storage Partition Premium Feature upgrade.

The total number of storage enclosures supported varies depending on the model of DS3500 storage subsystem and EXP3500 storage enclosure. See the following tables Table 3-1 and Table 3-2 on page 3-18.

Note: The DS3500 ships with four storage partitions by default. For additional storage partitions, purchase a Storage Partition Premium Feature upgrade. Contact the IBM reseller or marketing representative for more information.

Table 3-1 shows the maximum number of EXP3512 and EXP3524 storage enclosures that can be attached to either a DS3512 or a DS3524 storage subsystem, and not exceed 192 total disk drives with controller firmware level 7.77.xx.xx and later. Any combination of EXP3512 or EXP3524 storage enclosures can be attached to a DS3512 or a DS3524 as long as the total number of disk drives does not exceed 192.

Table 3-1. Maximum number of EXP3512 and EXP3524 storage enclosures with controller firmware level 7.77.xx.xx and later

DS3512					DS3524				
Storage enclosures	Quantity				Storage enclosures	Quantity			
EXP3512	15	14	13	12	EXP3524	7	6	5	4
EXP3524	0	0	1	1	EXP3512	0	2	5	6

DS3512					DS3524				
or					or				
EXP3512	11	10	9	8	EXP3524	3	2	1	
EXP3524	2	2	3	3	EXP3512	8	10	12	
or									
EXP3512	7	6	5	4					
EXP3524	4	4	5	5					
or									
EXP3512	3	2	1						
EXP3524	6	6	7						

Table 3-2 shows the maximum number of EXP3512 and EXP3524 storage enclosures that can be attached to either a DS3512 or a DS3524 storage subsystem and not exceed the 96 total disk drives with controller firmware level 7.75.xx.xx and earlier. Any combination of EXP3512 or EXP3524 storage enclosures can be attached to a DS3512 or a DS3524 as long as the total number of disk drives does not exceed 96.

Table 3-2. Maximum number of EXP3512 and EXP3524 storage enclosures with controller firmware level 7.75.xx.xx and earlier

DS3512									
Storage enclosures	Quantity				Storage enclosures	Quantity			
EXP3512	7	5	3	1	EXP3524	3	2	1	0
EXP3524	0	1	2	3	EXP3512	0	2	4	6

Redundant drive channel pair

Each storage controller on the DS3500 has a drive expansion channel that contains an x4 SAS port. The storage enclosures that are connected to this connector form a drive channel. You can install a maximum of 96 drives in one drive channel. In a dual-controller DS3500, one drive channel from each controller combines to form a redundant drive-channel pair.

Figure 3-23 on page 3-19 shows an example of a redundant drive-channel pair. If any component of the drive channel fails, the controllers can still access the storage enclosures in the redundant drive-channel pair.

Note: In storage enclosures that are connected to a dual-controller storage subsystem, you must install the optional second ESM to support dual redundant drive paths.
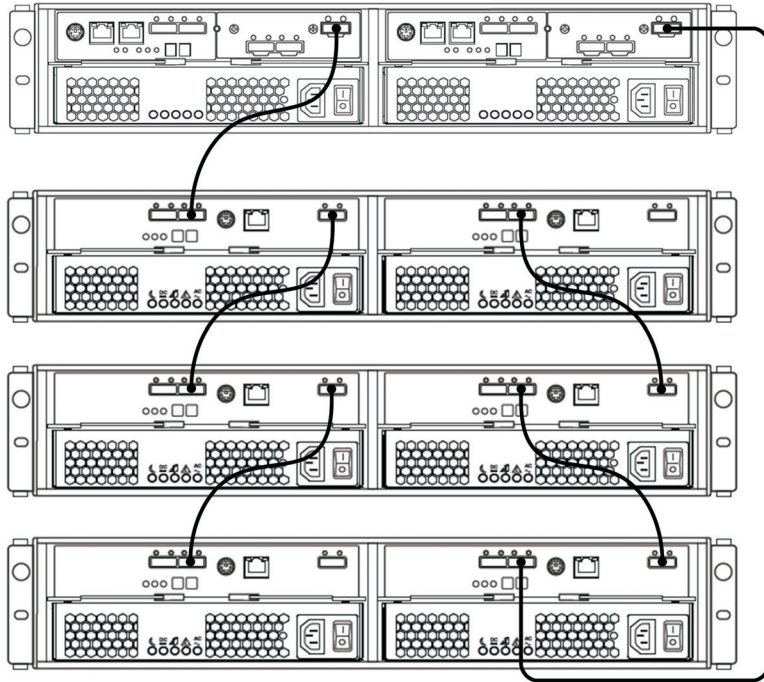
Figure 3-23. Example of a redundant drive path

Connecting storage enclosures to a storage subsystem

To connect storage enclosures to the storage subsystem, complete the following steps:

1. Follow the instructions in the *IBM System Storage DS3500 and EXP3500 Rack Installation and Quick Start Guide* for the storage enclosure and the rack installation instructions to set up and mount the storage enclosures.

2. Select a cabling topology applicable to the number of ESMs in the storage enclosures that you will connect to the DS3500. "DS3500 storage subsystem drive cabling topologies" describes the recommended schemes for cabling storage enclosures with one ESM or two ESMs to the DS3500 and to each other (if you are connecting more than one storage enclosure).

3. Follow the cabling diagram for the selected topology.

4. If required, set unique enclosure IDs for all storage enclosures that are cabled to the DS3500. For information about setting the enclosure ID, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) and *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later).

The DS3500 storage subsystem locates the drives in the storage enclosures after you power-on the configuration. Always turn on the storage enclosures first and then turn on the DS3500. After you have powered-on the configuration, use the Storage Manager software to check the status of the new drives, correct any errors, and configure the new drives.

DS3500 storage subsystem drive cabling topologies

This section contains the preferred cabling topologies for cabling storage enclosures to the DS3500 storage subsystem:

- "One single-controller DS3500 and one or more storage enclosures" on page 3-20
- "One dual-controller DS3500 and one storage enclosure" on page 3-20
- "One dual-controller DS3500 and two storage enclosures" on page 3-21

- "One dual-controller DS3500 and up to eight storage enclosures" on page 3-21

If one of these topologies is suitable for the hardware and application in your business setup, complete the cabling connections as shown in the illustrations. If you have a setup other than the ones shown in these examples, use these examples as a starting point for creating your specific topology.

Note: In storage enclosures that are connected to a dual-controller storage subsystem, you must install the optional second ESM to support dual redundant drive paths.

One single-controller DS3500 and one or more storage enclosures:
To cable one single-controller DS3500 to one or more single-ESM storage enclosures, connect them as shown in Figure 3-24.
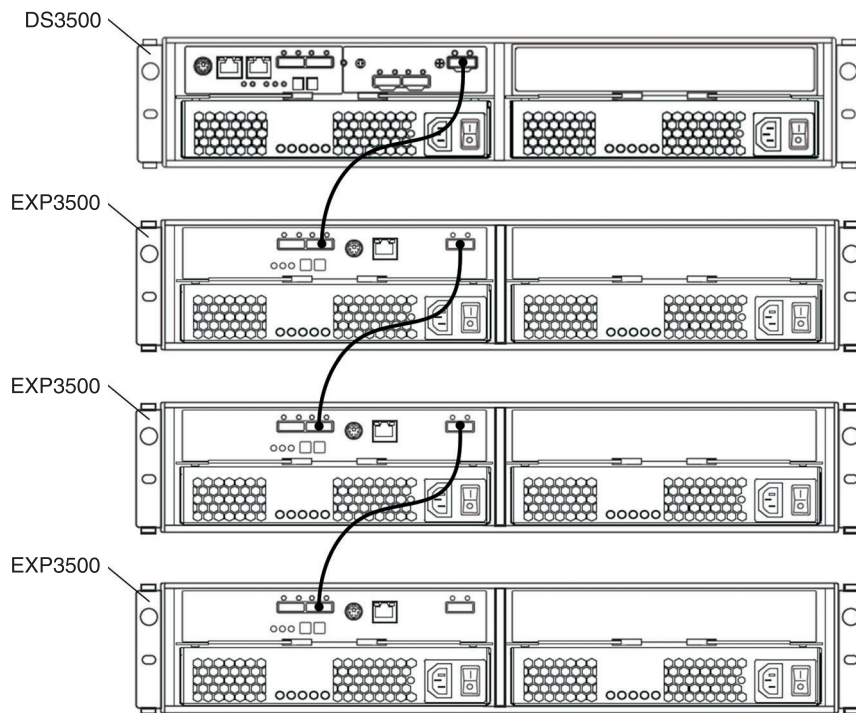
Figure 3-24. One single-controller DS3500 and multiple single-ESM storage enclosures

Note: In storage enclosures that are connected to a dual-controller storage subsystem, you must install the optional second ESM to support dual redundant drive paths, and must use one of the dual-controller topologies that are described in this section.

One dual-controller DS3500 and one storage enclosure:
To cable a dual-controller DS3500 to a storage enclosure, connect them as shown in Figure 3-25 on page 3-21.
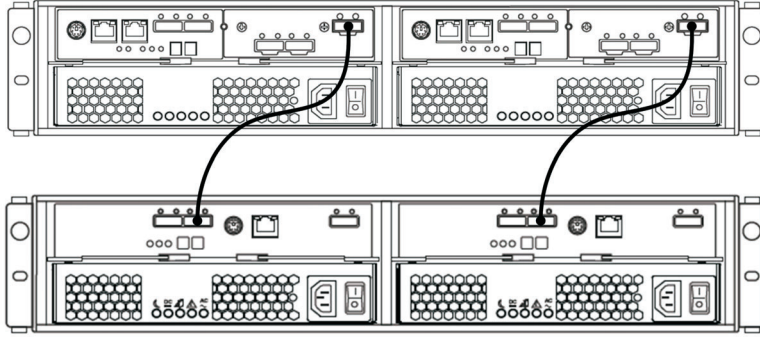
Figure 3-25. A dual-controller DS3500 and a storage enclosure

One dual-controller DS3500 and two storage enclosures:
To cable a dual-controller DS3500 and two storage enclosures, connect them as shown in Figure 3-26.
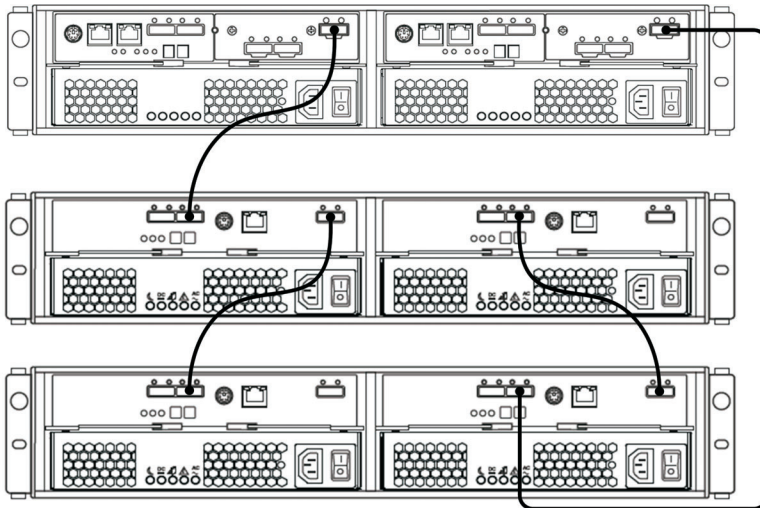
Figure 3-26. A dual-controller DS3500 and two storage enclosures

One dual-controller DS3500 and up to eight storage enclosures:
To cable a dual-controller DS3500 and up to eight storage enclosures, connect them as shown in Figure 3-27 on page 3-22.
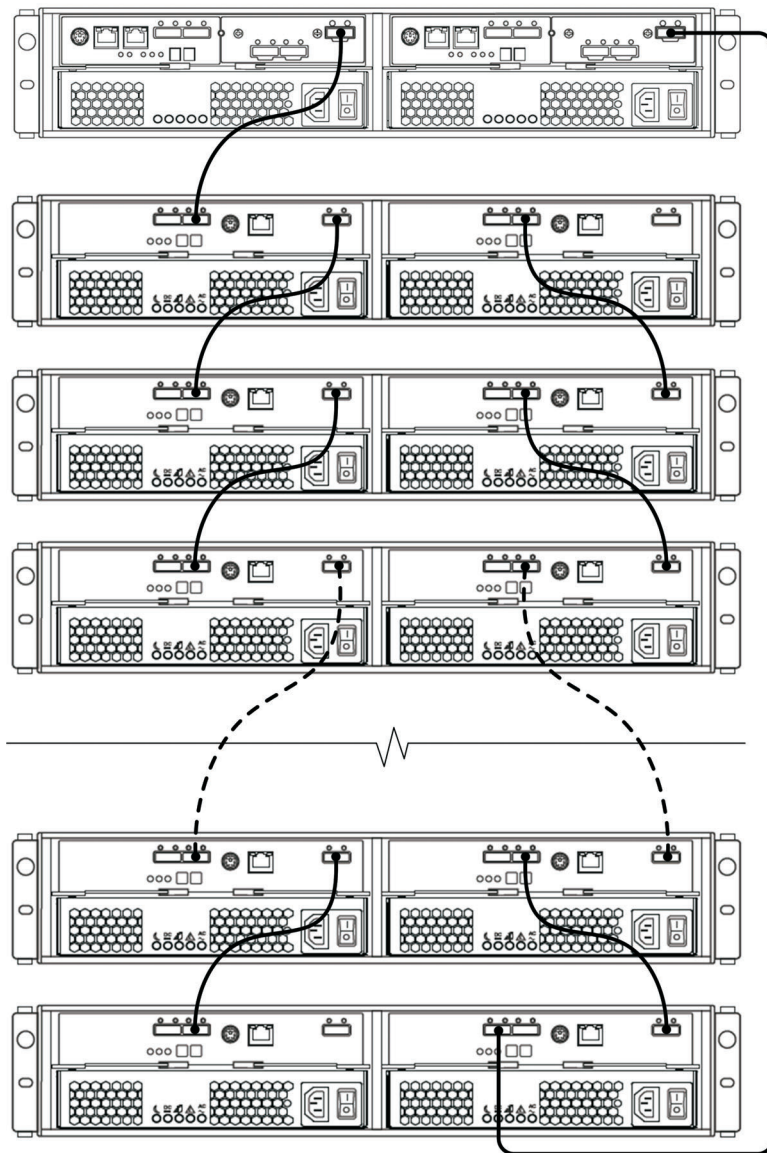
Figure 3-27. A dual-controller DS3500 and eight storage enclosures

Adding a storage enclosure to a running dual-controller configuration

Complete the following steps to add storage enclosures to a running dual-controller DS3500 storage subsystem.

Note: Ensure that each storage enclosure has two ESMs before you connect it to a dual-controller DS3500 storage subsystem. The second ESM must be purchased separately. Contact your IBM marketing representative or authorized reseller for more information about purchasing a second ESM. For more information about installing a second ESM, see the Installation Guide that is shipped with the storage enclosure.

1. Ensure that the DS3500 storage subsystem status is Optimal in the Storage Manager software.
2. Use the storage enclosure Rack Installation Instructions document to install the new storage enclosure in the rack.
3. Connect the power cables to the new storage enclosure.
4. Power on the storage enclosure.

5. Connect one end of a Serial Attached SCSI (SAS) cable to the Drive expansion port on Controller A in the DS3500 storage subsystem.

6. Connect the other end of the SAS cable to either of the In ports on the left ESM in the storage enclosure.

7. Connect one end of a second SAS cable to the Drive expansion port on Controller B in the DS3500 storage subsystem.

8. Connect the other end of the second SAS cable to the In port on the right ESM in the storage enclosure.

9. Wait until the storage subsystem status is Optimal in the Storage Manager software before proceeding to step 10.

10. Add the drives to the storage enclosure. Ensure that you wait for at least 30 seconds for the Storage Manager software to recognize each newly added drive before you install another drive.

    To add additional storage enclosures after the first storage enclosure is connected to a dual-controller DS3500 storage subsystem, complete the following steps:

    a. Ensure that the storage subsystem status is Optimal in the Storage Manager software.

    b. Use the storage enclosure Rack Installation Instructions document to install the new storage enclosure in the rack.

    c. Connect the power cables to the new storage enclosure.

    d. Power on the storage enclosure.

    e. Connect one end of a Serial Attached SCSI (SAS) cable to the In port on the left ESM in the storage enclosure that is being added to the configuration.

    f. Connect the other end of the SAS cable to the Out port on the left ESM in the last storage enclosure in the configuration (this storage enclosure is directly connected to the Drive expansion port on controller A of the DS3500).

    g. On the last storage enclosure in the configuration, disconnect the SAS cable from the In port on the right ESM and connect it to the In port on the right ESM on the new storage enclosure that is being added to the configuration.

       Note: When the SAS cable is disconnected in step 7, a loss of path redundancy occurs and an error message is displayed in the Storage Manager Recovery Guru. Ignore this error message. The redundant path is restored in step h after the SAS cable is connected.

    h. Connect a SAS cable to the Out port on the right ESM of the new storage enclosure and connect the other end to either of the In port on the right ESM in the storage enclosure that was previously connected to controller B of the DS3500.

    i. Wait until the storage subsystem status is Optimal in the Storage Manager software before proceeding to step 10.

    j. Add the drives to the storage enclosure. Make sure that you wait for at least 30 seconds for the Storage Manager software to recognize each newly added drive before you install another drive.

Upgrading a single-controller to a dual-controller when there is no attached EXP3500 enclosure

If you are upgrading a single-controller DS3500 storage subsystem to a dual-controller DS3500 storage subsystem and there are no EXP3500 storage enclosures attached to the DS3500 storage subsystem, see "Installing a controller" on page 5-3.

Upgrading a single-controller to a dual-controller when there is one or more EXP3500 enclosures attached to the storage subsystem

Before you upgrade the DS3500 storage subsystem from a single-controller to a dual-controller, ensure that you purchase:

- a second environmental services module (ESM) for each EXP3500 storage enclosure that is attached to the DS3500 storage subsystem. You will install the second ESM during this procedure.
- the SAS cables that are required to create a redundant drive enclosure path.

To upgrade a single-controller DS3500 storage subsystem to a dual-controller DS3500 storage subsystem when there are EXP3500 storage enclosures attached to the DS3500, complete the following steps:

1. Turn off the DS3500 storage subsystem and all attached EXP3500 storage enclosures.
2. Install a second controller in the DS3500 storage subsystem by using the instructions in "Installing a controller" on page 5-3.
3. Install a second ESM in each EXP3500 that is connected to the DS3500 storage subsystem:
   a. Read the safety information on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
   b. Remove the ESM filler panel from the rightmost ESM bay of the EXP3500. On the left side of the ESM filler panel, press the orange release tab to the right just enough to release the handle (no more than 6 mm [0.25 in.]) as you turn the handle upward. Using the handle, gently slide the ESM filler panel out of the EXP3500. Save the ESM filler panel for future use.
   c. Hold the new ESM so that the handle is fully extended.
   d. Gently slide the ESM into the bay until it stops. Turn the handle downward into the closed position until it clicks.
4. Using the information provided in "DS3500 storage subsystem drive cabling topologies" on page 3-19, connect SAS cables to create a redundant drive-channel path from the DS3500 controllers to the EXP3500 ESMs.

Connecting secondary interface cables

This section applies to direct (out-of-band) management configurations only. If your configuration uses host-agent (in-band) management, skip this section.

Connect the Ethernet management port on the rear panel of the storage subsystem to the controllers for direct management of the storage subsystems (see "Direct (out-of-band) management method" on page 3-26).

Important:
1. To minimize security risks, do not connect the DS3500 to a public LAN or public subnet. Use a local private network for the DS3500 and the storage management station Ethernet connectors.
2. For proper EMI shielding, use good-quality braided and shielded serial cables.

Connect an Ethernet cable from the management station to the Ethernet connector on controller A on the rear of the storage subsystem. For a dual-controller storage subsystem, you can connect a second Ethernet cable from the management station to the Ethernet connector on controller B. Figure 3-28 on page 3-25 shows the locations of the Ethernet management connectors on the DS3500 storage subsystem.
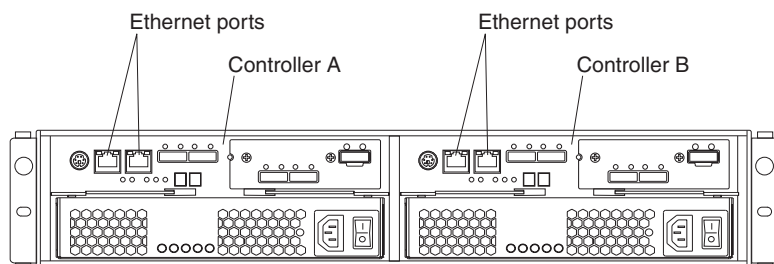
Figure 3-28. Ethernet port locations on a dual-controller DS3500

Configuring the storage subsystem

You must configure the storage subsystem after you install the storage subsystem in a rack. Use the information in the following sections to configure the storage subsystem.

Storage subsystem management methods

Before you configure the storage subsystem, determine which method of storage subsystem management you want to use. You can manage the storage subsystem in either of two ways: host-agent (in-band) management or direct (out-of-band) management.

Note: See the Storage Manager readme file for information about in-band limitations or restrictions that are associated with particular combinations of controllers and host bus adapters.

For more information about setting up in-band or out-of-band management connections, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) or *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later) for the operating system of the host server that you will use to manage the DS3500 storage subsystem. The document is in the Documentation folder on the IBM *System Storage DS3500 Support* DVD.

Important: If the operating system of the host server that the storage subsystem logical drives are mapped to is not Microsoft Windows Server 2003 or Windows Server 2008, you must make a direct (out-of-band) management connection to the storage subsystem to set the correct host type first. The server will then be able to recognize the storage subsystem correctly for host-agent (in-band) management.

Host-agent (in-band) management method:
To use this method, host-agent software must be installed on the host server. Using the host-agent software, you can manage the storage subsystem through the Storage Manager software client program by using the same connections between the host server and the storage subsystem. You must install at least one management station and a software agent host. The management station can be the host or a workstation on the Ethernet network. The client software is installed on the management station. Figure 3-29 on page 3-26 shows the host-agent (in-band) management method.

Controller

Controller

Host computer

I/O Path

Ethernet

Management Station

dcsi0023
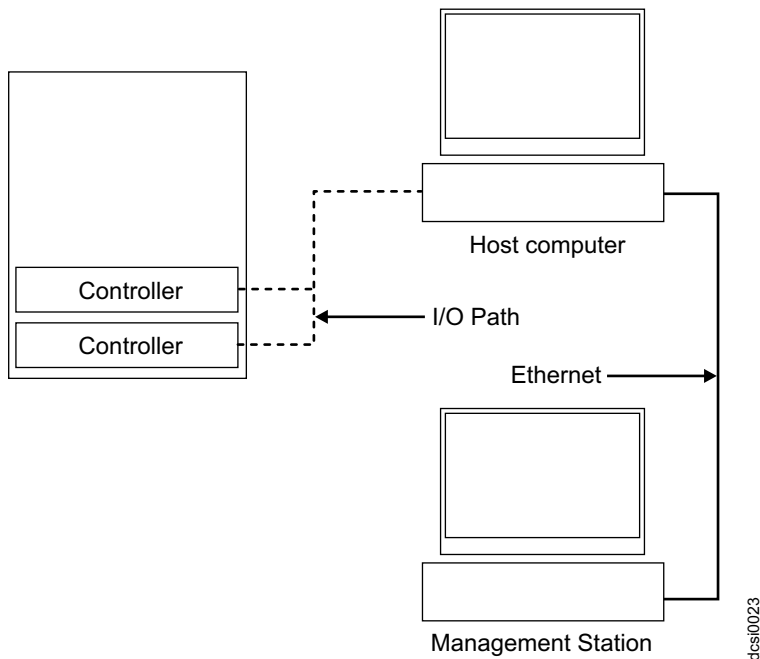
Figure 3-29. Host-agent (in-band) managed storage subsystems

Direct (out-of-band) management method:
This method contains information about Ethernet connections from a management station to each controller in the storage subsystem. You must install at least one management station. The management station can be the host or a workstation on the Ethernet network. The client software is installed on the management station. Attach Ethernet cables to each management station (one pair per storage subsystem). You will connect the cables to each storage subsystem controller later when you install the storage subsystem. Figure 3-30 on page 3-27 shows the direct (out-of-band) management method.

Note: Do not connect the DS3500 storage subsystem Ethernet ports to a public network or public subnet. To minimize security risks, create a private network between the DS3500 storage subsystem and the management station.
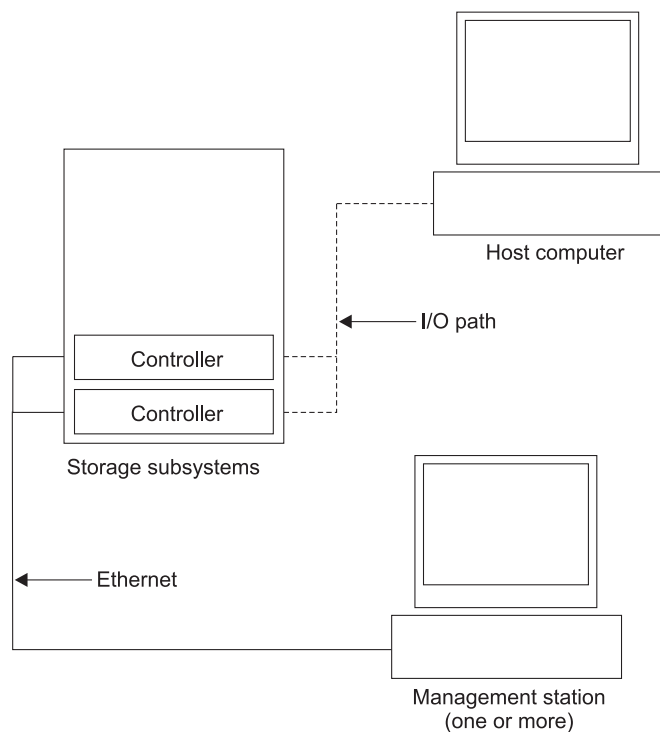
Figure 3-30. Direct (out-of-band) managed storage subsystems

Installing the storage subsystem configuration

Before attempting to attach hosts to the storage subsystem, ensure that the host systems and host bus adapters (HBAs) are installed correctly and updated with the latest firmware and drivers.

Note: Use the correct HBA firmware and device driver. For the latest supported HBAs and device drivers, consult the readme that is shipped with the DS3500 controller firmware. See the documentation that is shipped with the HBA for installation requirements and procedures.

For a SAS attached host, attach a SAS cable to each HBA. Continue with "Connecting SAS hosts to the DS3500" to connect the other end of each cable to a controller.

For a Fibre Channel attached host, attach a fibre channel cable to each HBA. Continue with "Connecting Fibre Channel hosts to the DS3500" on page 3-33 to connect the other end of each cable to the controller.

For an iSCSI attached host, attach an Ethernet cable to each host. Continue with "Connecting iSCSI hosts to the DS3500" on page 3-38 to connect the other end of each cable to the controller.

Connecting SAS hosts to the DS3500

The DS3500 can support up to 28 hosts when attached to the SAS Connectivity Module for IBM BladeCenter®, and up to four hosts in a direct attached host environment. The number of supported hosts depends on the number of host ports installed on the controller. To protect against the loss of any one path from the host servers to the DS3500 storage subsystem, use redundant host connections.

Note: In a single-controller storage subsystem, redundant host connections are supported. Redundant host connections provide path failover but limit the number of redundant host connections to a single connection. The DS3500 ships with four storage partitions by default. For additional storage partitions, purchase an optional Storage Partition Premium Feature upgrade. Contact your IBM reseller or marketing representative for more information.

To connect a SAS host bus adapter (HBA) to the storage subsystem, complete the following steps:

1. Connect a SAS cable from the controller host port to the SAS HBA that is in the host. Figure 3-4 on page 3-3 shows the location of the host ports.

2. Create a redundant host connection:
   - If the storage subsystem is a single-controller storage subsystem, connect a SAS cable from the second SAS HBA to another host port on the controller. You can create a maximum of one redundant host connection to a single-controller storage subsystem.
   - If the storage subsystem is a dual-controller storage subsystem, connect a SAS cable from the second SAS HBA to a host port on the other controller. You can create a maximum of three redundant host connections to a dual-controller storage subsystem.

See "Direct-attached single-controller connections" on page 3-33 and "Direct-attached dual-controller connections" on page 3-35 for illustrations of host connections.

Starting with controller firmware version 7.77.xx.xx and later, the DS3500 also supports host connections via SAS switch. See "Single-controller and dual-controller connections via SAS switch" on page 3-30 for illustrations of host connections to the DS3500 SAS host port via SAS switch.

Note: For information about supported SAS switch models, SAS HBAs, and operating-system version requirements for SAS switch connection environments, see the interoperability matrix at http://www.ibm.com/systems/support/storage/ssic/.

Direct-attached single-controller connections:
The following illustration shows a direct-attached SAS connection to a single host HBA.
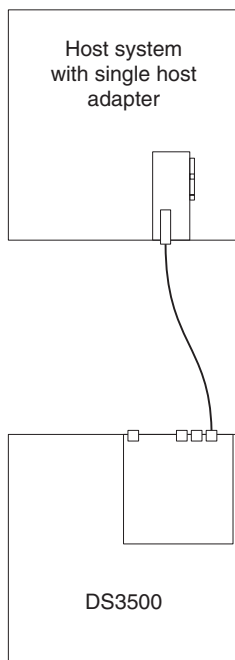
Figure 3-31. Single-controller direct-attached SAS connection to a single-host HBA

The following illustration shows a direct-attached SAS connection to dual HBAs in a single-host (redundant host connection).
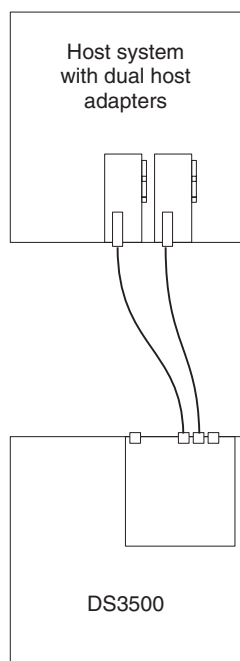
Figure 3-32. Single-controller direct-attached SAS connection to dual HBAs in a single-host (redundant host connection)

The following illustration shows a direct-attached SAS connection to single HBAs in multiple hosts.
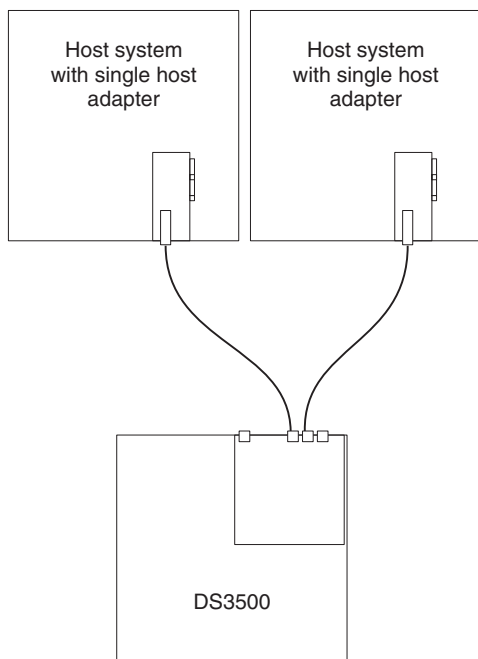
Figure 3-33. Single-controller direct-attached SAS connection to single HBAs in multiple hosts

Direct-attached dual-controller connections:
The following illustration shows a direct-attached SAS connection from each controller to a single HBA in the same host (redundant host connection).
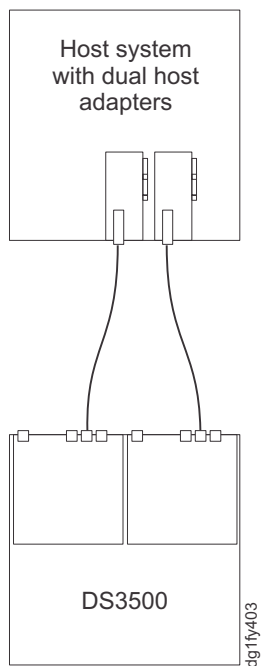
Figure 3-34. Dual-controller direct-attached SAS connection to two HBAs in the same host (redundant host connection)

The following illustration shows multiple redundant direct-attached SAS host connections. This configuration is also the configuration to use for a dual-node cluster configuration.
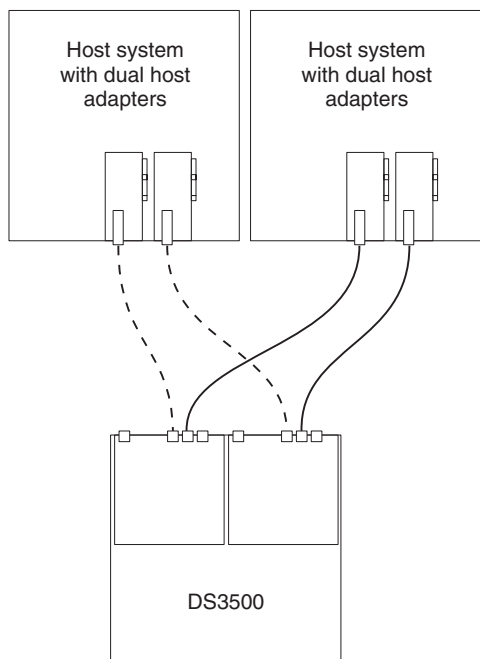
Figure 3-35. Dual-controller direct-attached SAS connections to multiple HBAs in multiple hosts

Single-controller and dual-controller connections via SAS switch:
The illustration Figure 3-36 on page 3-31 shows the connections from the host server to the dual-controller or single-controller DS3500 using one SAS switch. This figure also illustrates the use of the SAS switch to allow the host server connected to multiple DS3500s.
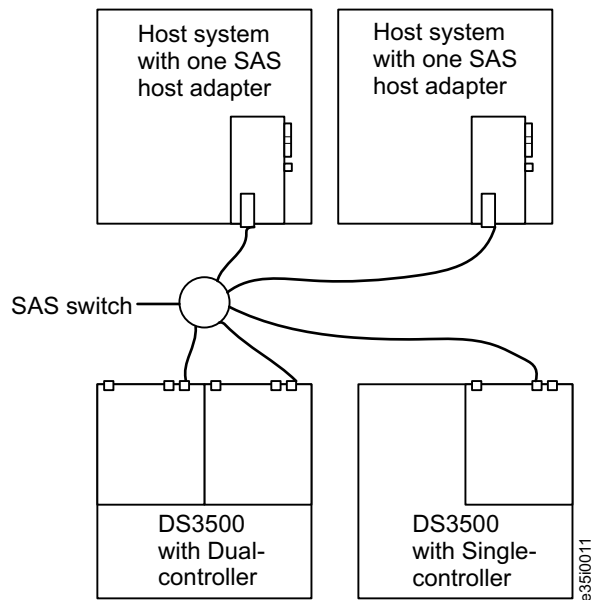
Figure 3-36. Dual-controller DS3500 or single-controller DS3500 SAS connection to multiple hosts using one SAS switch

The illustration Figure 3-37 shows the connections from the host server to the dual-controller DS3500 using two SAS switches that are not connected together. Each switch forms its own group of connections. This is also the configuration to use for dual-node cluster configuration. The illustration Figure 3-38 on page 3-32 shows the host server connects to multiple DS3500s via two separate SAS switches.
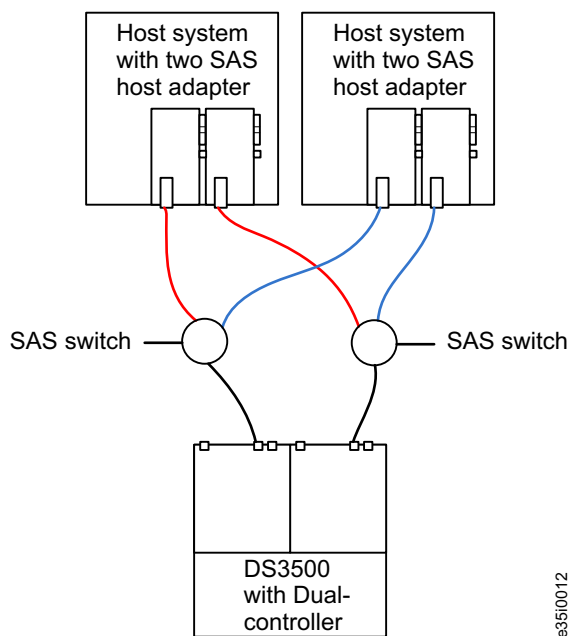
Figure 3-37. Dual-controller DS3500 SAS connection to multiple hosts using two separate SAS switches
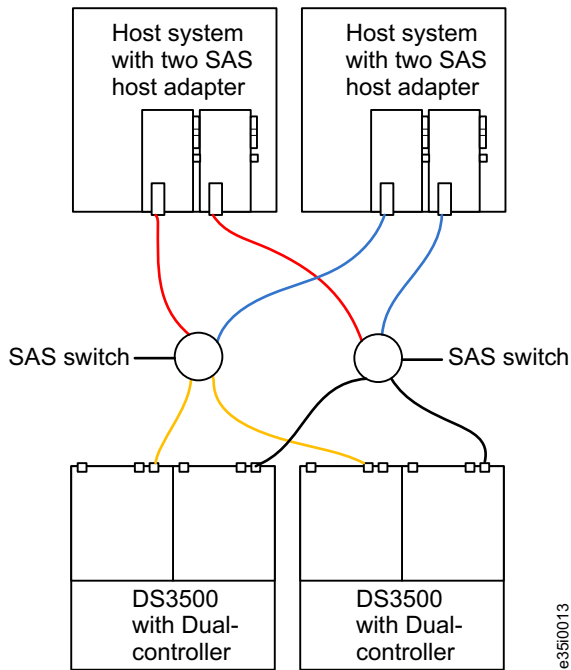
Figure 3-38. Multiple dual-controller DS3500s SAS connection to multiple hosts using two using two separate SAS switches

The illustration Figure 3-39 shows the connections from the host server to the dual-controller DS3500 using two SAS switches that are connected together via an inter-switch link.
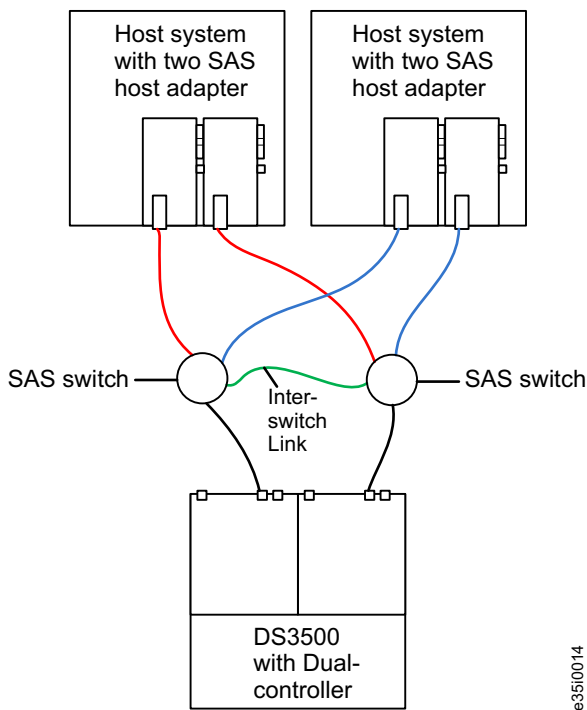
Figure 3-39. Dual-controller DS3500 SAS connection to multiple hosts using two SAS switches that are connected together via an interlink switch

Connecting Fibre Channel hosts to the DS3500

Using Fibre Channel switches, up to 64 hosts can be redundantly attached to the DS3500 storage subsystem in a Fibre Channel storage area network (SAN) fabric.

Note: The DS3500 ships with four storage partitions by default. For additional storage partitions, purchase an optional Storage Partition Premium Feature upgrade. Contact your IBM reseller or marketing representative for more information.

To connect a host to the controllers, complete the following steps:

1. Install SFP modules in the host ports on controllers A and B.
2. Connect the Fibre Channel cables to the SFP modules in the controller host ports and to either the SFP modules in the Fibre Channel switch or the optical interface connector on the host bus adapters. Figure 3-40 shows the location on the controllers of the storage subsystem ports where the host-system cables connect.
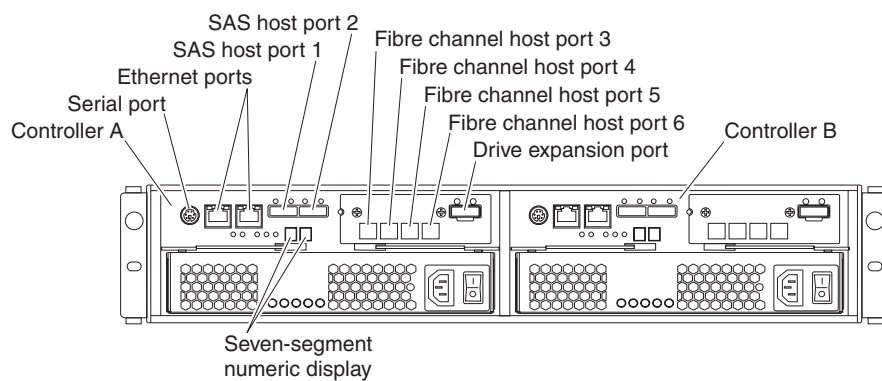
Figure 3-40. Location of host connectors on storage controllers

3. Repeat steps 1 and 2 for an additional redundant host connection. In a direct connection configuration, you can create a maximum of two redundant host connections for the storage subsystem.

See "Direct-attached single-controller connections" and "Direct-attached dual-controller connections" on page 3-35 for illustrations of host connections.

For examples of redundant, partially-redundant, and non-redundant host and drive loop configurations, see "Fibre Channel host loop configurations" on page 3-36.

Direct-attached single-controller connections:
The following illustration shows a direct-attached connection to a single host HBA.
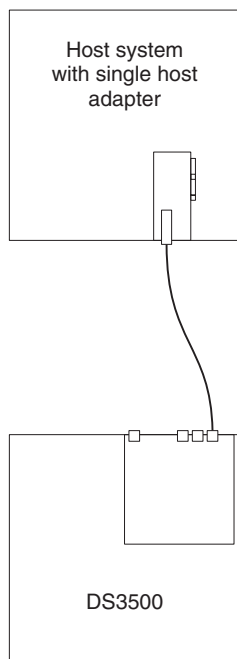
Figure 3-41. Single-controller direct-attached Fibre Channel connection to a single host HBA

The following illustration shows a direct-attached connection to dual HBAs in a single host (redundant host connection).
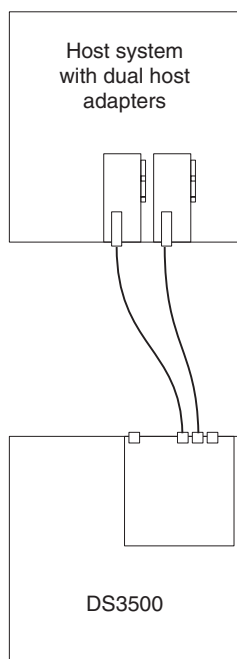
Figure 3-42. Single-controller direct-attached Fibre Channel connection to dual HBAs (redundant host connection)

The following illustration shows a direct-attached connection to single HBAs in multiple hosts.
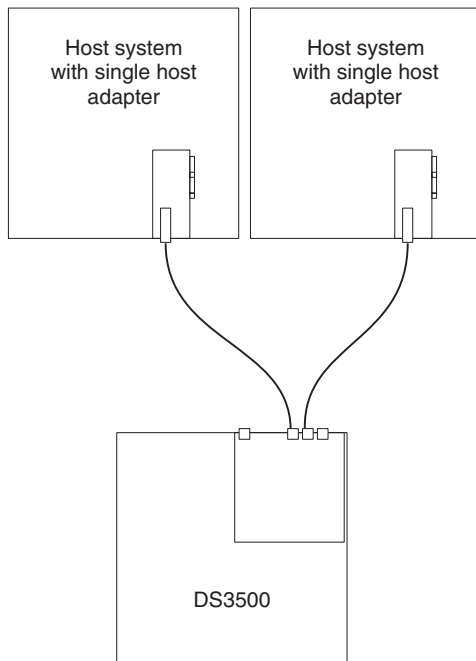
Figure 3-43. Single-controller direct-attached Fibre Channel connection to single HBAs in multiple hosts

Direct-attached dual-controller connections:
The following illustration shows a direct-attached connection from each controller to a single HBA in the same host (redundant host connection).
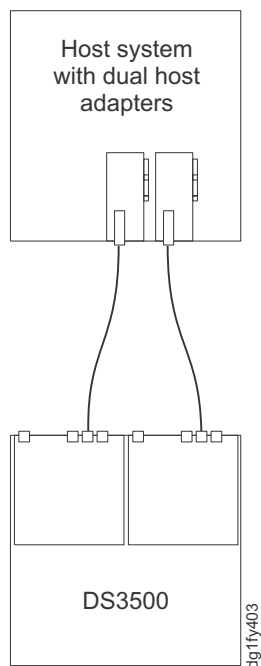
Figure 3-44. Dual-controller direct-attached Fibre Channel connection to two HBAs in the same host (redundant host connection)

The following illustration shows multiple redundant direct-attached host connections.
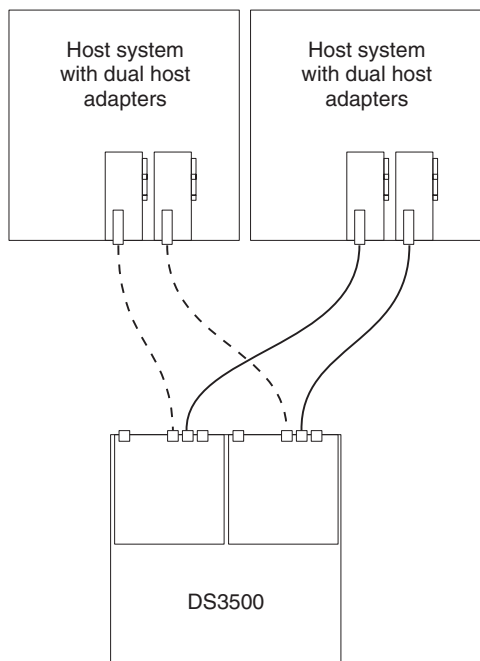
Figure 3-45. Dual-controller direct-attached Fibre Channel connections to multiple HBAs in multiple hosts

Fibre Channel connections:
The storage subsystem Fibre Channel connection consists of up to two host Fibre Channel loops. The host Fibre Channel loops provide the fibre path for host attachment. They can consist of Fibre Channel cables, SFP modules, host bus adapters, Fibre Channel switches, and controllers.

Fibre Channel host loop configurations:
You must determine how the host systems will connect to the storage subsystem. You can connect up to two host systems directly to the storage subsystem. The illustrations in the following sections show common host system configurations.

Redundant host loops:
This section provides examples of host Fibre Channel configurations.

Host Fibre Channel configurations:
This section provides the following examples of host Fibre Channel configurations.
* Single SAN fabric configuration, as shown in Figure 3-46 on page 3-37
* Dual SAN fabric configuration, as shown in Figure 3-47 on page 3-37
* Two storage subsystems in a dual SAN fabric configuration, as shown in Figure 3-48 on page 3-38

Note: These configurations have host and drive path failover protection and are recommended for high availability.

In Figure 3-46 on page 3-37, the Fibre Channel switches are connected together through the Inter-Switch Link (ISL) to form a single SAN fabric.
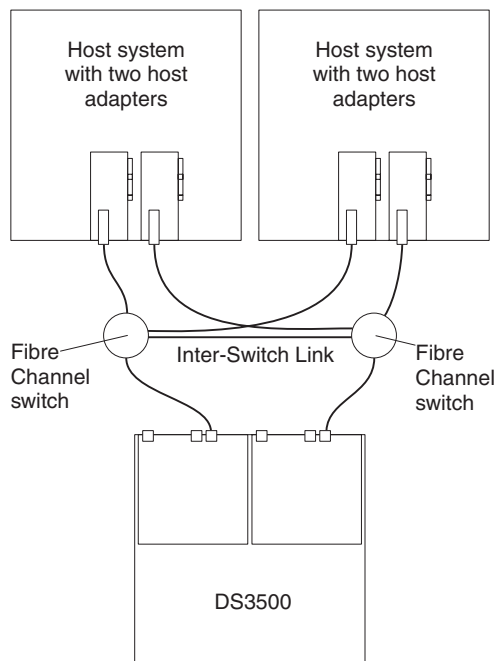
Figure 3-46. Example of a single Fibre Channel SAN fabric configuration

In Figure 3-47, the Fibre Channel switches are *not* connected together through an ISL. Each switch forms its own SAN fabric. This configuration is also the configuration to use for a dual-node cluster configuration.
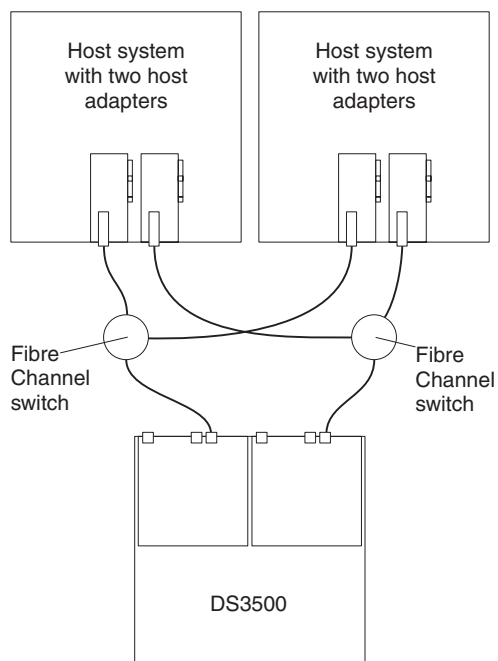
Figure 3-47. Example of a dual Fibre Channel SAN fabric configuration

In Figure 3-48 on page 3-38, the Fibre Channel switches are not connected together. Each switch forms its own SAN fabric.
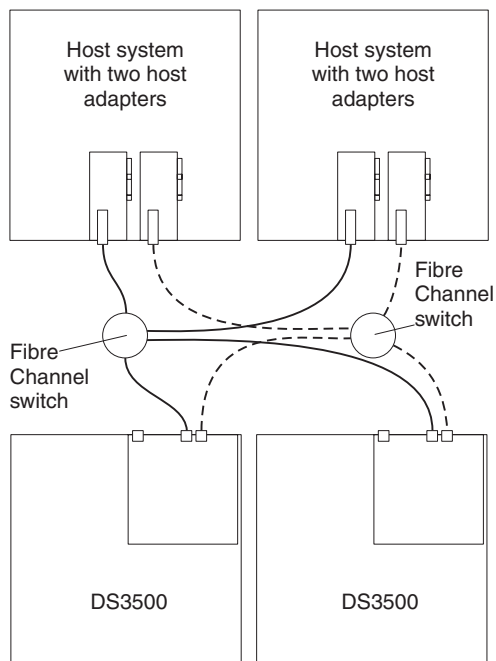
Figure 3-48. Example of two storage subsystems in a dual Fibre Channel SAN environment

Connecting iSCSI hosts to the DS3500

The DS3500 can support up to 64 hosts, depending on the number of host ports and host partitions that are used on the controller. To protect against the loss of any one path from the host servers to the storage subsystem, use redundant host connections.

To connect a hardware or software iSCSI initiator to the storage subsystem, complete the following steps:

1. Connect Ethernet cables from the controller host port to the 1 gigabit or 10 gigabit Ethernet switch:

   - For a 1 gigabit Ethernet switch, connect a Category 5e or Category 6 Ethernet cable from the controller host port to a gigabit Ethernet switch, and then connect an Ethernet cable from the switch to the host iSCSI initiator port.

   - For a 10 gigabit Ethernet switch, connect a Category 6 (shielded or unshielded), Category 6A (shielded or unshielded), or Category 7 Ethernet cable from the controller host port to a gigabit Ethernet switch, and then connect an Ethernet cable from the switch to the host iSCSI initiator port. For these cables, the following cable lengths are supported:

     - Cat 6 unshielded - 30m
     - Cat 6 shielded - 100m
     - Cat 6A unshielded - 55m
     - Cat 6A shielded - 100m
     - Cat 7 - 100m

   Note: These cables must be customer-supplied and are not available with the DS3500. IBM recommends using Category 6A or Category 7 cables to obtain the highest signal quality and reliability when operating at 10 Gbps, because these cables are designed to support 10 Gbps and minimize alien crosstalk. The quality of Category 6 cables can vary between different manufacturers and even different manufactured lots. Please contact your IBM representative or reseller if you require any clarifications.

   Figure 3-2 on page 3-2 shows the host ports.

2. Create a redundant host connection:

- If the storage subsystem is a single-controller storage subsystem, connect an Ethernet cable from the second host port on the controller to a gigabit Ethernet switch.
- If the storage subsystem is a dual-controller storage subsystem, connect an Ethernet cable from the host port on the other controller on the storage subsystem to a gigabit Ethernet switch.

Note: Do not configure any two interfaces on the same subnet. If you are using DHCP on more than one interface, multiple interfaces can end up on the same subnet. Direct iSCSI connections from the host to the storage subsystem are not supported.

For illustrations of host connections, see "Single-controller iSCSI connections" and "Dual-controller iSCSI configurations" on page 3-41.

Single-controller iSCSI connections:
The following illustration shows a single controller storage subsystem that is attached to a single host. This configuration has no redundancy.
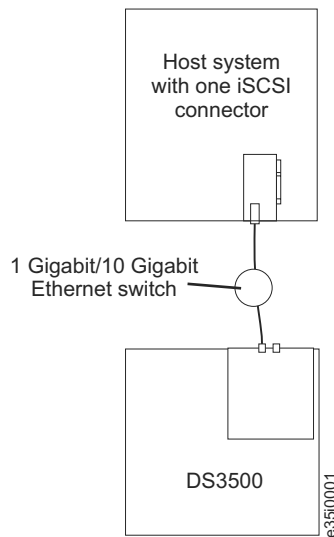
Figure 3-49. Single-host, single-controller iSCSI configuration

A system with dual iSCSI ports can provide enhanced performance compared to a system that uses only one iSCSI port.

The following illustration is an example of a host that uses multiple ports attached to a single-controller configuration. This configuration provides some path redundancy.
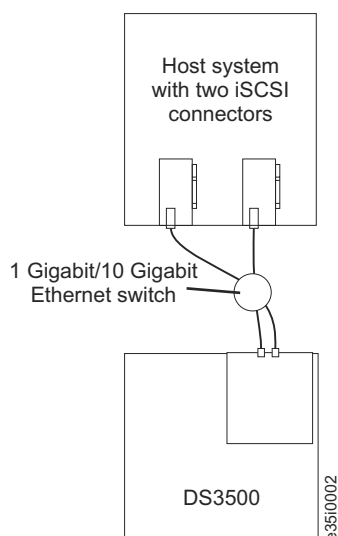
Figure 3-50. Multiple-port, single-controller iSCSI configuration

The following illustration is an example of multiple single-port host systems that are connected to a single-controller DS3500 using multiple connections.
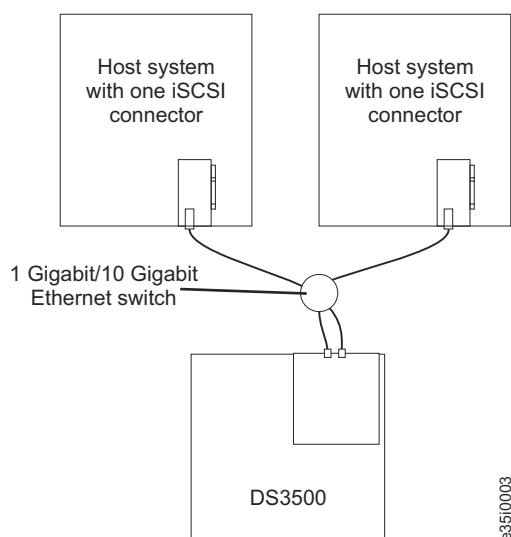
Figure 3-51. Multiple single-port hosts, single-controller iSCSI configuration

For cluster configurations, the following illustration is an example of a multiple-host, multiple-port, single-controller, and redundant-path configuration.
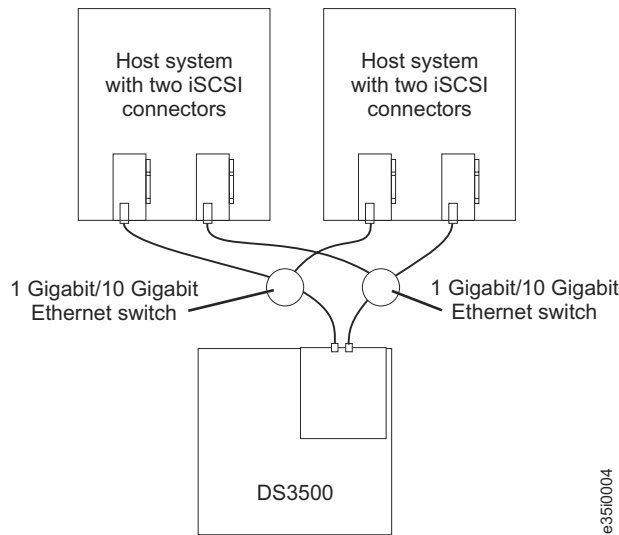
Figure 3-52. Multiple-host, multiple-port, single-controller, and redundant-path iSCSI configuration

You can replace the two gigabit Ethernet switches that are shown in Figure 3-52 and Figure 3-53 with one large gigabit Ethernet switch that has the required number of ports. Virtual local area network (VLAN) can also be used to isolate the two iSCSI networks, instead of a single switch.
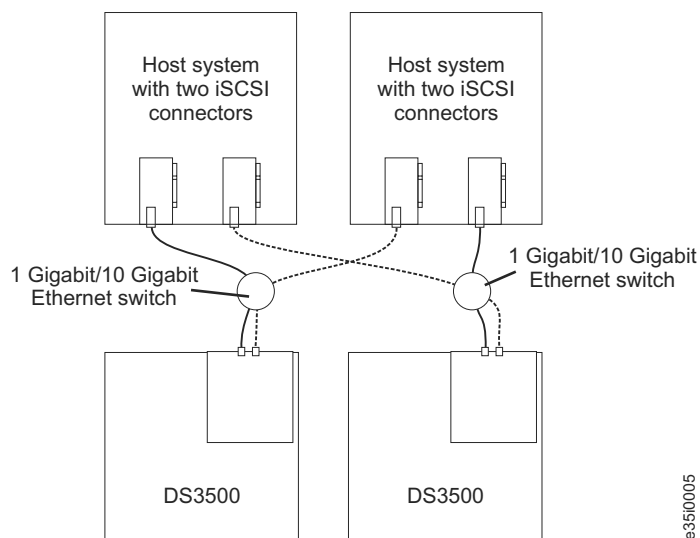
Figure 3-53. Multiple-host, multiple-port, multiple-storage-subsystem iSCSI configuration

Dual-controller iSCSI configurations:
The following illustration is an example of a multiple port, single-host configuration. A system that uses multiple iSCSI ports can provide enhanced performance compared to a single-port iSCSI connection.
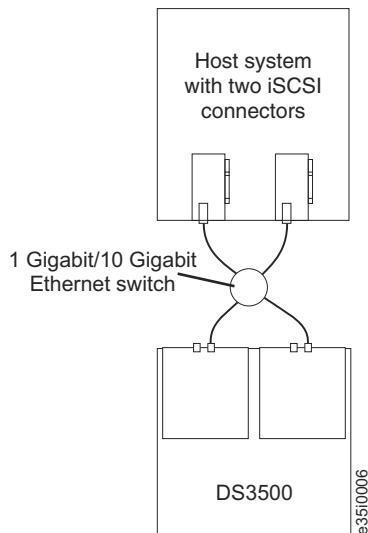
Figure 3-54. Single-host, multiple-port, dual-controller iSCSI configuration

For cluster configurations, the following illustration is an example of a multiple-host, multiple-port, and redundant path and controller configuration.

You can replace the two gigabit Ethernet switches that are shown in Figure 3-55 with one large gigabit Ethernet switch that has the required number of ports. Virtual local area network (VLAN) can also be used to isolate the two iSCSI networks, instead of a single switch.
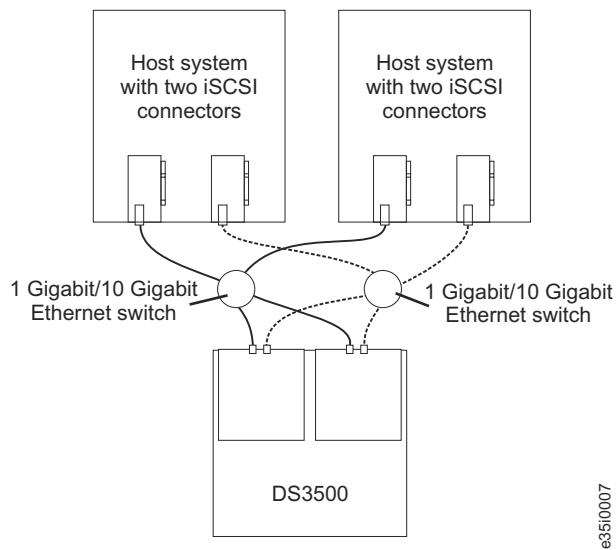
Figure 3-55. Multiple-host, multiple-port, dual-controller iSCSI configuration

Figure 3-56 on page 3-43 shows an example of a multiple-host, multiple-port, and multiple-fabric (Fibre Channel or iSCSI, and SAS) configuration.
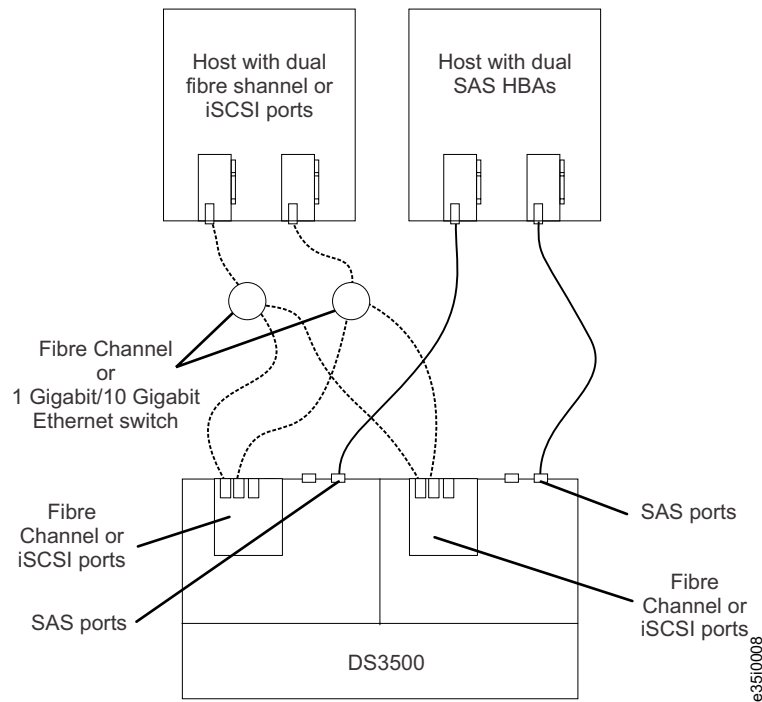
Figure 3-56. Example of a multiple-host, multiple-port, and multiple-fabric (Fibre Channel or iSCSI, and SAS) configuration

Overview of installing an IBM BladeCenter configuration to connect to a DS3500

This section contains an overview of and guidelines for installing an IBM BladeCenter configuration to connect to a DS3500.

Before you install the BladeCenter configuration:

- Ensure that the BladeCenter chassis, blade server, SAS connectivity module, and SAS expansion card are supported. Go to http://www.ibm.com/servers/storage/support/disk/, select the link for the DS3500, and see the interoperability matrix.
- Ensure that an Advanced Management Module is installed in the BladeCenter chassis. The latest level of management-module firmware is available at http://www.ibm.com/bladecenter/.
- For the latest SAS connectivity module firmware, SAS expansion card firmware, blade server BIOS code, and device drivers, see http://www.ibm.com/systems/support/.

Installing the BladeCenter configuration

To install the IBM BladeCenter SAS Expansion Card (CFFv), IBM BladeCenter SAS Connectivity Module, and blade server, complete the following steps:

1. Install an IBM BladeCenter SAS Expansion Card (CFFv) in each blade server that you want to connect to the DS3500. See the documentation that is shipped with the SAS expansion card for installation requirements and procedures.
2. Install the blade servers in the BladeCenter chassis. See the documentation that is shipped with the blade server for installation requirements and procedures.
3. Install the IBM BladeCenter SAS Connectivity Modules in the I/O bays in BladeCenter unit. See the documentation that comes with the SAS connectivity modules for installation requirements and procedures.
4. Go to "Connecting BladeCenter hosts to the DS3500" on page 3-44.

Connecting BladeCenter hosts to the DS3500

The dual-controller DS3500 comes with two SAS host connectors on each controller, enabling up to 28 blade servers in one BladeCenter unit to be redundantly connected to the storage subsystem.

To protect against the loss of any one path from the host blade servers to the DS3500, use redundant host connections.

To connect a SAS expansion card that is installed in a blade server to the DS3500, complete the following steps:

1. Connect a SAS cable from the SAS host connector on the DS3500 storage controller to any SAS port on an IBM BladeCenter SAS Connectivity Module, which is installed in a BladeCenter unit (port 3 is recommended).

2. To create a redundant host connection, connect a SAS cable from a second SAS connectivity module to a host connector on the other controller in the DS3500. You can create a maximum of two redundant host connections in a dual-controller DS3500, one connection each from the blade center to the DS3500 controller host port as shown in Figure 3-57.

   Attention: You can connect only one DS3500 to the BladeCenter SAS Connectivity Module. No other external devices can be connected to the SAS connectivity module.

3. (Optional) For additional storage, connect EXP3500 storage enclosures to the DS3500. See the illustration to configure storage enclosures inFigure 3-23 on page 3-19.

Figure 3-57 shows an example of a DS3500 that is connected to one BladeCenter unit.
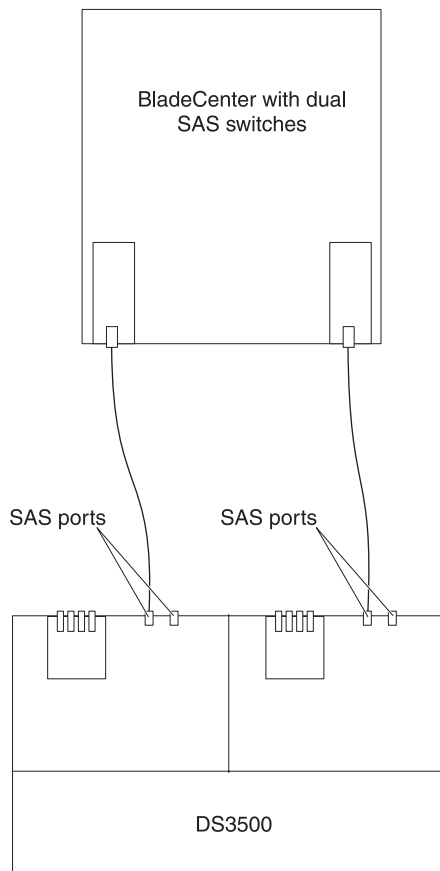
Figure 3-57. Example of a DS3500 that is connected to a BladeCenter unit

Cabling the DS3500 and EXP3500 ac power supplies

To connect the DS3500 and EXP3500 ac power-supply cords, complete the following steps:

1. Connect a power cord to a power supply in the DS3500 or EXP3500.
2. Attach the power cord to the strain relief guide.
3. Repeat steps 1 and 2 for the second power supply.
4. Connect the other end of each power cord to a correctly grounded electrical receptacle. For maximum protection against power loss, connect each of the two power supplies to a different power source.

Cabling the DS3500 and EXP3500 dc power supplies

Statement 29

CAUTION:
This equipment is designed to enable the connection of the earthed conductor of the dc supply circuit to the earthing conductor at the equipment. If this connection is made, all of the following conditions must be met:

- **This equipment must be connected directly to the dc supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the dc supply system earthing electrode conductor is connected.**
- **This equipment must be located in the same immediate area (such as adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same dc supply circuit and the earthing conductor, and also the point of earthing of the dc system. The dc system shall not be earthed elsewhere.**
- **The dc supply source must be located within the same premises as this equipment.**
- **Switching or disconnecting devices must not be in the earthed circuit conductor between the dc source and the point of connection of the earthing electrode conductor.**

Statement 34

CAUTION:

To reduce the risk of electric shock or energy hazards:

* **This equipment must be installed by trained service personnel in a restricted-access location, as defined by the NEC and IEC 60950-1, First Edition, The Standard for Safety of Information Technology Equipment.**

* **Connect the equipment to a reliably grounded safety extra low voltage (SELV) source. An SELV source is a secondary circuit that is designed so that normal and single fault conditions do not cause the voltages to exceed a safe level (60 V direct current).**

* **Incorporate a readily available approved and rated disconnect device in the field wiring.**

* **See the specifications in the product documentation for the required circuit-breaker rating for branch circuit overcurrent protection.**

* **Use copper wire conductors only. See the specifications in the product documentation for the required wire size.**

* **See the specifications in the product documentation for the required torque values for the wiring-terminal nuts.**

To connect the DS3500 and EXP3500 dc power-supply cables, complete the following steps:

1. Ensure that the power on-off switch on both of the dc power supply and fan units in the chassis are in the off position.

2. Using the supplied strap, tie the dc power supply cable to the rail to provide strain relief for the power cable.

   Note: The supplied dc power cable uses 10 AWG copper conductors.

3. Connect the dc power cable to the power supply. See Figure 3-58 for the dc power supply connector PIN positions.
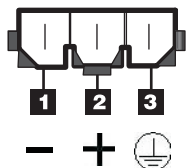
Figure 3-58. DC power connector - pin positions

Table 3-3. DC power supply connector - pin descriptions

Number	Function	DC power cable wire color
1	Pin 1: - 48 V dc	Brown
2	Pin 2: POS RTN	Blue
3	Pin 3: GND	Green/yellow

4. Connect the - 48V wire (brown) of the dc power cable to an approved disconnect device (circuit breaker) rated at 20 A. The disconnect device must be easily accessible from the back of the DS3500 unit.

   Attention:

   * The disconnect device (circuit breaker) must be rated at 20 A. Ensure that at least 12 AWG or larger copper conductor wires are used for all of the wiring between the DS3500 or EXP3500 dc power connectors and the dc power source.

   *

5. Complete the wiring from the disconnect device to the terminal marked -48V of the Reliably grounded safety extra low voltage (SELV) dc power source. Connect the POS RTN wire (blue) and the ground wire (green/yellow) of the dc power cable to the terminals marked POS RTN and GND on

the dc power source, as shown in Figure 3-59.
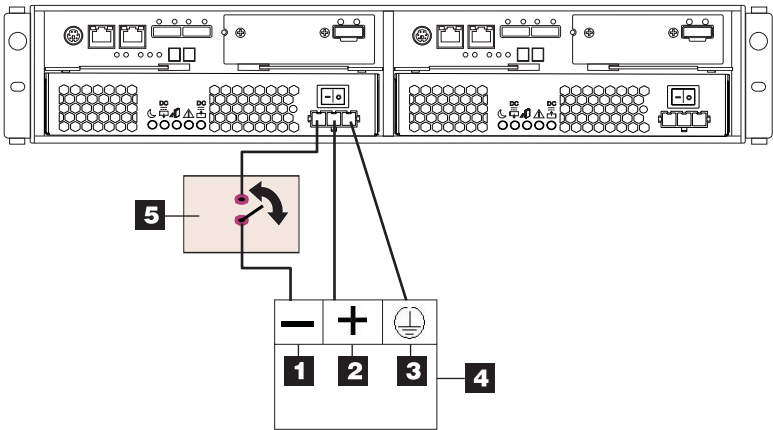
Figure 3-59. DC wiring from DS3500 to disconnect device and dc power source

Table 3-4. DC power source wiring descriptions

Number	Description
1	Pin 1: - 48 V dc
2	Pin 2: POS RTN
3	Pin 3: GND
4	DC power source
5	Disconnect device

Chapter 4. Operating the storage subsystem and storage enclosure

This chapter describes operating procedures for the storage subsystem and storage enclosure.

To ensure optimal operation of the storage subsystem and storage enclosure, see "Best practices guidelines" on page 1-7.

Performing the health check process

Use the health check process to help you verify and maintain the optimal performance of the storage configuration. The information that you collect in these steps also helps provide IBM Service with important information that is needed during a service call.

Perform the following health check tasks after the initial configuration of the storage subsystem and after all configuration sessions.

1. Monitor the Recovery Guru in the Storage Manager software for any obvious storage subsystem errors or problem conditions.
2. Gather and save the following storage subsystem event logs for review by IBM Service. These event logs should be gathered periodically for regular health check monitoring regardless of the state of the Recovery Guru. (You can collect all these logs at once and compress them into a single file by clicking the **Support** tab and then **Gather Support Information** in the Subsystem Management window.)
   - DS3500 storage subsystem management event log (MEL)
   - Storage Subsystem Profile or DS3500 Profile
   - SAS PHY error log

   In addition, you should also collect event logs for the host servers that have mapped logical drives from the storage subsystem.

   Attention: Save these event-log files to a server disk that will remain accessible in the event of a DS3500 storage configuration failure. Do not save these event log files only to a LUN in the DS3500 storage subsystem.
3. Use the Storage Subsystem Profile or DS3500 Profile to make sure that the following firmware levels are at the latest versions:
   - Controller firmware
   - ESM firmware
   - Drive firmware

   If the firmware is not up-to-date, upgrade the firmware and software to the latest level that is applicable to the storage configuration. See "Software and hardware compatibility and upgrades" on page 1-14 for information about where to find the latest firmware and software.

   Attention: You must resolve Recovery Guru errors or problems before you upgrade firmware.

   Save the storage subsystem profile before you perform any controller or ESM firmware upgrades. Save the storage subsystem profile and all .cfg files to a server disk that will remain accessible in the event of a DS3500 storage configuration failure.
4. Use the Storage Subsystem Profile or DS3500 Profile to make sure that the following functions are enabled:
   - For all DS3500 models, enable Media Scan both at the controller level and at the LUN level.
   - For all DS3500 models, enable the read/write cache. In addition, use the Storage Subsystem Profile to make sure that cache is matched between the controllers.

Set a regular schedule of periodic health check evaluations to keep the firmware levels current and to preserve optimal data access and performance.

Hardware inspection

In addition to the health check process, regular hardware inspection and maintenance helps to support the optimal performance of the storage configuration. Periodically inspect the components of the storage configuration.

For best results, follow these guidelines:

* Maintain an up-to-date storage subsystem profile for the storage configuration. Save the profile to a server disk that will remain accessible in case of a DS3500 storage configuration failure. Do not save the profile only to a LUN in the storage subsystem.
* Develop a change-management plan. The plan should include schedules for updating subsystem firmware and server host software.

    Note: Some updates might require storage subsystem downtime.

* Use applicable IBM-approved cables for all situations. Note in the configuration documentation whether any cables are not IBM-approved.
* Create and maintain a cabling diagram of the current configuration. Keep this diagram updated as you make configuration changes, and keep the cabling diagram available for review.
* Create and maintain a list of other components that are being used within the cabling diagram (such as the host system and other attached devices).
* Make sure that all controllers and ESMs are correctly seated.
* Make sure that all drives are correctly seated.
* Make sure that cables are managed correctly.
* Ensure proper air flow and temperature for all components in the storage configuration.

You can find details about many of these inspection and maintenance responsibilities in other sections of this document.

In addition to these inspection and maintenance responsibilities, conduct training for staff that support storage configurations. Although training is not a part of the health check process, training reduces the potential for configuration problems and contributes to the correct operation of the system.

Turning on the storage subsystem

This section contains instructions for turning on the storage subsystem under normal situations. "Turning off the storage subsystem" on page 4-13 contains instructions for turning off the storage subsystem under normal and emergency situations. When you turn on and turn off the storage subsystem, be sure to use the startup sequence that is described in this section. If you are turning on the storage subsystem after an emergency shutdown or power outage, see "Restoring power after an unexpected shutdown" on page 4-16.

The following procedure addresses two situations:

* The entire storage subsystem has been shut down (the main circuit breakers for the rack are off).
* Some storage enclosures are being powered-on while others remain online (the main circuit breakers for the rack are on). You might encounter this if you are adding a storage enclosure to increase storage capacity.

Attention:

1. Repeatedly turning the power off and on without waiting for the drives to spin down can damage the drives. Always wait at least 70 seconds after you turn off the power before you turn it on again.

2. If you are connecting a power cord to a storage subsystem or storage enclosure, turn off both of its power switches first. If the main circuit breaker is off, make sure that both power switches are off on each storage enclosure in the rack before you turn on the main circuit breakers.

1. Are the main circuit breakers turned on?
   - **Yes:** Turn off *both* power switches on each enclosure that you intend to connect to the power.
   - **No:** Turn off *both* power switches on *all* enclosures in the storage subsystem.

2. Make sure that all power cords are connected.

   Note: If the power cords are not connected, turn off both power switches on all modules in the configuration before you connect power cords or turn on the main circuit breakers.

3. If the main circuit breakers are turned off, turn them on.

   Attention: You must turn on power to each attached storage enclosure before you turn on power to the storage subsystem so that the controllers recognize all drives in the configuration during the startup process.

4. If you have enclosures with dc power supplies, turn on the disconnect device that you installed on the -48V line in "Cabling the DS3500 and EXP3500 dc power supplies" on page 3-45.

5. Turn on both power switches on the rear of each storage enclosure that is attached to the storage subsystem. While each storage enclosure powers up, the green and amber LEDs on the front and rear of the storage enclosure turn on and off intermittently. Depending on the configuration, it can take several minutes for each storage enclosure to power-on.

   Check the LEDs on the front and rear of all the storage enclosures. Make sure that no amber LEDs are lit on any of the storage enclosures.

6. Turn on both power switches on the rear of the storage subsystem. Figure 4-1 shows the locations of the ac power switches. Figure 4-2 shows the locations of the dc power switches.
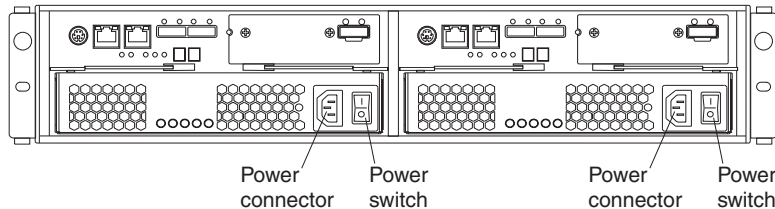
Figure 4-1. Power-supply switches and connectors for DS3500 ac models
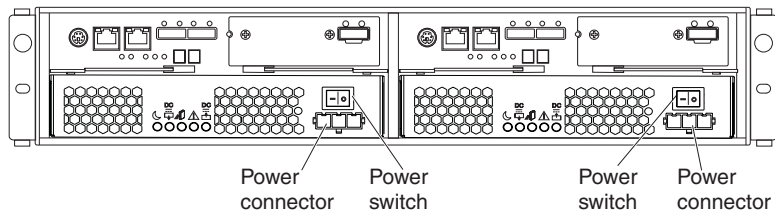
Figure 4-2. Power-supply switches and connectors for DS3500 dc models

Depending on the number of storage enclosures in the configuration, the storage subsystem might take up to 10 minutes to fully power-on. While each storage enclosure powers-on, the green and amber LEDs on the front and rear of the storage enclosure turn on and off intermittently. The cache battery backup self-test might take up to an additional 15 minutes to be completed. During this time, the LEDs on the front and rear of the storage subsystem might flash intermittently.

7. Determine the status of all storage subsystems and components in the configuration by completing the following steps:

   a. Check all LEDs on each component in the storage enclosures. Make sure that all the LEDs show normal status. For more information about LED status for storage enclosures, see "Checking the LEDs" on page 4-7.

   b. Check all LEDs on each component in the storage subsystem. Make sure that all the LEDs show normal status. For information about LED status, see Chapter 6, "Solving problems," on page 6-1.

   c. Open the Subsystem Management window, and display the status of the storage subsystem.

8. Are the LEDs indicating normal operation, and is the status Optimal on all the configuration components?

   - **Yes:** The procedure is complete.
   - **No:** Go to step 9.

9. Diagnose and correct the fault by completing the following steps:

   a. Run the Storage Manager Recovery Guru by clicking **Recovery Guru** in the Subsystem Management window toolbar.

   b. Complete the recovery procedure.

      If the Recovery Guru directs you to replace a failed component, use the individual LEDs on the storage subsystem to locate the specific failed component. For troubleshooting procedures, see Chapter 6, "Solving problems," on page 6-1.

   c. When the recovery procedure is completed, select **Recheck** in the Recovery Guru. This action runs the Recovery Guru again to make sure that the problem is corrected.

   d. If the problem remains, contact your IBM technical-support representative.

Installing the Storage Manager Client

For instructions to install the Storage Manager software, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) or the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later) for the applicable operating system. The document is in the Documentation folder on the IBM *System Storage DS3500 Support* DVD. Use that document and the online help to configure the logical drives, partitions, and so on for the controllers. Follow the instructions in the operating-system documentation to make the new logical drives accessible to the operating system. Do not proceed with the configuration setup until you have completed the Storage Manager installation.

Assemble any additional items in preparation for software installation. These items might include the following items:
- HBA device drivers
- Controller firmware
- IP addresses for controllers (for out-of-band management only)
- Additional documentation for hosts, HBAs, and storage enclosures

Save the storage subsystem profile before any planned system shutdown or after any system additions, removals, or modifications (including firmware updates, logical drive creations, storage partitioning definitions, hardware changes, and so on). For instructions to save the storage subsystem profile, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) or the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later) for your operating system. Save the profile in a location other than the logical drives that are created for the storage subsystem.

Always see the readme file that is included with the DS3500 Storage Subsystem firmware package (whether the firmware is accessed by the Web or a CD) for any special requirements or restrictions that apply to that firmware version.

Note: Be sure to install the Storage Manager event monitoring service to enable continuous monitoring of the status of the storage subsystem. For more information about the importance of this information, see "Monitoring status through software."

Monitoring status through software

Use the Storage Manager software to monitor the status of the storage subsystem. Run the software constantly, and check it frequently.

Note:

1. You can monitor only storage subsystems that are within the management domain of the storage-management software.
2. If you have not installed the Storage Manager Event Monitor service as part of the storage-management software installation, the Storage Manager Enterprise Management window must remain open. (If you close the window, you will not receive any alert notifications from the managed storage subsystems.)

   For more information, see the Enterprise Management online help.

Important: For instructions to install the DS Storage Manager software, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) or the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later) for the applicable operating system. The document is in the Documentation folder on the IBM *System Storage DS3500 Support* DVD.

To download the latest version of the Storage Manager software, controller firmware, NVSRAM firmware, and the latest ESM firmware, go to http://www.ibm.com/servers/storage/support/disk/.

The Storage Manager software provides the best way to diagnose and repair storage-subsystem failures. The software can help you:

- Determine the nature of the failure
- Locate the failed component
- Determine the recovery procedures to repair the failure

Amber (needs attention) LEDs do not necessarily indicate which component has failed or must be replaced or which type of recovery procedure you must perform. In some cases (such as when a drive exceeds its Predictive Failure Analysis [PFA] threshold), the amber LED is not lit. Only the Storage Manager software can detect the failure.

For example, the recovery procedure for a PFA flag (impending drive failure) on a drive varies depending on the drive status (hot spare, unassigned, RAID level, current logical drive status, and so on). Depending on the circumstances, a PFA flag on a drive can indicate a high risk of data loss (if the drive is in a RAID 0 volume) or a minimal risk (if the drive is unassigned). Only the Storage Manager software can identify the risk level and provide the necessary recovery procedures.

Note: For PFA flags, the system-error LED and drive status LEDs are not lit, so checking the LEDs will not notify you of the failure, even if the risk of data loss is high.

Recovering from a storage-subsystem failure might require you to perform procedures other than replacing the component (such as backing up the logical drive). The Storage Manager software provides these procedures.

Attention: Not following the software-recovery procedures can result in data loss. In addition, always replace a failing component as soon as possible to minimize additional failures that might occur, causing loss of data access.

Firmware updates

Attention: Save the storage subsystem profile before you perform any controller or ESM firmware upgrades. Save the profile and all configuration (.cfg) files to a server disk that will remain accessible in the event of a DS3500 storage configuration failure. Do not save these files only to a LUN in the storage subsystem.

To ensure the optimal operation of the storage subsystem and its attached storage enclosures, the ESM firmware, controller firmware, drive firmware, and the NVSRAM firmware must be up-to-date. Go to http://www.ibm.com/servers/storage/support/disk/ to get the latest updates.

Always see the readme files that are included with the firmware packages for the most up-to-date information about firmware prerequisites, firmware update instructions, download-sequence information, and host I/O restrictions, if any. Apply the necessary updates before you configure the storage subsystem arrays and logical drives. Subscribe to My Support for automatic notifications of firmware or Storage Manager software updates or any important information about the DS3500 storage subsystems (see "Product updates" on page 1-6).

Attention: Failure to observe the limitations, prerequisites, sequences, and dependencies in the readme file might result in a loss of data access.

Unless the readme file contains special requirements for the sequence in which you upgrade firmware, perform firmware upgrades in the following sequence:
1. ESM firmware for the storage enclosures
2. Controller firmware
3. Controller NVSRAM
4. Drive firmware

Troubleshooting the storage subsystem

The Storage Manager software is the best way to monitor the storage subsystem, diagnose a problem, and recover from a hardware failure. Run the Storage Manager software continuously, and frequently check the configuration status.

To check the status of and identify a problem with the storage subsystem, complete the following steps. If a problem has occurred, use the Storage Manager software and the LEDs on the storage subsystem to help locate a failed component.
1. Open the Subsystem Management window.
2. Click the **Summary** tab, and view the status of the storage subsystem.
3. Does any storage subsystem have a Needs Attention status?
   - **Yes:** Go to step 4.
   - **No:** All components are Optimal. Go to step 5.
4. Click **Recovery Guru** on the toolbar. Perform the procedure in the Recovery Guru to correct the problem. The Recovery Guru might direct you to replace the failed component. If so, go to step 5.

   Attention: If the fault requires you to power-off an attached storage enclosure, you might have to cycle the power on the DS3500 storage subsystem and all remaining storage enclosures that are connected to the storage subsystem. Contact your IBM technical-support representative before you power-off any attached storage enclosures.
5. Check the LEDs on the front and the rear of the storage enclosure. A green LED indicates a normal status; an amber LED indicates a hardware fault.
6. Is an amber LED lit?
   - **Yes:** Locate and troubleshoot the failed components. See "Checking the LEDs" on page 4-7.

- **No:** You are finished with this procedure. If you are still experiencing a problem with the storage subsystem, create, save, and print a storage subsystem profile, and contact your IBM technical-support representative for assistance. When the recovery procedure is completed, select **Recheck** in the Recovery Guru to run the Recovery Guru again to make sure that the problem is corrected.

Checking the LEDs

The LEDs indicate the status of the storage subsystem and components. Green LEDs indicate a normal operating status; amber LEDs indicate a possible failure; a blue LED on a component indicates that it is safe to remove the component.

The DS3500 also has a blue system locator LED that is lit when the menu function is selected in the Subsystem Management window, causing the Locate command to be sent to the DS3500.

Check all the LEDs on the front and rear of the storage subsystem when you turn on the power. During power-on, the LEDs flash intermittently as the storage subsystem and components complete the power-on process. In addition to checking for faults, you can use the LEDs on the front of the storage subsystem to determine whether the drives are responding to I/O transmissions from the host.

AC power-supply LEDs

This section describes the primary LEDs on the DS3500 ac power supplies.

Standby power LED (green)
DC power LED (green)
OK to remove LED (blue)
Fault LED (amber)
AC power LED (green)

Figure 4-3. AC power-supply LEDs

Standby power LED (green)
 Future use only.

DC power LED (green)
 When this green LED is lit, it indicates that the DS3500 is turned on and is supplying both 5-volt and 12-volt dc power.

OK to remove LED (blue)
 When this blue LED is lit, it indicates that it is safe to remove the power supply.

Fault LED (amber)
 When this amber LED is lit, it indicates that a power supply or fan has failed or that a redundant power supply is not turned on.

AC power LED (green)
 When this green LED is lit, it indicates that the storage subsystem is receiving ac power.

DC power-supply LEDs

This section describes the primary LEDs on the DS3500 dc power supplies.
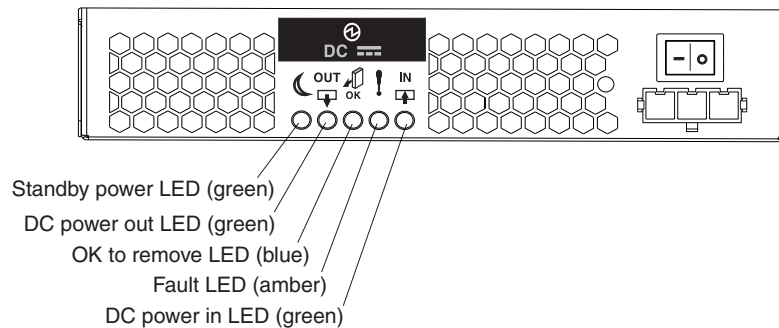
Figure 4-4. DC power-supply LEDs

Standby power LED (green)
> Future use only.

DC Out LED (green)
> When this green LED is lit, it indicates that the DS3500 is turned on and is supplying both 5-volt and 12-volt dc power.

OK to remove LED (blue)
> When this blue LED is lit, it indicates that it is safe to remove the power supply.

Fault LED (amber)
> When this amber LED is lit, it indicates that a power supply or fan has failed or that a redundant power supply is not turned on.

DC In LED (green)
> When this green LED is lit, it indicates that the storage subsystem is receiving dc power.

Front LEDs

This section describes the primary LEDs and controls on the front of the storage subsystem.

The front LEDs and controls on the DS3512 storage subsystem and EXP3512 storage enclosure are shown in Figure 4-5. The front LEDs and controls on the front of the DS3524 storage subsystem and EXP3524 storage enclosure are shown in Figure 4-6 on page 4-9.
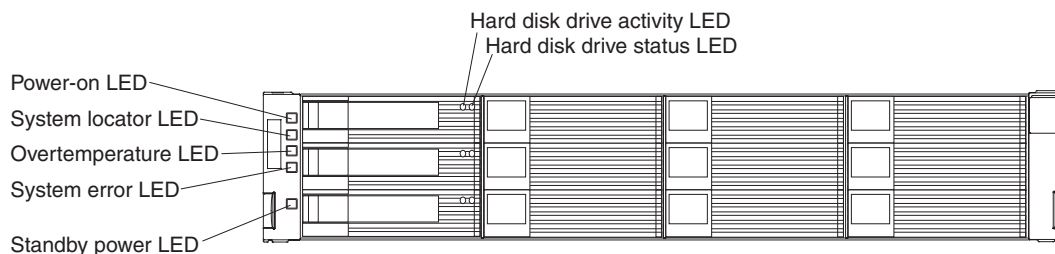
Figure 4-5. DS3512 storage subsystem and EXP3512 storage enclosure front LEDs and controls
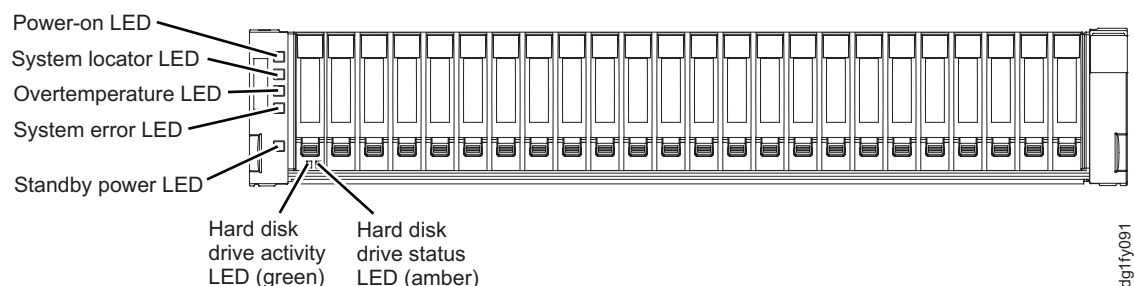
Figure 4-6. DS3524 storage subsystem and EXP3524 storage enclosure front LEDs

Power-on LED (green)
> LED is lit, it indicates that the power supply is turned on and is supplying both 5-volt and 12-volt dc power.

System locator LED (blue)
> This blue LED can be lit by the Storage Manager software to aid in visually locating the storage subsystem.

Overtemperature LED (amber)
> When this amber LED is lit, it indicates that the storage subsystem is in an over temperature condition.

System error LED (amber)
> When this amber LED is lit, it indicates that the unit has a fault, such as in a power supply, controller, or drive.

Standby power LED (green)
> Future use only.

Drive activity LED (green)
> Each drive has an activity LED. When this green LED is flashing, it indicates drive activity.

Drive status LED (amber)
> Each drive has a status LED. When this amber LED is lit continuously, it indicates a drive failure. When it is flashing, it indicates that the controller is identifying or building a drive.

Controller LEDs

This section describes the controller LEDs on the rear of the storage subsystem.
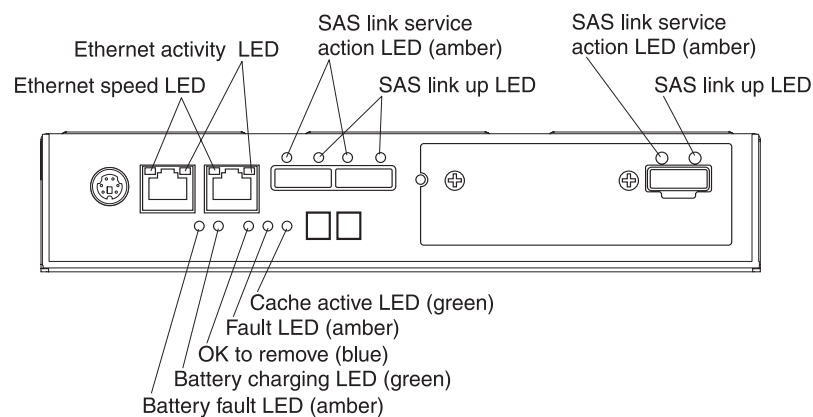
Figure 4-7. Controller LEDs

Ethernet speed LED
When this LED is lit, it indicates that the Ethernet speed between the controller and the management workstation is 1000 Mbps. When this LED is off, it indicates that the Ethernet speed is 100 Mbps.

Ethernet activity LED
When this LED is lit, it indicates that the link is established between the controller and the management workstation. When this LED is flashing, there is activity between the controller and the management workstation. When this LED is off, no link is established between the controller and the management workstation.

SAS link service action LED (amber)
When this LED is lit, it indicates a problem with the SAS link that requires service action. The normal condition of this LED is off.

SAS link up LED (green)
When this LED is lit, it indicates that the link is established between the controller and a host. When this LED is flashing, it indicates activity on the link. When this LED is off, no link is established.

Cache active LED (green)
When this LED is lit, it indicates that battery backup has been enabled and data is in the memory cache. When this LED is blinking, cache offload is in process. When this LED is off, caching is turned off and no data is in the memory cache.

Fault LED (amber)
When this LED is lit, it indicates that a fault has occurred in the controller and the controller must be replaced. The normal condition of this LED is off.

OK to remove LED (blue)
When this LED is lit, it indicates that it is safe to remove the controller from the DS3500; no activity is taking place, and no data remains in the memory cache. The normal condition of this LED is off.

Battery charging LED (green)
When this LED is lit, the battery is fully charged. When this LED is blinking, the battery is charging. When this LED is off, the battery either failed or has been removed from the controller.

Battery fault LED (amber)
When this LED is lit, it indicates that the battery fails to hold a charge and should be replaced. The normal condition of this LED is off.
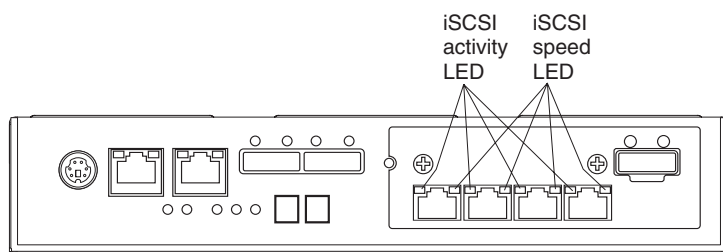
Figure 4-8. iSCSI host port adapter LEDs

iSCSI activity LED (green)
When this LED is lit, it indicates that the link is established with the controller. When this LED is flashing, there is activity on this port. When this LED is off, no link is established with this port.

iSCSI speed LED (amber)
When this LED is lit, it indicates that the port is operating at 1000 Mbps. When this LED is off, it indicates that the speed of the port is 100 Mbps.

If the optional Fibre Channel host port adapter is installed in the controller, the host port adapter contains four additional Fibre Channel host connectors with LEDs.
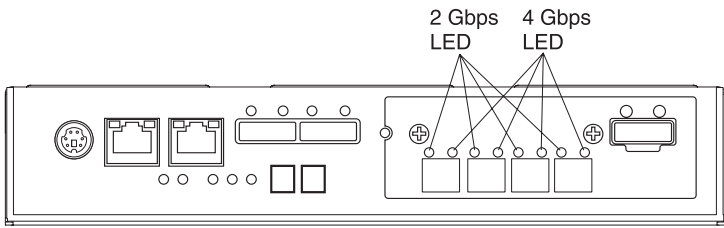
Figure 4-9. Fibre Channel host port adapter LEDs

Fibre Channel speed LEDs 2 Gbps and 4 Gbps
These LEDs in combination indicate the speed of the Fibre Channel host port.

Table 4-1. Fibre Channel port LEDs

2 Gbps LED	4 Gbps LED	Host port speed
On	Off	2 Gbps
Off	On	4 Gbps
On	On	8 Gbps
Off	Off	No SFP module is present or the SFP module is faulty
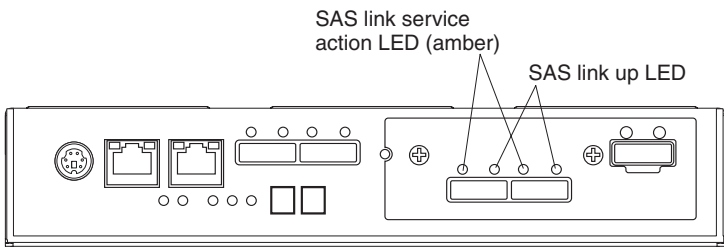
Figure 4-10. SAS host port adapter LEDs

SAS link service action LED (amber)
When this LED is lit, it indicates a problem with the SAS link that requires service action. The normal condition of this LED is off.

SAS link up LED (green)
When this LED is lit, it indicates that the link is established between the controller and a host. When this LED is flashing, it indicates activity on the link. When this LED is off, no link is established.

10 Gbps iSCSI host port adapter LEDs

10 Gbps iSCSI link rate LED (green, left)
When this LED is lit solid on, it indicates that the link rate is 10 Gbps. When this LED is off, it indicates that the link rate is 1 Gbps. When this LED is flashing, it indicates that the link is being acquired.

10 Gbps iSCSI activity LED (green, right)

When this LED is lit solid on, the link is established and there is no activity on this port. When this LED is off, no link is established. When this LED is flashing, there is activity on this port.
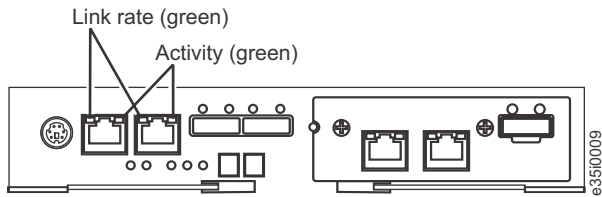
Figure 4-11. 10 Gbps iSCSI port LEDs

Seven-segment numeric display LEDs

The seven-segment numeric display LEDs provide information about enclosure identification and diagnostics. Figure 4-12 shows the numeric display LEDs and the heartbeat and diagnostic LEDs.
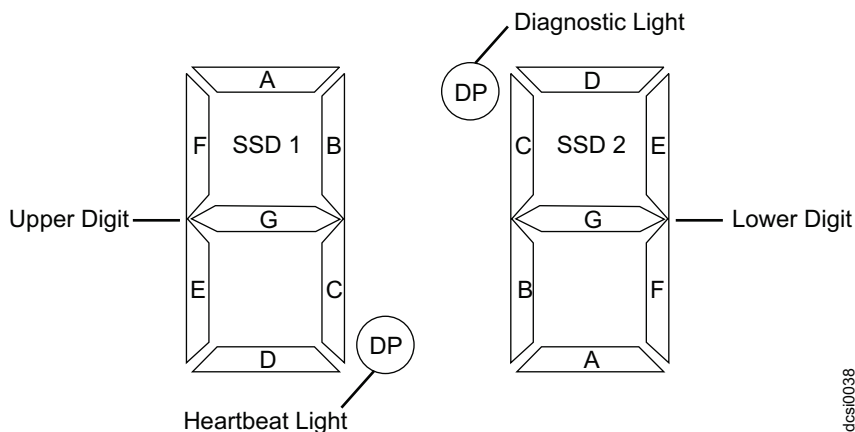
Figure 4-12. Numeric display LEDs

When you turn on the power to the storage or storage enclosure, the numeric display LEDs cycle through various codes as the controller or ESM firmware starts to boot. If the diagnostic LED is illuminated and the heartbeat LED is turned off, it indicates that diagnostic information is displayed on the numeric display. When the controller completes the boot process and is operating normally, the diagnostic LED turns off, the heartbeat LED blinks, and the numeric display changes to show the enclosure identification (enclosure ID) for that individual enclosure.

If an error occurs during the boot process and the Needs Attention LED is on, the numeric display shows diagnostic information as sequence of 2-digit diagnostic code. The number of time each 2-digit code is displayed during a sequence is fixed and under hardware control. Each sequence minimally consists of a two-digit category code, followed by a two-digit detail code that is specific to the category. Longer sequences can be displayed if more than one event is to be reported. This nominally consists of a series of category-detail sequences with a delimiter between each category-detail sequence. The entire display goes blank at the end of the sequence (all segments off, the diagnostic light off), and then the sequence repeats.

For more information about the diagnostic codes and their possible causes, see "Seven-segment display sequence codes and their causes" on page 6-7.

ESM LEDs

This section describes the ESM LEDS. Figure 4-13 shows the LEDs on the ESM.
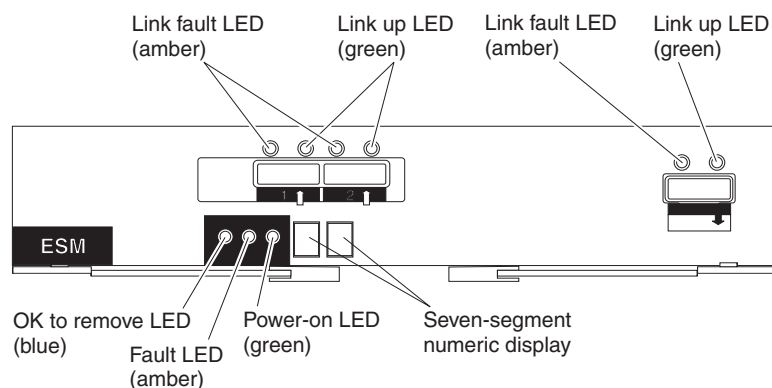
Figure 4-13. ESM LEDs

Link fault LED (amber)
> When this amber LED is lit, it indicates that the link through the SAS cable is not successful.

Link up LED (green)
> When this green LED is lit, it indicates that the link through the SAS cable is successful.

OK to remove LED (blue)
> This LED is supported only when the EXP3500 is attached to a DS3500 controller. Do not remove the ESM unless this blue LED is lit.

Fault LED (amber)
> When this amber LED is lit, it indicates that the ESM has failed.

Power-on LED (green)
> When this green LED is lit, it indicates that the ESM is receiving power.

Turning off the storage subsystem

The DS3500 is designed to run continuously. After you turn it on, do not turn it off. Turn off the power only in the following situations:

- Instructions in a hardware or software procedure require that you turn off the power.
- An IBM technical-support representative instructs you to turn off the power.
- A power outage or emergency situation occurs, see "Restoring power after an unexpected shutdown" on page 4-16.

Attention: Except in an emergency, never turn off the power if any amber (needs attention) LEDs are lit. Correct the fault before you turn off the power. Use the Storage Manager software and the amber LEDs to check the overall status of the DS3500. All LEDs should be green on the front of the storage subsystem. If they are not, use the Storage Manager software to diagnose the problem so that the DS3500 will power-on correctly later.

(L003)
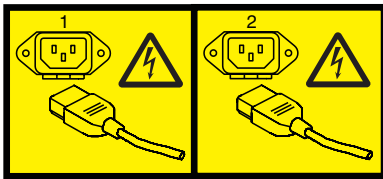
or

Attention: Turning off and turning on power without waiting for the storage subsystem disk drives to spin down can damage the drives and might cause data loss. Always wait at least 70 seconds after you turn off the power before you turn on the power again.

Power-off overview

Review the following information before you continue with the power-off procedure:

Turn off the power to each device according to the following shutdown sequence:

1. Turn off power to the host before the storage subsystem. If the host must stay powered-on to support a network, see the operating-system documentation for information about disconnecting the storage subsystem logical drives from the host before the storage subsystem is powered-off.
2. Turn off power to the storage subsystem before you turn off power to the storage enclosures. Turn off both power-supply switches on the rear of the storage subsystem.
3. If there are enclosures with dc power supplies in your storage subsystem, turn off the -48V disconnect devices after turning off the power-supply switches.
4. Turn off power to other supporting devices (for example, management stations).

   Note: You do not have to perform this step if you are servicing only the storage subsystem.

To turn off power to one or more storage subsystems for a planned shutdown, complete the steps in the following procedure. To turn off power for an unplanned shutdown, see "Restoring power after an unexpected shutdown" on page 4-16. Figure 4-1 on page 4-3 shows the locations of the power switches on a storage subsystem.

Before you proceed, use the Storage Manager software to determine the status of the system components and special instructions. The operating-system software might require you to perform other procedures before you turn off the power.

1. Stop all I/O activity to each storage subsystem.
2. Determine the status of all storage subsystems and components in the configuration by completing the following steps:
   a. Check all LEDs on each component in the storage enclosures. Make sure that all the LEDs show normal status.
   b. Check all LEDs on each component in the storage subsystem. Make sure that all the LEDs show normal status.
   c. Review the status of the configuration in the Subsystem Management window by clicking the **Summary** tab.

   The status is either Optimal or Needs Attention.
3. Do the LEDs indicate normal operation, and is the status Optimal on all configuration components?
   - **Yes:** Go to step 5.
   - **No:** Go to step 4.
4. To diagnose and correct the fault, complete the following steps:
   a. Run the Recovery Guru by clicking **Recovery Guru** in the toolbar in the Subsystem Management window.
   b. Complete the recovery procedure.

   If the Recovery Guru directs you to replace a failed component, use the individual LEDs to locate the failed component.
   c. When the recovery procedure is completed, click **Recheck** in the Recovery Guru. This action runs the Recovery Guru again to make sure that the problem is corrected.
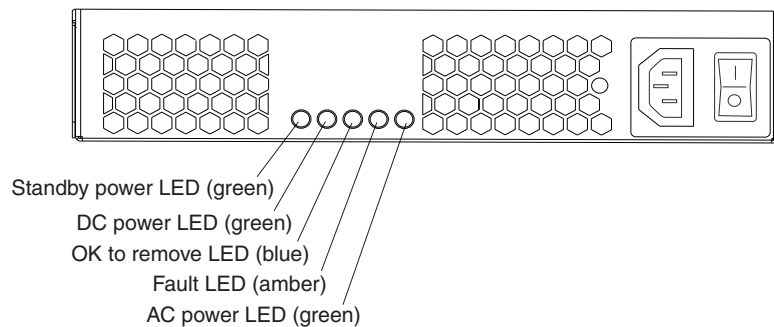   d. If the problem has not been corrected, contact your IBM technical-support representative. Do not turn off power until all problems are corrected.
5. Check the cache active LED, and make sure that it is off

   If the cache active LED is lit, the cache contains data. Wait for the data to clear from cache memory before you turn off the power.
6. Check the LEDs on the storage enclosures to make sure that all drive activity LEDs are off.

   If one or more LEDs are flashing, data is being written to or from the drives. Wait for all activity LEDs to stop flashing.
7. Turn off the ac power switch on the rear of each controller in the storage subsystem.

   Note: Until the power switch on each controller is turned off, power remains turned on for both controllers.
8. Turn off both power switches on the rear of each storage enclosure in the configuration.
9. If there are enclosures with dc power supplies in your configuration, turn off the -48V disconnect devices after turning off the power-supply switches.
10. After you perform the necessary maintenance procedures, turn on the power, using the procedure in "Turning on the storage subsystem" on page 4-2.

Performing an emergency shutdown

Attention: Emergency situations might include fire, flood, extreme weather conditions, or other hazardous circumstances. If a power outage or emergency situation occurs, always turn off all power switches on all computing equipment. This helps to safeguard your equipment from potential damage due to electrical surges when power is restored. If the storage subsystem loses power unexpectedly, it might be due to a hardware failure in the power system or in the midplane.

To shut down the system during an emergency, complete the following steps:

1. If you have time, stop all I/O activity to the storage subsystem by shutting down the host or disconnecting the storage subsystem logical drives through the host.
2. Check the LEDs. Make note of any amber LEDs that are lit so that you can correct the problem when you turn on the power again.
3. Turn off all power-supply switches, starting with the storage subsystem first and followed by the storage enclosures. Then, disconnect the power cables from the storage subsystem.
4. If there are enclosures with dc power supplies in your storage subsystem, turn off the -48V disconnect devices after turning off the power-supply switches.

Restoring power after an unexpected shutdown

To restore power to the storage subsystem in a configuration after an unplanned shutdown, complete the following steps.

DANGER

> **Never turn on any equipment when there is evidence of fire, water, or structural damage.**

1. After the emergency situation is over or power is restored, visually check the storage subsystem for damage. Is there evidence of damage to any of the storage subsystem components, cables, or equipment that is attached to the storage subsystem?
   - **Yes:** Do not continue with this procedure. Contact your IBM technical-support representative for assistance. Depending on the current service agreements, you might have to return the equipment to the factory or local service center for repair.
   - **No:** Go to step 2.

     Attention: To avoid potential data loss, make sure that the storage subsystem and storage enclosure power switches are turned off before you reset circuit breakers in the rack. Resetting circuit breakers after an emergency situation while the storage subsystem and storage enclosure power switches are turned on can cause data loss, because the configuration components might not be powered-on in the correct sequence. See "Turning on the storage subsystem" on page 4-2 for details about the correct power-on sequence.
2. After you check the storage subsystem for damage, make sure that the power switches are off; then connect the DS3500 power cables, if required.
3. Check the system documentation of the hardware devices that you want to turn on and determine the correct startup sequence.

   Be sure to turn on all of the storage enclosures and make sure that no ESM or power-supply fault LEDs are lit before you turn on the storage subsystem.

   In addition, consider the following items:
   - The storage subsystem supports simultaneous power-on of the system components; however, always check the system documentation of the hardware devices that you want to turn on and determine the correct startup sequence.
   - A storage subsystem in an optimal state recovers automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, contact your IBM technical-support representative if any of the following conditions occur:

- The storage subsystem logical drives and subsystems are not displayed in the Storage Manager graphical user interface.
- The storage subsystem logical drives and subsystems do not come online.
- The storage subsystem logical drives and subsystems seem to be degraded.

4. Turn on the power to each device, according to the startup sequence.

5. If there are enclosures with dc power supplies in your storage subsystem, turn on the -48V disconnect devices before turning on the power-supply switches.

6. Turn on both of the power-supply switches on the DS3500. The green LEDs on the front and the rear of the DS3500 should remain lit. If other amber LEDs are lit, see Chapter 6, "Solving problems," on page 6-1.

Recovering from an overheated power supply

Each storage subsystem contains two power supplies. Each power supply contains a built-in temperature sensor to prevent the power supply from overheating. Under normal operating conditions, with an ambient air temperature range of 10°C to 40°C (50°F to 104°F), the fans in the power supplies maintain a suitable operating temperature inside the module.

If the internal temperature reaches 65°C (149°F), the power supply shuts down automatically. If both power supplies shut down because of overheating, the storage subsystem has no power, and all LEDs are off.

The following factors can cause the power supplies to overheat:
- An unusually high room temperature
- Fan failures in the power supplies
- Defective circuitry in a power supply
- Blocked air vents
- Failures in other devices in the configuration or rack

If a fan failure causes overheating, the system-error LED and overtemperature LEDs on the storage subsystem are lit. The fault LED on the power supply might also be lit. "Checking the LEDs" on page 4-7 shows the location of the LEDs on the DS3500.

If the storage subsystem temperature exceeds 45°C (113°F), the storage management software displays a Needs Attention icon in the Subsystem Management window. If the air temperature inside the rack reaches 65°C (149°F), the power supplies automatically shut down. If event monitoring is enabled and event notification is configured, the software issues two critical-problem notifications.

- If *one* power supply shuts down, the storage management software displays a Needs Attention status in the Subsystem Management window.
- If *both* power supplies shut down, the storage subsystem shuts down, and the storage management software displays a Not Responding status in the Array Management window.

  Attention: To prevent damage to the storage subsystem components when the power supplies automatically shut down, immediately remove all rack panels to help reduce the rack air temperature.

To resume normal operation after a power-supply shutdown, complete the following steps:

1. Did you use the procedure "Troubleshooting the storage subsystem" on page 4-6 to identify an overheating problem?
   - **Yes:** Go to step 2.
   - **No:** Perform the procedure in "Troubleshooting the storage subsystem" on page 4-6 to make sure that the power supplies have shut down because of an overheating problem, and then go to step 2.

2. Stop I/O activity to the storage subsystem and all attached storage enclosures.

3. Take all or some of the following measures to alleviate the overheating problem:
   - Remove all panels from the rack immediately.
   - Use external fans to cool the area.
   - Shut down the power to the storage enclosure, using the procedure that is described in "Performing an emergency shutdown" on page 4-16.
4. Wait for the air in and around the storage subsystem to cool.

   After the temperature inside the power supplies drops to below 65°C (149°F), the storage subsystem is capable of power-on recovery without operator intervention. After the air has cooled, the power supplies should turn on automatically. If the power supplies restart automatically, the controllers will reset and return to normal operation.
5. Did the power supplies restart automatically?
   - **Yes:** Go to step 8.
   - **No:** Go to step 6.
6. Turn off both power switches on the DS3500 (see Figure 4-1 on page 4-3) and then power-off all connected storage enclosures. Wait 1 minute and then turn on power to all connected storage enclosures.

   While a storage enclosure powers-on, the LEDs on the front and the rear of the enclosure flash intermittently. Depending on your configuration, the storage enclosure can take between 20 seconds and several minutes to power-on.

   Note: If there are enclosures with dc power supplies in your storage subsystem, make sure that the -48V disconnect devices are turned on and are working.
7. Turn on both power switches on the rear of the storage subsystem. See Figure 4-1 on page 4-3

   A storage subsystem can take 10 seconds to power-on and up to 15 minutes for the battery self-test to be completed. During this time, the LEDs on the front and the rear of the DS3500 flash intermittently.
8. Check the LEDs on the front and rear of the storage subsystem and each attached storage enclosure (a green LED indicates a normal status; an amber LED indicates a hardware fault); then, check the array status in the Subsystem Management window.
   a. Open the Subsystem Management window for the storage array.
   b. Click the **Summary** tab and review the status of the configuration.

      The status is either Optimal or Needs Attention.
9. Does each module (controller, power supply, ESM) display green status LEDs only, and is the status Optimal for each module component?
   - **Yes:** Go to step 11.
   - **No:** Go to step 10.
10. Diagnose and correct the fault.
    a. To run the Recovery Guru, click **Recovery Guru** in the toolbar in the Subsystem Management window.
    b. Complete the recovery procedure.

       If the Recovery Guru directs you to replace a failed component, locate and troubleshoot that component. See "Checking the LEDs" on page 4-7.
    c. When the procedure is completed, select **Recheck** in the Recovery Guru. This runs the Recovery Guru again to make sure that the problem is corrected.
    d. If the problem remains, contact your IBM technical-support representative.
11. Replace the bezel on the storage enclosure, if applicable.

Cache memory and cache battery

Each storage controller in the DS3500 storage subsystem contains 1 GB or 2 GB of cache memory to store read and write operations. In a dual controller configuration, both controllers in the DS3500 must have the same amount of cache memory. The battery unit contains enough charge to back up the cached data in each controller to a flash drive in the event of a DS3500 power failure.

Cache memory

Cache memory is memory on the storage controller that is used for intermediate storage of read and write data on the DS3500 controllers. Using cache memory can increase system performance. The data for a read operation from the host might be in the cache memory from a previous operation (thus eliminating the need to access the drive itself), and a write operation is completed when it is written to the cache, rather than to the drives.

The controller has a cache active LED that indicates the current status of the cache. The LED is lit when there is data in the cache, and it is off when there is no data in the cache.

If caching is enabled and the cache active LED is not lit during I/O activity, it indicates one of the following conditions:
- The cache memory from either controller A or controller B has failed
- The cache sizes in controller A and controller B are not the same
- The battery has failed

Note: Always use the Storage Manager client to check the cache memory settings before you assume that a hardware failure has occurred.

See "Controller LEDs" on page 4-9 for the location of the cache active LED on a controller.

Controller cache battery

The backup battery unit provides power to back up the cache memory of each controller onto flash drives in the event of a power failure. Each battery unit contains a sealed, rechargeable SMART lithium ion battery.

CAUTION:
The battery is a lithium ion battery. To avoid possible explosion, do not burn. Exchange only with the IBM-approved part. Recycle or discard the battery as instructed by local regulations. In the United States, IBM has a process for the collection of this battery. For information, call 1-800-426-4333. Have the IBM part number for the battery unit available when you call. (C007)

Replace the battery units in the DS3500 when they are identified as failing by the Storage Manager Subsystem Management window, or when the battery fault LEDs light. See "Controller LEDs" on page 4-9 for the location of the battery fault LED.

Replace only the battery unit that is indicated as failed by the LEDs or in the Storage Manager Subsystem Management window. In a dual controller configuration, you do not need to replace both battery units when the Battery fault LEDs indicate that only one battery unit has failed. Each controller has a green Battery charging LED that indicates the status of the battery unit.
- The LED is on when the battery is fully charged
- The LED flashes when the battery is charging or performing a self-test

- The LED is off when the battery or the battery charger has failed or is missing

Cache battery learn cycle

The battery performs a learn cycle the first time the storage subsystem is turned on, and again every eight weeks thereafter, to assess the charge capacity of the battery. If the battery fails the learn cycle or takes too much time to reach full charge, the Battery charging LED turns off, the Battery fault LED turns on and the Storage Manager identifies the battery as failed.

The learn cycle takes up to three hours. During this time, the cache will be active if the battery is in optimal condition. If the learn cycle is interrupted, the current learn cycle will be terminated and the battery will perform a new learn cycle at the next scheduled interval (eight weeks from the current learn cycle). A learn cycle interruption is caused by removing the battery from the controller chassis, resetting the power to the storage subsystem, or if a storage enclosure or battery overheats.

Data caching starts after the battery is charged to the programmed voltage level, which occurs when the storage subsystem power is first turned on, when a new battery is installed to replace a failed battery, or when the subsystem power is turned on after months of inactivity.

Attention: Write caching is suspended while a battery pack is either charging or self-testing.

Chapter 5. Replacing components

This chapter contains information about replacing the storage subsystem and storage enclosure components and installing optional devices.

Attention: To avoid overheating the storage enclosure and causing damage to its components, replace failed parts within 10 minutes. The Recovery Guru in the Storage Manager software identifies failed parts.

Do not remove the failed part from the storage enclosure until you:
- Review the replacement procedure for the failed part in this guide.
- Locate screw drivers or any other hand tools that you might need to replace the failed part.
- Receive the replacement part and are ready to install it in the enclosure.

OK to remove LED

Before you begin, ensure that you wear an anti-static wrist strap.

Each controller, ESM, and power supply has a blue OK to remove LED. The purpose of the OK to remove LED is to help ensure that a component is not removed before it is safe to do so. Do not remove any component unless the component OK to remove LED is lit.

Attention

If you remove a controller, ESM, or power supply when the OK to remove LED is not lit, a loss of data availability can result. If an amber LED is lit and the associated OK to remove LED is *not* lit, you must perform additional diagnostics *before* you can remove the indicated component. Use the Recovery Guru instructions in the Subsystem Management window or see the applicable component replacement instructions in this chapter for the additional diagnostics that are required in this case.

The OK to remove LED automatically turns on or off as conditions change. Wait at least 2 minutes after you replace a component for the storage subsystem to recognize the new component and update the LED status. In most cases, when a single component fails, the OK to remove LED stays lit when the amber LED is lit for the component.

Working with controllers

This section describes how to remove a controller, remove and install a cover, install a controller, replace a controller, and dispose of the system-board battery on the controller.

Before you begin, ensure that you wear an anti-static wrist strap.

Attention: To avoid overheating the storage enclosure and causing damage to its components, replace failed parts within 10 minutes. The Recovery Guru in the Storage Manager software identifies failed parts.

Do not remove the failed part from the storage enclosure until you:
- Review the replacement procedure for the failed part in this guide.
- Locate screw drivers or any other hand tools that you might need to replace the failed part.
- Receive the replacement part and are ready to install it in the enclosure.

Removing a controller

Attention: Before you remove a controller in a single-controller storage subsystem, shut down the storage subsystem to avoid data loss (see "Turning off the storage subsystem" on page 4-13).

To remove a controller from the storage subsystem, complete the following steps:

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.

   Attention: Never remove a controller unless the OK to remove LED is lit. Doing so can result in a loss of data. See "Controller LEDs" on page 4-9 to see an illustration of the LED display array.

2. If the controller has failed, do not continue with this procedure. Instead, go to "Replacing a controller" on page 5-5.

   Attention: Handle and install cables correctly to avoid degraded performance or loss of communication with devices. See "Cabling the DS3500 storage subsystem" on page 3-1 for more information.

3. Disconnect all attached interface cables from the controller. Be sure to label each cable so that you can reconnect it correctly.

4. Remove the controller from the chassis.

Figure 5-1. Removing a controller

   a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).

   b. Pull the controller out of the bay.

   > **DANGER**
   >
   > **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

   c. Place the controller on a dry, static-free level surface.

Attention: After you remove a controller, wait 70 seconds before you reseat or replace the controller. Failure to do so might cause unpredictable results.

Removing and installing a cover

To remove a cover from a controller, complete the following steps:

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.

2. Press on the two release buttons and slide the cover toward the rear of the controller.

Release
buttons
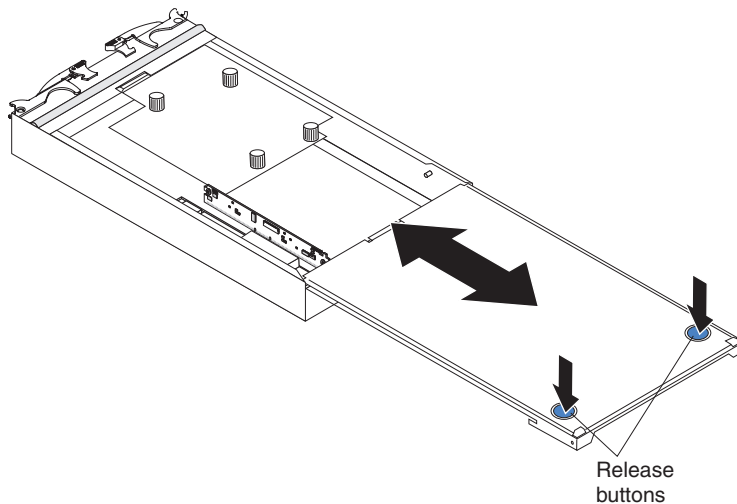
Figure 5-2. Removing the cover

3. Remove the cover and save it for future use.

To install a cover on a controller, complete the following steps:

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
2. Align the cover on the controller and slide it toward the front of the controller to install it.

Installing a controller

Use this procedure to install a second controller. The second controller is controller B. If the storage subsystem contains only one controller, that controller is controller A.

Attention: Ensure that the two controllers have the same host port adapter, DIMM size, and options. An incompatible controller will be placed in a lockout state by the other controller.

To install a controller in the storage subsystem, complete the following steps:

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
2. Install new dual-controller NVSRAM firmware on controller A. For instructions to download the NVSRAM firmware, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) or the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later).

   Note: Obtain the latest dual-controller NVSRAM firmware from http://www.ibm.com/servers/ storage/support/disk/.
3. Start the command-line interface; then, enter the following command to change controller A from simplex (single-controller) mode to duplex (dual-controller) mode:

   `Smcli ctlr_A_IP_address -c "set storageSubsystem redundancyMode=duplex;"`
4. Shut down the storage subsystem, and then start it again (see "Turning on the storage subsystem" on page 4-2). If controller A was successfully converted to duplex mode, the subsystem reports an `alternate controller missing` error message. If the error message is not reported, reinstall the new dual-controller NVSRAM firmware on controller A and repeat steps 3 through 4.
5. Unpack the new controller. Save all packing materials in case you have to return a controller.
6. Make sure that both controllers have the same host port adapter, DIMM size, and options.

7. If controller A contains an optional host port adapter, install an identical optional host port adapter in the new controller. See "Installing an optional host port adapter or replacing a failed host port adapter" on page 5-10 for instructions.
8. Remove the controller filler panel from the bay:
    a. Open the two release levers. The filler panel moves out of the bay approximately 0.6 cm (0.25 inch).
    b. Pull the filler panel out of the bay.
    c. Place the filler panel in a safe place for future use.
9. Install the new controller.

    Note: The following illustration shows installing controller A. Be sure to install the new controller in the rightmost bay, as controller B.
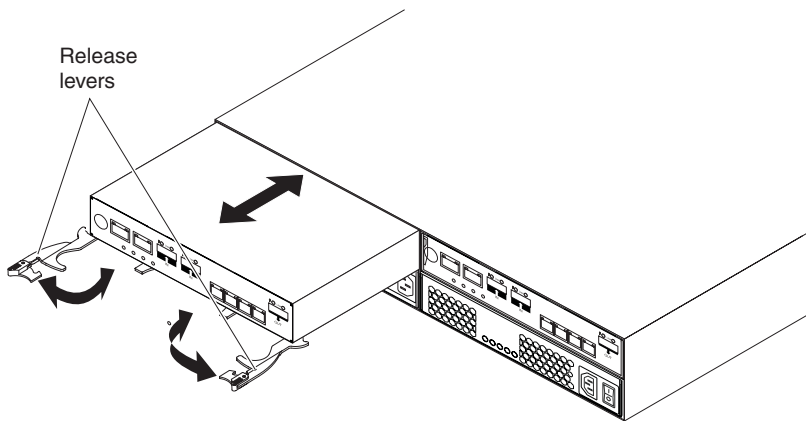
a. Make sure that the release levers on the controller are in the open position.
b. Slide the controller into the bay until it stops.
c. Push the release levers to the closed position.

Figure 5-3. Installing a controller

10. Wait up to 5 minutes for the Storage Manager software to recognize the new controller.
11. Connect the host interface cables to the controller. See "Cabling the DS3500 storage subsystem" on page 3-1 for more information.
12. Make sure that all storage enclosure connections have been completed (see the dual-controller topologies in "DS3500 storage subsystem drive cabling topologies" on page 3-19); then, connect the SAS drive expansion cable from the right ESM in the last storage enclosure in the chain to the drive expansion port on controller B of the DS3500.
13. Wait up to 5 to 10 minutes for the Storage Manager software to report the drives and the redundant drive path.
14. Verify the state of the LEDs on the newly inserted controller. See "Controller LEDs" on page 4-9. You can also use the Subsystem Management window to identify any new faults. Do any storage subsystems have a fault (Needs Attention) status?
     *   **Yes:** Click **Recovery Guru** in the Subsystem Management window toolbar, and complete the recovery procedure. If the problem remains, contact your IBM technical-support representative.
     *   **No:** Go to step 15.
15. Use the Storage Manager software to print a new storage subsystem profile.

Replacing a controller

Use this procedure to replace a controller that has failed.

Before you replace a controller, perform the following prerequisite tasks:

Familiarize yourself with the steps to access the Storage Manager software. For details about installing and using the Storage Manager software, see the *IBM System Storage DS Storage Manager Version 10 Installation and Host Support Guide* (for DS Storage Manager V10.77 or earlier) or the *IBM System Storage DS Storage Manager Version 10.8 Installation and Host Support Guide* (for DS Storage Manager V10.83 or later) for the applicable host operating system. The document is in the Documentation folder on the *IBM System Storage DS3500 Support* DVD.

Important:

Obtain the following information about your storage subsystem and components:
- Determine whether you have a single-controller storage subsystem or a dual-controller storage subsystem. For details, see "DS3500 storage subsystem overview" on page 1-2. See Figure 1-7 on page 1-11 for an illustration of a single-controller storage subsystem.
- See the topic "Checking the LEDs" on page 4-7 to understand how to check the status lights on the LED panel.
- Check the WWIDs or the MAC addresses of the host ports after replacing the controller and/or the host port interface adapter. If you need to change any WWID or MAC address, update the servers or switches in the configuration.

Attention:
- Ensure that both power supplies are connected and powered-on and no amber LEDs are lit. If the status of either of the power supplies is not Optimal, replace that power supply before you proceed with the controller replacement procedure.
- If you are replacing a failed controller, you need to determine the capacity of the DIMM it contains. There are two methods to determine the capacity of the DIMM in a failed controller:
  - When you remove the failed controller you can look at the label on the DIMM to see if it is a 1 GB or 2 GB DIMM.
  - Use the Storage Manager Client. You can view the controller cache size either on the controller properties screen (found in the Physical tab) or by viewing the storage subsystems profile. Refer to the *IBM System Storage DS Storage Manager 10 Installation and Host Support Guide* for your host operating system, for guidance on how to install the Storage Manager Client program, and to make Management connections to the Storage subsystems after its installation. Also, refer to the illustrations for reference.

To replace a controller in a storage subsystem, complete the following steps:
1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7. See "Checking the LEDs" on page 4-7 for an illustration of the LED panel.
2. Use the Storage Manager software to print a storage subsystem profile. See Chapter 4, "Operating the storage subsystem and storage enclosure," on page 4-1 for more information.
   - In a dual-controller storage subsystem, move the logical drive ownership to the other controller.
   - If the controller that you are replacing is still operating, move the failed controller to the offline state.

   Attention: Never remove a controller unless the OK to remove LED is lit. Doing so can result in a loss of data.
3. Locate the failed controller by checking the amber LEDs on the controllers in the storage subsystem.

4. If you have a single controller storage subsystem, skip this step and go to step 5. For a dual controller storage subsystem, follow these instructions:

   - Is the OK TO REMOVE LED lit? If **Yes**, go to step 5
   - If **No**, another component might require attention before you can remove the controller. Run the Storage Manager Recovery Guru to identify and correct any additional failures. To open Recovery Guru, click the **Support tab** in the Subsystem Management window. See "Troubleshooting the storage subsystem" on page 4-6 topic for information about using the Recovery Guru.

     If there are no additional failures, proceed with step 5 to replace the controller.

   Attention: Static electricity can damage the storage subsystem and other electronic devices. To avoid damage, keep static-sensitive devices in their static-protective packages until you are ready to install them.

5. Unpack the new controller. Save all packing materials in case you have to return the new controller.

6. Determine whether the replacement controller will be controller A or controller B (controller A is installed in the left controller bay; controller B is installed in the right controller bay), and then apply the controller labels for host ports and drive expansion ports to the replacement controller. In a single-controller storage subsystem, the new controller will go into the same slot, as the old one. The controller labels and instructions are included with the replacement controller. Make sure that the labels are aligned correctly and do not cover any connectors or LEDs.

   Attention: Handle and install cables correctly to avoid degraded performance or loss of communication with devices. See "Cabling the DS3500 storage subsystem" on page 3-1 for more information.

7. Disconnect all attached interface cables from the failed controller. Ensure that you label each cable so that you can reconnect it correctly to the new controller.

8. In a single-controller storage subsystem, shut down the storage subsystem (see "Turning off the storage subsystem" on page 4-13 for the correct sequence of steps) ; then, continue with step 3 on page 5-5. See Figure 1-7 on page 1-11 for an example of a single-controller Storage Subsystem.

9. Remove the controller from the chassis.

Figure 5-4. Removing and replacing a controller
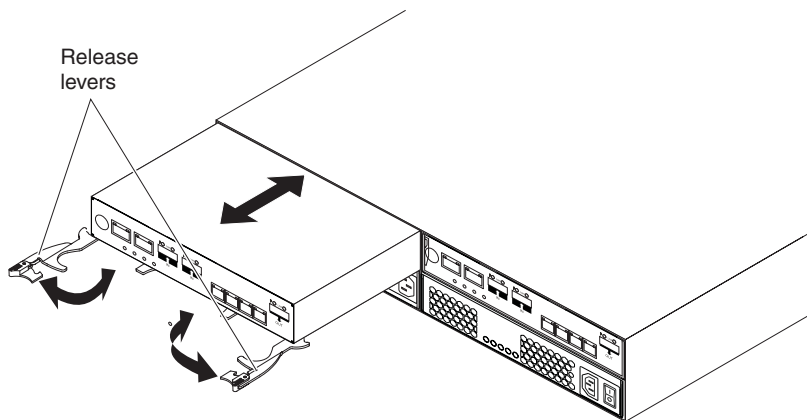
   a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).
   b. Pull the controller out of the bay.

DANGER

> **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

   c. Place the controller on a dry, static-free level surface.

Attention: The DS3500 replacement controller ships with a temporary filler. Place the temporary filler in the controller chassis bay after the failed controller is removed, to maintain proper airflow and cooling.

10. Remove the cover (see "Removing and installing a cover" on page 5-2).
11. Remove the battery from the failed controller.

Battery connector
Memory cache battery
Captive fastener
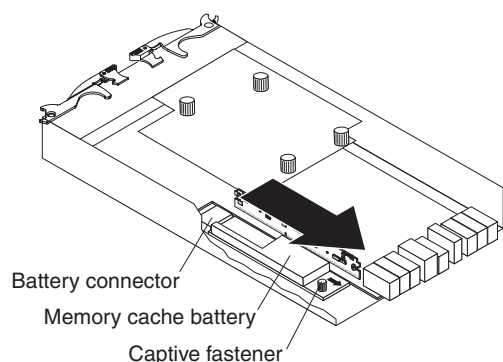
Figure 5-5. Removing the battery unit from the controller

   a. Loosen the blue captive fastener till you can move the battery in the direction that is indicated by the arrow.
   b. Slide the battery unit out of the controller in the direction that is indicated by the arrow.
   c. Set the battery aside.
12. Remove the cache backup flash memory device from the controller and install in the new controller.
   a. Release the flash memory device by gently pushing the memory farther into the slot. The slot will release the flash memory device and push the flash memory device out of the slot.
   b. Carefully pull the flash memory device free from the slot.
   c. Install the cache battery backup flash memory device into the empty slot location of the new controller by pressing the flash memory device into the slot until the flash memory is fully seated.

The following figure shows the location of the cache backup flash memory device on the controller board.

Cache backup
flash memory
device
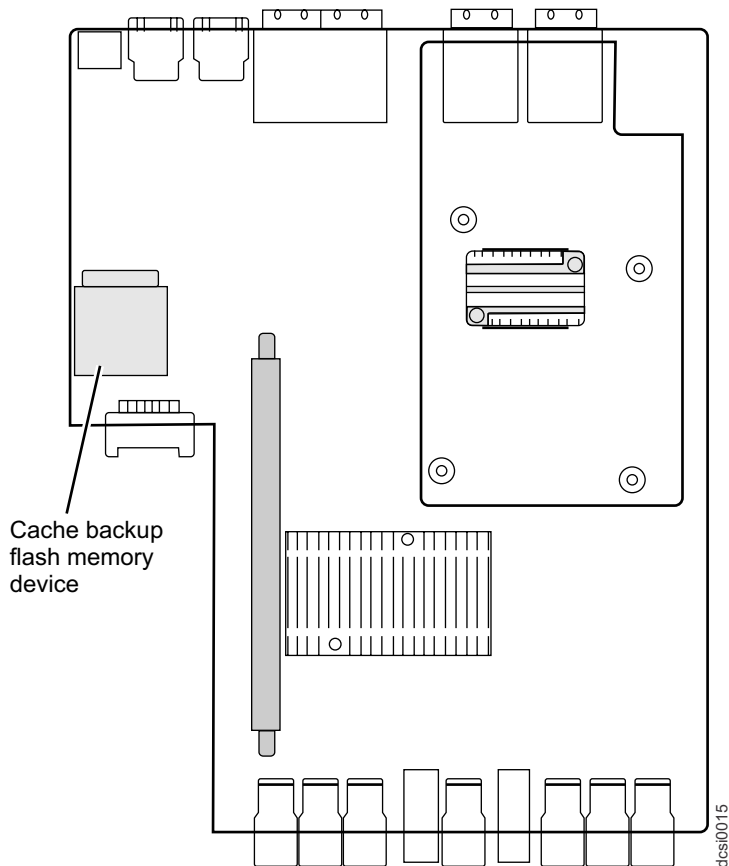
Figure 5-6. Cache backup flash memory device

13. If the capacity of the DIMM in the controller that you removed is more than 1024 MB, complete the following steps to transfer the DIMM to the new controller:

   a. Remove the 1024 MB DIMM from the new controller and set it aside (see "Replacing the memory cache DIMM" on page 5-35 for instructions).

   b. Insert the DIMM into the new controller (see "Installing the DIMM" on page 5-37 for instructions).

14. Install the battery from step 11 on page 5-7 into the new controller:

   a. Slide the battery into the controller until the connector pins of the battery are firmly affixed to the battery connector of the controller.

   b. Turn the captive fastener clockwise to secure the battery in place.

15. Install the cover (see "Removing and installing a cover" on page 5-2)

   Attention: Remove the temporary filler before you install the replacement controller.

16. Install the new controller.

   a. Make sure that the release levers on the controller are in the OPEN position.

   b. Slide the controller into the bay until it stops.

   c. Push the release levers to the CLOSED position.

17. Connect the cables that you disconnected in step 7 on page 5-6.

18. **(Single-controller only)** Turn on the storage subsystem (see "Turning on the storage subsystem" on page 4-2).

19. Wait up to 5 minutes for the Storage Manager software to detect the new controller.

20. Complete any remaining RECOVERY GURU procedures for controller replacement.

21. Check the LEDs on the new controller to ensure that the controller is fully operational.

22. Use the Subsystem Management window to check the status of all components in the storage subsystem.
    - If the new controller is online and the Subsystem Management window indicates normal operation, go to step 25.
    - If the new controller is online and the Subsystem Management window indicates a problem status, go to "Troubleshooting the storage subsystem" on page 4-6.
    - If the new controller is offline, continue with step 23.
23. If the newly inserted controller is in an offline state, see the Storage Manager online help for instructions on bringing the controller online. If necessary, open the Subsystem Management window and place the controller online; select the offline controller and click **Advanced > Recovery > Place controller online**.
24. Verify the state of the LEDs on the newly inserted controller. See "Controller LEDs" on page 4-9. You can also use the Subsystem Management window to identify any new faults. Do any storage subsystems have a fault (Needs Attention) status?
    - **Yes:** Click **Recovery Guru** in the Subsystem Management window toolbar, and complete the recovery procedure. If the problem remains, contact your IBM technical-support representative.
    - **No:** Go to step 25.
25. Use the Storage Manager software to print a new storage subsystem profile.
26. Check the WWIDs or the MAC addresses of the host ports after replacing the controller and/or the host port interface adapter. If you need to change any WWID or MAC address, update the servers or switches in the configuration.
27. You may have to reboot your system to remove LUNs information associated with the WWID of the controller you removed.

Removing and disposing of the system-board lithium battery

When you disassemble the storage subsystem for disposal, use the information in this section to locate, remove, and dispose of the lithium batteries that are on the system boards in controller A and controller B.

Statement 2

CAUTION:
When replacing the lithium battery, use only an equivalent type battery recommended by the manufacturer. If your system has a module containing a lithium battery, replace it only with the same module type made by the same manufacturer. The battery contains lithium and can explode if not properly used, handled, or disposed of.

Do not:
- Throw or immerse into water
- Heat to more than 100°C (212°F)
- Repair or disassemble

Dispose of the battery as required by local ordinances or regulations.

To remove the batteries for disposal, complete the following steps:
1. Locate the battery compartment on the system board in the controller.

    Note:

a. The battery compartment is located near the edge of the controller system board next to the mounting posts for the optional host daughter cards.

b. If a host daughter card is installed on the controller, you must remove the card to gain access to the battery compartment.

2. Insert the flat blade of a small screwdriver into the slot on the battery-compartment cover.
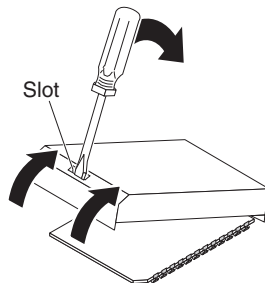
3. Move the screwdriver as shown in the illustration until the cover is released from the battery-compartment base.

4. Lift the contact tab; then, slide the battery out of the battery compartment.
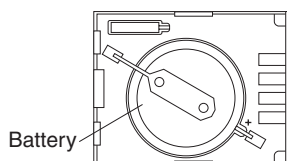
5. Repeat Steps 1 on page 5-9 through 4 to locate and remove the lithium battery in Controller B; then, continue with Step 6.

6. Dispose of the batteries as required by local ordinances or regulations.

The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, see http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml or contact your local waste disposal facility.

In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used batteries. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333.

Installing an optional host port adapter or replacing a failed host port adapter

Attention: If you install a host port adapter in a controller and the storage subsystem contains two controllers, you must make sure that an identical host port adapter is installed in the other controller.

Before you begin, ensure that you wear an anti-static wrist strap.

To install a host port adapter, complete the following steps.

Attention: When you add a host port adapter to an existing configuration the subsystem must be powered off, and you must schedule maintenance time to perform this task offline. To prevent data loss, you must shut down the storage subsystem before you remove the controller from the chassis. For the correct shutdown sequence, see "Turning off the storage subsystem" on page 4-13. However, you do not have to power off the subsystem when replacing a failed host port adapter in a dual controller subsystem.

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.

2. If you are replacing a failed host port adapter, skip to the next step. Otherwise, turn off the storage subsystem (see "Turning off the storage subsystem" on page 4-13).

3. Label all of the cables that are connected to the controller, then disconnect those cables.
4. Remove the controller from the chassis.

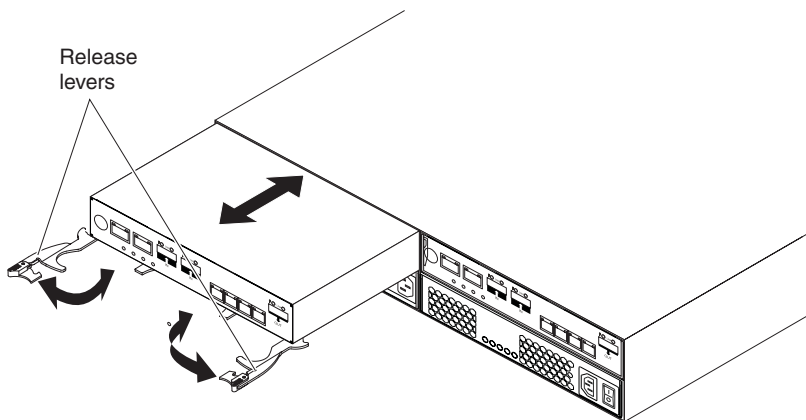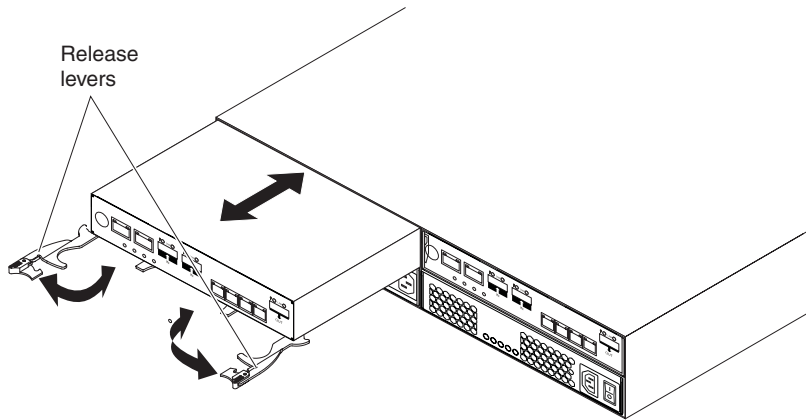*Figure 5-7. Removing a controller*

    a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).

    b. Pull the controller out of the bay.

DANGER

> **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

    c. Place the controller on a dry, static-free level surface.

5. Remove the cover (see "Removing and installing a cover" on page 5-2).
6. If no host port adapter is installed, skip to the next step. Otherwise, release the four captive thumbscrews that hold the host port adapter to the controller board. Then, remove the host port adapter by lift it slightly upward to release it from the board connector, and pull it away from the front of the controller module.
7. If you are replacing a failed host port adapter, skip to the next step. Otherwise, remove the two screws from the cover plate. Flip the top edge of the cover plate outward to release the alignment tab and remove the cover plate from the controller.
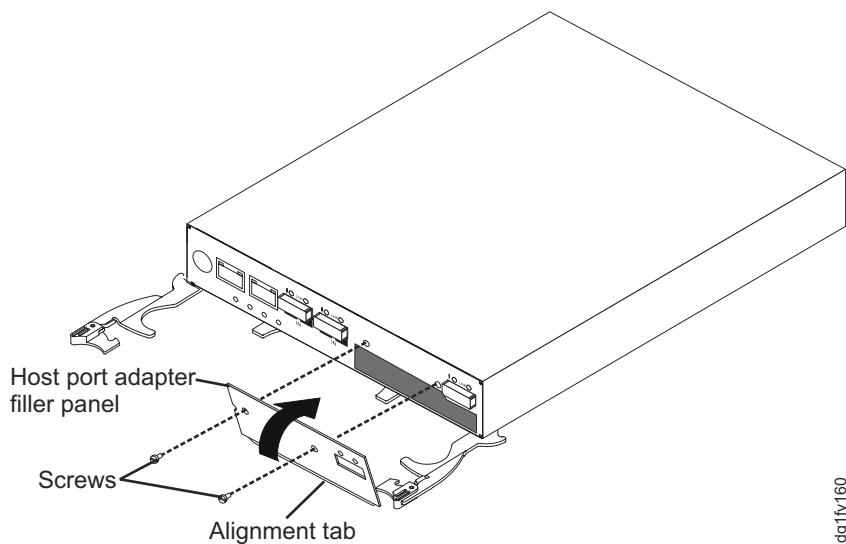
Figure 5-8. Removing the host port adapter filler panel

8. Touch the static-protective package that contains the host port adapter to any unpainted metal surface on the storage subsystem; then, remove the adapter from the package.

9. If you are replacing a failed host port adapter, skip to the next step. Otherwise, install the host port cover that comes with the optional host port adapter.

   a. Place the alignment tab/edge inside the host port cutout.

   b. Secure the host port cover with two screws.

10. Align the host port adapter as shown in the following illustration. The host port will protrude slightly from the host port cover. Because the host port cover cutout is a tight fit, you must apply slight pressure to get the port connectors through the cutout.
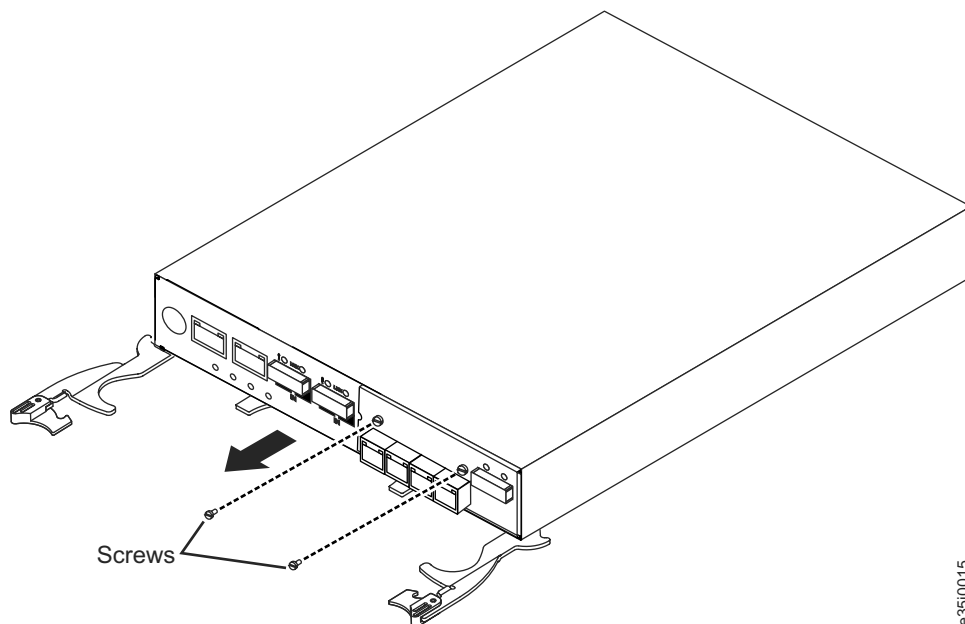
Figure 5-9. Installing a host port adapter

11. Ensure that the host port adapter connector and the controller board connector are aligned. *Do not force fit*, but use *slight* pressure to press the card in the connector. Then, tighten the four captive fasteners.

12. Install the cover (see "Removing and installing a cover" on page 5-2).

13. Insert the controller into the chassis.

    a. Make sure that the release levers on the controller are in the open position.

    b. Slide the controller into the bay until it stops.

    c. Push the release levers to the closed position.

14. Reconnect the cables that you disconnected in step 3 on page 5-11.

15. If you are replacing a failed host port adapter operation in a dual-controller subsystem, skip to the next step. Otherwise, if a second controller exists, repeat the preceding steps for the second controller beginning with 3 on page 5-11.

16. Turn on the storage subsystem (see "Turning on the storage subsystem" on page 4-2).

17. Wait up to 5 minutes for the Storage Manager software to recognize the controller.

18. Check the LEDs on the controller to make sure that the controller is fully operational.

19. Use the Subsystem Management window to check the status of all components in the storage subsystem.

    • If the controller is online and the Subsystem Management window indicates normal operation, go to step 22.

    • If the controller is online and the Subsystem Management window indicates a problem status, go to "Troubleshooting the storage subsystem" on page 4-6.

    • If the controller is offline, continue with step 20.

20. If the newly inserted controller is in an offline state, see the Storage Manager online help for instructions on bringing the controller online. If necessary, open the Subsystem Management window and place the controller online; select the offline controller and click **Advanced → Recovery → Place controller online**.

21. Verify the state of the LEDs on the newly inserted controller. See "Controller LEDs" on page 4-9. You can also use the Subsystem Management window to identify any new faults. Do any storage subsystems have a fault (Needs Attention) status?

    • **Yes:** Click **Recovery Guru** in the Subsystem Management window toolbar, and complete the recovery procedure. If the problem remains, contact your IBM technical-support representative.

    • **No:** Go to step 22.

22. Use the Storage Manager software to print a new storage subsystem profile.

23. Check the WWIDs or the MAC addresses of the host ports after replacing the controller and/or the host port interface adapter. If you need to change any WWID or MAC address, update the servers or switches in the configuration.

Working with hot-swap drives

This section explains how you can increase the storage subsystem capacity by adding more drives or by replacing existing drives with ones that have a larger capacity.

Before you begin, complete the following tasks:

• Read the safety information that begins on page "Safety" on page xi and "Handling static-sensitive devices" on page 2-3.

• Ensure that the current system configuration is working correctly.

• Back up all important data before you make changes to data storage devices.

• Ensure that you wear an anti-static wrist strap.

Before you install or remove drives, review the following information:

- **Filler panels:** A storage subsystem contains filler panels in the unused drive bays. Before you install new drives, you must remove these filler panels. Save the filler panels for future use. For proper cooling and EMC protection, each bay must always contain either a filler panel or a hot-swap drive.
- **Drives:**
  - The DS3500 supports the following drives:
    - Up to 12 LFF 3.5–inch 6 Gbps SAS or NL SAS drives (DS3512 and EXP3512)
    - Up to 24 SFF 2.5–inch 6 Gbps SAS, NL SAS, or SSD drives (DS3524 and EXP3524)
  - For optimum performance, never insert a drive into the storage subsystem without first confirming the drive firmware level. Contact your IBM technical-support representative for information about supported drive firmware levels.
  - Use of unsupported drives can cause the storage subsystem to fail.
  - After you remove a drive, wait 70 seconds before you replace or reseat the drive to allow the drive to spin down. Failure to do so might cause unpredictable results.
- **Drive labels:** A label is provided on the front of each drive. Use this label to record the location information for each drive before you remove it. Be sure to keep a record of the drives and their corresponding bays. Also, record the location information in "Hard disk drive locations" on page A-1. If you install a drive in the wrong bay, you might lose data.
- **Drive LEDs:** Each drive tray has two associated LEDs, a green activity LED and an amber status LED. These LEDs indicate the status for that drive.

  The drive LEDs on the DS3512 storage subsystem and EXP3512 storage enclosure are shown in Figure 5-10. The drive LEDs on the DS3524 storage subsystem and EXP3524 storage enclosure are shown in Figure 5-11.
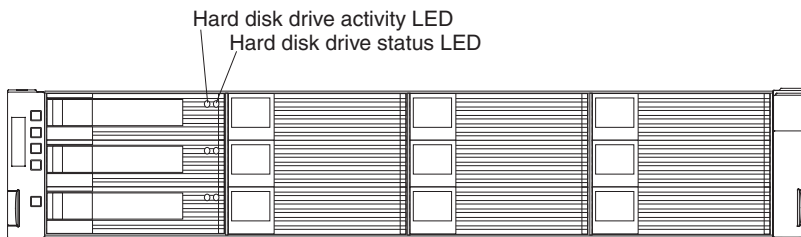
Figure 5-10. DS3512 storage subsystem and EXP3512 storage enclosure drive LEDs
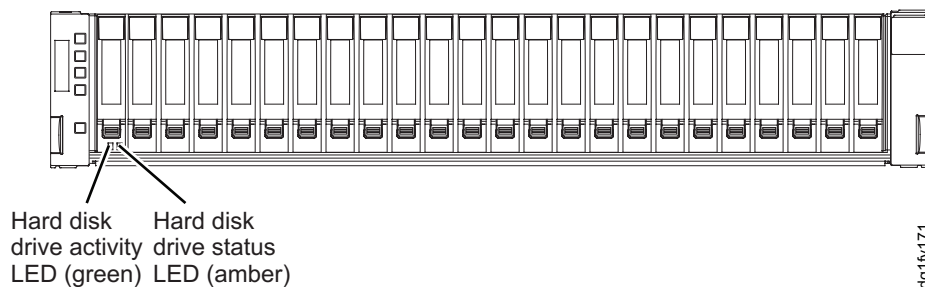
Figure 5-11. DS3524 storage subsystem and EXP3524 storage enclosure drive LEDs

Drive activity LED (green)
When this LED flashes, it indicates that there is activity to the drive.

Drive status LED (amber)
When this LED flashes, it indicates that the drive has been identified by the software. When this LED is lit and not flashing, it indicates that the drive has failed.

- **Hot-swap hardware:** The storage subsystem contains hardware that enables you to replace a failed drive without turning off the storage subsystem. You can continue to operate the storage subsystem while a drive is being removed or installed. These drives are known as hot-swap drives.

Removing a hard disk drive

To remove a hot-swap drive, complete the following steps.

Note: The drive comes installed in a drive tray. Do not attempt to detach the drive from the tray.

Attention: Handle drives gently and do not stack them. Follow all precautions for static-sensitive devices.

1. Use "Hard disk drive locations" on page A-1 to record the location and identify the drives. Record this information so that you can replace the drives in the same bays from which you removed them.
2. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.

   Attention: Never remove a drive when its green activity LED is flashing. Remove a drive only when its amber status LED is lit (not flashing), when the drive is inactive (activity LED is off), or when the storage subsystem is turned off.
3. (DS3512 and EXP3512) Remove the drive.
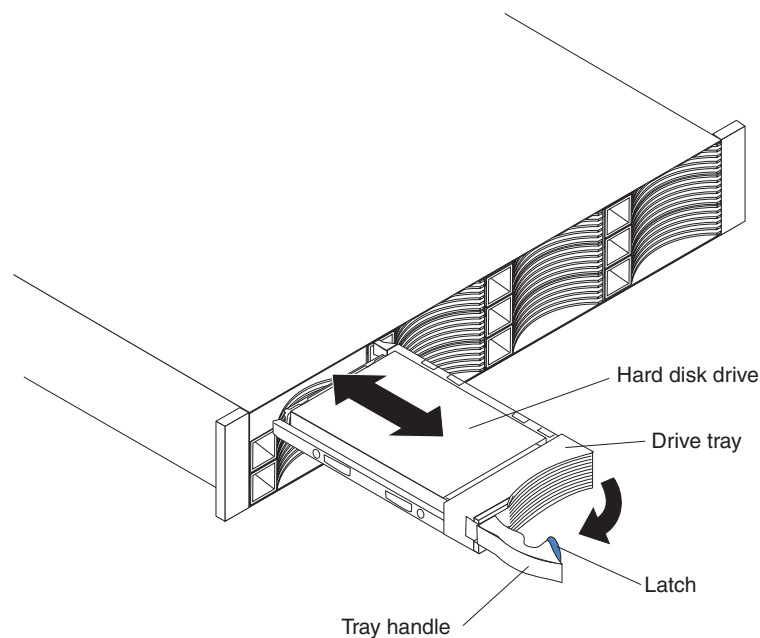
Figure 5-12. Removing a drive from a DS3512 or EXP3512

   a. Press the latch on the end of the tray handle to release it, then pull out the tray handle to the open position.
   b. Pull the drive approximately 12 mm (0.5 in.) out of the bay and wait 70 seconds to allow the drive to spin down and the storage subsystem controller to recognize that a drive is removed from the configuration.
4. (DS3524 and EXP3524) Remove the drive.

Hard disk drive assembly
Drive handle
Release latch
Hard disk drive status LED (amber)
Hard disk drive activity LED (green)
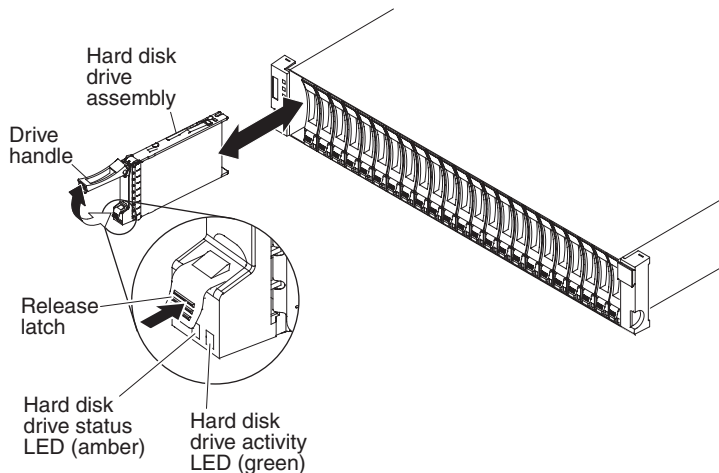
Figure 5-13. Removing a drive from a DS3524 or EXP3524

DANGER

> **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

   a. Push up the latch on the handle, then open the drive handle and pull the drive assembly out of the server.

   b. Pull the drive approximately 12 mm (0.5 in.) out of the bay and wait 70 seconds to allow the drive to spin down and the storage subsystem controller to recognize that a drive is removed from the configuration.

5. Make sure that there is proper identification (such as a label) on the drive; then, slide the drive completely out of the bay. If the drive has failed, indicate that on the label.

6. Place the drive horizontally on a dry, static-free level surface.

Installing a hard disk drive

Except during the storage subsystem initial power-on, you can add drives while the storage subsystem is turned on and running. To install hot-swap drives in the storage subsystem, complete the following steps.

Attention: After you remove a drive, wait 70 seconds to allow the drive to spin down before you replace or reseat the drive. Failure to do so might cause unpredictable results.

Note: The drive comes with a tray already attached. Do not attempt to detach the drive from the tray.

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.

2. Read the documentation that comes with the drive.

3. Remove the filler panel from the bay in which you will install the drive. Save the filler panel for later use.

4. Unpack the new drive. Save all packing material in case you have to return the drive.

Attention: To prevent damage to the drive enclosure:

- For drive enclosures without disk drawers, do not force the drive into the drive slot at an angle. Ensure that you carefully insert each hard disk drive straight into the drive slot (horizontal or vertical).

  The following figure shows correct and incorrect ways of inserting a hard disk drive into a horizontal drive slot. The subsystem shown in the figure is for illustration only.
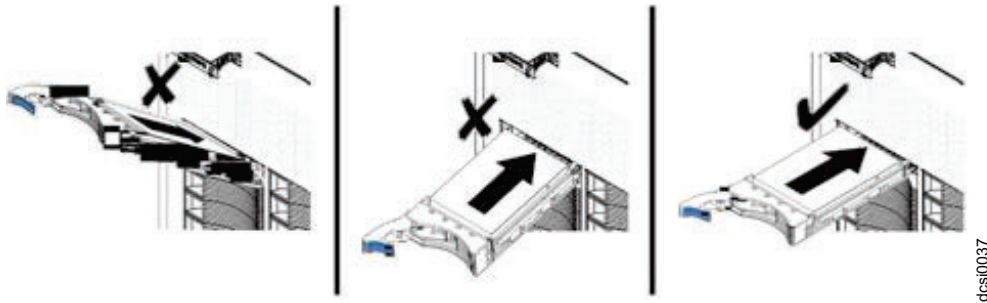
Figure 5-14. Inserting a hard disk drive into a drive slot

- For drive enclosures with disk drawers, gently press on the back of the drive while pulling the lever downward to push the drive into the connector on the drive drawer board.
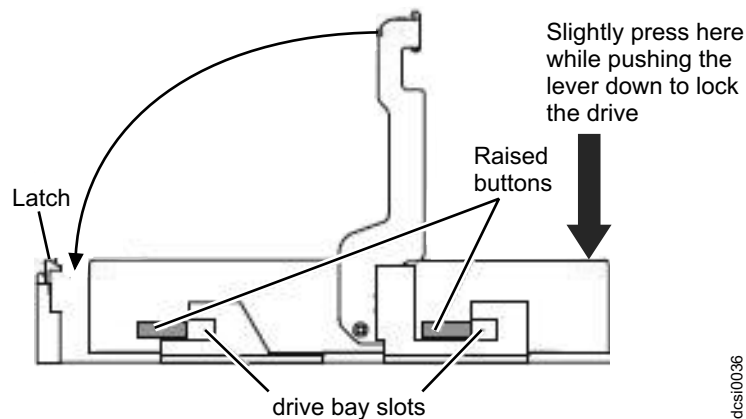
Figure 5-15. Inserting a hard disk drive into the connector

5. (DS3512 and EXP3512) Install the drive.

Hard disk drive

Drive tray
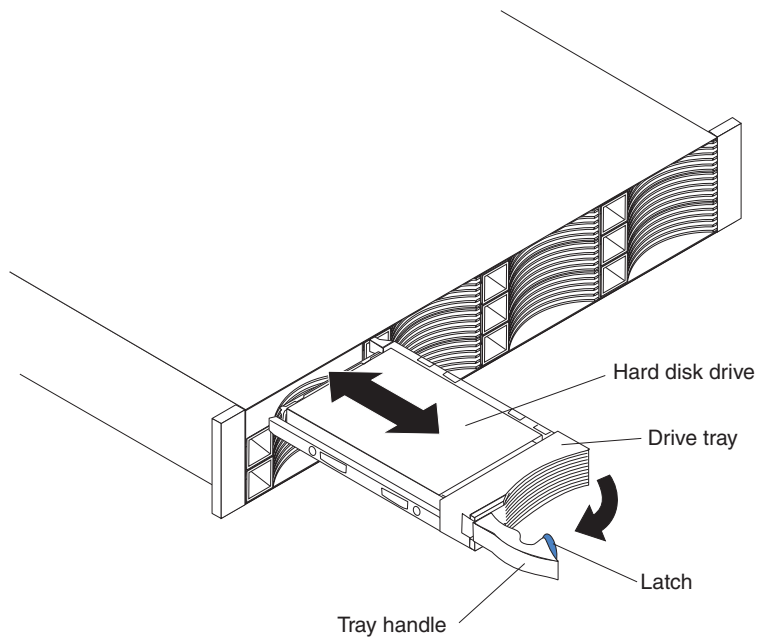
Latch

Tray handle

Figure 5-16. Installing a drive in a DS3512 or EXP3512

    a. Press the latch on the end of the drive tray handle to release it, then pull out the tray handle to the open position.

    b. Slide the drive all the way into the empty bay until the drive stops.

    c. Push the tray handle into the closed (latched) position.

6. (DS3524 and EXP3524) Install the drive.

Hard disk drive assembly

Drive handle

Release latch

Hard disk drive status LED (amber)

Hard disk drive activity LED (green)
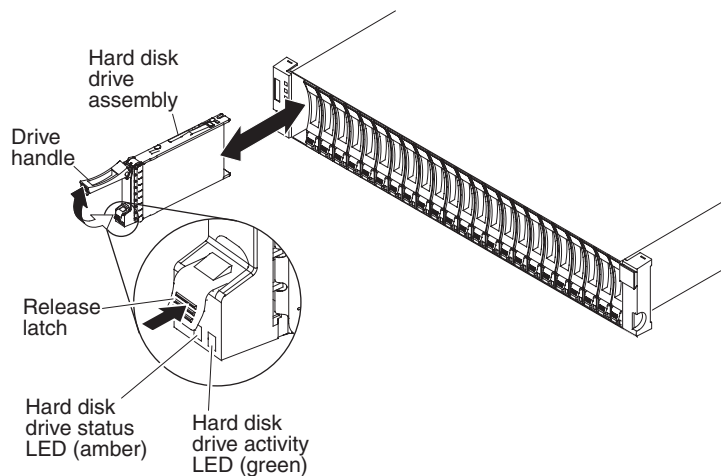
Figure 5-17. Installing a drive in a DS3524 or EXP3524

    a. Push up the latch on the handle to release it then, pull out the tray handle to the open position.

    b. Slide the drive all the way into the empty bay until the drive stops.

    c. Push the tray handle into the closed (latched) position.

7. If you are installing additional drives, wait at least 30 seconds before you install each drive.

Replacing a hot-swap drive

Drive problems include any malfunctions that delay, interrupt, or prevent successful I/O activity between the hosts and the drives in the storage subsystem. This includes transmission problems between the host controllers and the drives. This section explains how to replace a failed drive.

Note: If you want to remove a drive that is not in a failed or bypass state, always use the Storage Manager software either to place the drive in a failed state or to place the array that is associated with the drive (or drives) in an offline state before you remove the drive from the storage subsystem.

Attention: Failure to replace a drive in its correct bay might result in loss of data. If you are replacing a drive that is part of a configured array and logical drive, be sure to install the replacement drive in the correct bay. See the hardware and software documentation that comes with the DS3500 to determine whether there are restrictions regarding drive configurations.

To replace a hot-swap drive, complete the following steps:
1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
2. Use the Storage Manager software to print a new storage system profile.
3. Determine the location of the drive that you want to remove.

   Attention: Never hot-swap a drive when its associated green activity LED is flashing. Hot-swap a drive only when its associated amber status LED is lit and not flashing.
4. Remove the drive (see "Removing a hard disk drive" on page 5-15).
5. Unpack the new drive. Save all packing material in case you have to return the drive.

   Note: Use "Hard disk drive locations" on page A-1 to make sure that you replace the drive into the correct bay.
6. Install the new drive (see "Installing a hard disk drive" on page 5-16).
7. Check the drive LEDs:
   - When a drive is ready for use, the green activity LED is lit and the amber status LED is off.
   - If the amber status LED is lit and is not flashing, remove the drive from the unit and wait 70 seconds; then, install the drive again.
8. Make sure that the drive is shown in the Subsystem Management window.

Note: If you are replacing more than one drive, replace only one drive at a time.

Replacing multiple drives

This section provides guidelines for upgrading the drives in the storage subsystem. Read the software documentation and this entire section to determine whether you should use this procedure, use a modified version of this procedure, or use a different procedure that is provided by the operating system.

Note:
1. Instructions that are provided with the software supersede any instructions and information in this document.
2. Use "Hard disk drive locations" on page A-1 to make sure that you replace the drives into the correct bays.

Attention: After you remove a drive, wait 70 seconds to allow the drive to spin down before you replace or reseat the drive. Failure to do so might cause unpredictable results.

There are two methods for upgrading drives:
- **Replacing all the drives at the same time**

This method requires that you back up the data on the affected drives and then turn off the DS3500 storage subsystem.

Attention: Turn off the DS3500 storage subsystem before you turn off the attached storage enclosures.

After you replace all the drives, you must reconfigure the new drives and restore data from backup. See the procedure in "Replacing all drives at the same time."

This is the safest way to exchange drives without losing data. However, this method might take a long time to complete because of the backup, reconfiguration, and restoration processes. In addition, other users are not able to use the storage subsystem (or any storage enclosures attached to the storage subsystem) until you finish the procedure. You must use this method on RAID 0 logical drives.

- **Replacing the drives one at a time**

  In this method, you manually fail each drive, replace it, and wait for the system to restore data to the new drive before you install the next drive. After you install the new drives, you can configure them to make the additional drive space available. See the procedure in "Replacing the drives one at a time" on page 5-22.

  Using this method, you can replace the drives while the storage enclosures and the DS3500 are running, eliminating the downtime that is required if you replace all the drives at once. However, this method is more risky because you can lose data if the drive restoration or storage subsystem reconfiguration process fails. In addition, the reconstruction process might take a long time. This method works only on redundant logical drives (RAID 1, 3, 5, or 6). You cannot use this method with any drives that contains RAID 0 logical drives.

  Consider backing up your data if you use this method. This safeguards your data if the restoration and reconfiguration process fails or the new drive malfunctions.

The method that you use depends on the following considerations:

- Which method most closely matches the recommended drive upgrade procedure that is provided in the operating-system or storage-management software documentation.
- Which RAID level is used on the affected drives (RAID 0 requires you to replace all the drives at the same time).
- How much downtime is acceptable as you swap the drives.
- The number of drives in an array. Replacing drives one at a time is better suited to arrays that consist of three to five drives. If you have more than 10 drives, consider replacing all drives at the same time.
- How much risk of losing data is acceptable. Because the array is in a degraded state during the RAID array reconstruction and copyback process as result of replacing a drive in the array, any new drive failure will cause the array to fail (causing a loss of data availability and even a loss of data). The duration of the reconstruction and copyback process can be quite long, depending on the size of the RAID array.
- How extensively the data will be changed while the array is in a degraded state during the RAID array reconstruction and copyback process as a result of replacing a drive in the array. The more extensive the data changes are, the more work that will have to be performed to restore the data in the event that the array fails because an additional drive fails while the array is in a degraded state.

Replacing all drives at the same time

Use this procedure to replace all drives at the same time. You must use this method if you are upgrading drives that contain RAID 0 logical drives. All the data that is currently on the drives is lost when you replace the drives; therefore, you must back up all data that is currently on the drives. This procedure also requires you to turn off the storage enclosures and the DS3500, which makes the storage subsystem (and any attached storage enclosures) inaccessible to other users.

Attention: After you remove a drive, wait 70 seconds to allow the drive to spin down before you replace or reseat the drive. Failure to do so might cause unpredictable results.

To replace all the drives at the same time, complete the following steps:

1. Read the following information:

- The information in "Replacing multiple drives" on page 5-19, particularly the paragraphs that explain the differences between the two possible upgrade procedures
- The information in the software documentation about drive upgrades and installation
- The documentation that comes with the new drives

  Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information about the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine whether you must modify this procedure.

2. Use the Storage Manager software to check the status of the DS3500. Correct any problems that are reported.

3. Perform a complete backup of the drives that you are replacing.

   You need the backup to restore data on the drives later in this procedure.

   Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see "Handling static-sensitive devices" on page 2-3.

   DANGER

   > **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

4. Unpack the new drives. Set the drives on a dry, static-free level surface, away from magnetic fields. Save the packing material and documentation in case you have to return the drives.

5. Complete the following steps:

   a. Stop all I/O activity to the storage subsystem and attached storage enclosures.

   b. Make sure that all of the green drive activity LEDs on the front of the storage subsystem (and on all attached storage enclosures) are not flashing.

   c. Make sure that the green cache active LEDs are off. See "Controller LEDs" on page 4-9 for the location of the cache active LEDs.

   d. If applicable, use the operating-system software to disconnect the storage subsystem logical drives from the host before you power-off the storage subsystem.

   Attention: To turn off all power to the storage subsystem, you must turn off both power-supply switches and disconnect both power cords. Use the procedure in step 6 for the correct shutdown sequence.

6. Turn off the power to each device according to the following shutdown sequence:

   a. Turn off power to the host before you turn off power to the storage subsystem. If the host must stay powered-on to support a network, see the operating-system documentation for information about disconnecting the storage subsystem logical drives from the host before the storage subsystem is powered-off.

   b. Turn off power to the storage subsystem before you turn off power to the storage enclosures. Turn off both power-supply switches on the rear of the storage subsystem.

   c. Turn off power to other supporting devices (for example, management stations or Ethernet switches).

7. Use the procedures in "Replacing a hot-swap drive" on page 5-19 to remove the drives that you want to replace. Use the procedures in "Installing a hard disk drive" on page 5-16 to install the new drives in the storage subsystem.

8. After you install all the new drives, check the system documentation for the hardware devices that you intend to power-on, and then determine the correct startup sequence. Use the following power-on sequence, where applicable:

a. Turn on the power to the supporting devices (for example, Ethernet switches and management stations) before you turn off power to the storage subsystem.

b. Turn on the storage enclosures before the storage subsystem. The controllers might not recognize the correct configuration if the drives are powered-on after the storage subsystem. For instructions for powering-on the storage subsystem, see the storage subsystem documentation.

c. Turn on the power to the storage subsystem; then, restart or turn on the power to the host.

9. Turn on the power to each device, according to the power-on sequence in step 8 on page 5-21. To turn on power to the storage subsystem and the storage enclosures, turn on the power-supply switches on the rear of the storage subsystem. You must turn on both power-supply switches to take advantage of the redundant power supplies.

10. Check the green drive activity LEDs and the amber drive fault LEDs above the new drives.

Make sure that the drive activity LEDs are lit and the drive fault LEDs are off.

Note: The drive fault LEDs might flash intermittently while the drives spin up.

* If a drive activity LED is off, the drive might not be installed correctly. Remove the drive, wait 70 seconds, and then reinstall it.
* If the drive fault LED stays lit or the drive activity LED stays off, the new drive might be faulty. See the Storage Manager software for problem determination.

11. Use the Storage Manager software to configure the new drives. See the Storage Manager software online help for detailed instructions.

12. Restore the data from backup to all the drives.

Replacing the drives one at a time

Use this procedure to replace all the drives one at a time. You cannot use this procedure on RAID 0 logical drives (use the procedure in "Replacing all drives at the same time" on page 5-20).

Note: If hot spares are assigned in the storage subsystem, you might want to unassign the hot spares while you perform this procedure. If you do not, reconstruction might start on the hot spare before you insert the new drive. The data on the new drive is still rebuilt, but the process takes longer for each drive. Remember to reassign the hot spares when you are finished with this procedure.

Attention: After you remove a drive, wait 70 seconds to allow the drive to spin down before you replace or reseat the drive. Failure to do so might cause unpredictable results.

To replace the drives one at a time, complete the following steps:

1. Read the following information:
   * "Replacing multiple drives" on page 5-19, particularly the paragraphs that explain the differences between the two possible upgrade procedures
   * Your software documentation about drive upgrades and installation
   * The documentation that comes with the new drives

   Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information about the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine whether you must modify this procedure.

2. Use the Storage Manager software to check the status of the unit. Correct any problems that are reported.

3. Back up the data in the arrays and logical drives that are configured, using the drives that you are replacing.

   Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see "Handling static-sensitive devices" on page 2-3.

DANGER

> **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

4. Unpack the new drives. Set the drives on a dry, static-free level surface, away from magnetic fields. Save the packing material and documentation in case you have to return the drives.

5. Use the Storage Manager software to make sure that the array that was defined using these drives is in Optimal (not Degraded) state before you manually fail the first drive that you want to replace. If the array is in a Degraded state, use the recovery procedures to bring the array into the optimal state.

   Make sure that:

   - You fail only one drive
   - The software status display shows a Failed status for the applicable drive
   - The amber drive fault LED (on the front bezel below the drive) is lit

   Attention: Removing the wrong drive can cause data loss. Make sure that you remove only the failed drive. A lit drive fault LED indicates the failed drive.

   If you remove an active drive accidentally, wait at least 70 seconds and then reinstall it. Because you have failed two drives in a RAID array, the array might be marked as failed by the controller. This array will not be available to the host for I/O. See the Storage Manager software for further recovery instructions. Do not attempt to replace any drives until the array is brought back to Optimal state.

6. Use the procedures in "Replacing a hot-swap drive" on page 5-19 to remove the failed drive. Use the procedures in "Installing a hard disk drive" on page 5-16 to install the new drives in the storage subsystem.

   The new drive automatically reconstructs the data after you install it in the drive bay.

   During data reconstruction, the amber drive fault LED might be lit for a few minutes and then turn off when the green drive activity LED begins flashing. A flashing drive activity LED indicates that data reconstruction is in progress.

   Note: If the storage subsystem has active hot spares, data might not start copying to the new drive until the data is reconstructed on the hot spare. This increases the time that is required to complete the procedure.

7. Check the green drive activity LED and the amber drive fault LED on each of the new drives.

   Make sure that the drive activity LEDs are lit and the drive fault LEDs are off.

   Note: The drive fault LEDs might flash intermittently while the drives spin up.
   - If the drive activity LED is off, the drive might not be installed correctly. Remove the drive, wait 70 seconds, and then reinstall it.
   - If the drive fault LED stays lit or the drive activity LED stays off, the new drive might be faulty or might be an uncertified drive. Use the Storage Manager software for problem determination. In the case of an uncertified drive, make sure that the drive options or drive FRU part number is correct for the storage subsystem.

8. Use the Storage Manager software to monitor the status of the new drive and the progress of the data reconstruction. Wait for data reconstruction to finish (the drive activity LED stops flashing).

   Note: The drive activity LED continues to flash after reconstruction is finished if there is I/O activity to that drive. In that case, use the host software to determine whether the data reconstruction is finished.

9. When reconstruction is finished on the new drive, repeat step 5 through step 8 for each additional drive that you want to install.

10. Use the Storage Manager software to configure the additional space on the new drives.

Replacing an ac power supply

(L003)
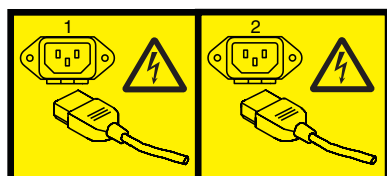
The power supplies are customer replaceable units (CRUs) and do not require preventive maintenance. Use only the supported power supplies for the storage subsystem.

Each power supply has a built-in sensor that detects the following conditions:
- Over-voltage
- Over-current
- Overheated power supply

If any of these conditions occurs, one or both power supplies will shut down. If the power remains off (does not automatically restart), make sure that the environment is optimal (no overheating has occurred, all electrical receptacles are working, and so on). For more information, see "Restoring power after an unexpected shutdown" on page 4-16.

If both power supplies fail or if the power supplies cannot maintain an internal temperature below 65°C (149°F), the power supplies will automatically shut down (an overtemperature condition). If this occurs, you must cool the storage subsystem and restart it. See "Restoring power after an unexpected shutdown" on page 4-16.

Attention: The fans in the power supplies draw in fresh air and force out hot air. The power supplies are hot-swappable and redundant; however, if the fans in one power supply fail, you must replace the entire failed power supply within 72 hours to maintain redundancy and optimum cooling. Do not remove the failed power supply until you have the replacement power supply. When you do remove the failed power supply, be sure to install the second power supply within 10 minutes to prevent any overheating due to the interruption to the air flow that cools the storage subsystem.

Do not run the storage subsystem without adequate ventilation and cooling, because it might cause damage to the internal components and circuitry.

To replace a power supply, complete the following steps.

Attention: To prevent damage to the storage subsystem components from overheating, replace a failed power supply within 10 minutes of removal. If replacing it will take longer than 10 minutes, stop all I/O activity to the storage subsystem and turn off the power until you complete the replacement. Do not remove the failed power supply from the storage enclosure until you:

- Review the replacement procedure in this section.
- Have the replacement power supply and are ready to install it in the enclosure.

(L001)

1. If necessary, use the Storage Manager software to print a storage system profile.
2. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
3. Did the Recovery Guru direct you to replace a failed power supply?
   - **Yes:** Go to step 4.
   - **No:** Run the Recovery Guru to identify the failed component, and then go to step 4.
4. Unpack the new power supply. Save all packing material in case you have to return the failed power supply.

   Note: The new power supply comes with an instruction sheet and label sheet. The instruction sheet provides instructions for placing the correct labels on the power supply to mark the LEDs correctly. The label sheet contains the peel-off labels that you actually place on the power supply.
5. Using the information on the instruction sheet, place the labels on the power supply to correctly mark the LEDs.
6. Turn off the power switch on the new unit.

7. Check the fault LED to locate the failed power supply. If a fault is detected, the amber fault LED is lit.

8. Make sure that the OK to remove LED is lit. Do not remove the power supply if the LED is off. For more information about the OK to remove LED, see "OK to remove LED" on page 5-1.

DANGER

When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard:

- Connect power to this unit only with the provided power cord. Do not use the provided power cord for any other product.
- Do not open or service any power supply assembly.
- Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.
- The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords.
- Connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate.
- Connect any equipment that will be attached to this product to properly wired outlets.
- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.
- Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices.

  To disconnect:
  a. Turn off everything (unless instructed otherwise).
  b. Remove the power cords from the outlets.
  c. Remove the signal cables from the connectors.
  d. Remove all cables from the devices.

  To connect:
  a. Turn off everything (unless instructed otherwise).
  b. Attach all cables to the devices.
  c. Attach the signal cables to the connectors.
  d. Attach the power cords to the outlets.
  e. Turn on the devices.

  (D005a)

9. Turn off the power switch and disconnect the power cord from the failed power supply.

10. Remove the power supply from the bay

Release
levels
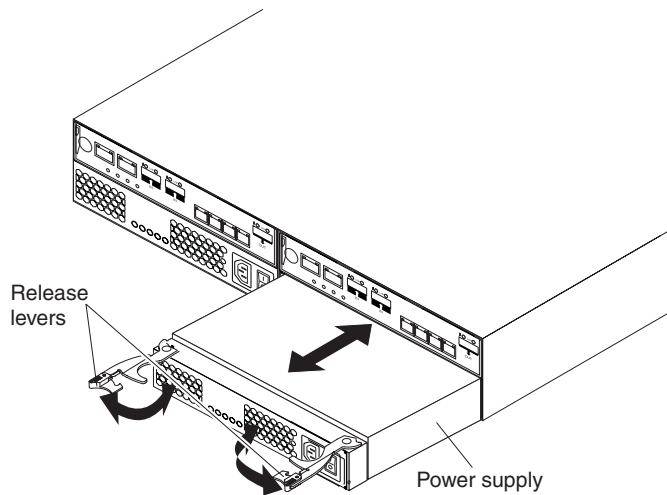
Power supply

Figure 5-18. Replacing a power supply

a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).

b. Slide the power supply out of the bay and set it aside.

DANGER

Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.

11. Place the replacement power supply on a dry, static-free level surface.

12. Make sure that the release levers on the power supply are in the open position.

13. Slide the power supply into the bay until it stops.

14. Push the release levers to the closed position.

15. Connect the power cord and turn on the power.

16. Check the power and fault LEDs on the new unit.

17. According to the status of the power and fault LEDs, use one of the following procedures:

   - **The fault LED is lit and the ac and dc power LEDs are off:** The new unit might be installed incorrectly. The power-supply switch might not be turned on. The power cord connector might not be fully inserted into the power receptacle or the power-supply ac socket. There might not be any power to the receptacle that the power supply is connected to. The power cord might be faulty. Go to step 18.

   - **The fault and ac power LEDs are lit but the dc power LED is off:** The power supply is faulty. Turn off the power switch and contact your IBM technical-support representative for a replacement power supply.

   - **The ac and dc power LEDs are lit but the fault LED is off:** Go to step 19.

18. Perform the following task or tasks to solve the problem:

   - Make sure that the power switch is turned to the on position.

   - Make sure that there is power at the ac outlet and no circuit breaker has tripped.

   - Make sure that the power cord is working and fully seated into the electrical receptacle and the power supply ac connector.

   - Reinstall the power supply.

   If these tasks do not solve the problem, contact your IBM technical-support representative.

19. Complete any remaining Recovery Guru procedures, if needed.

20. Check the status of each component in the storage subsystem.

21. Are any amber LEDs lit on any of the components?

    - **Yes :** Click **Recovery Guru** in the Subsystem Management window toolbar and complete the recovery procedure. If a problem is still indicated, contact your IBM technical-support representative.

    - **No:** Go to step 22.

22. Create, save, and print a new storage subsystem profile.

Replacing a dc power supply

Statement 29

CAUTION:
This equipment is designed to permit the connection of the earthed conductor of the dc supply circuit to the earthing conductor at the equipment. If this connection is made, all of the following conditions must be met:

- **This equipment shall be connected directly to the dc supply system earthing electrode conductor or to a bonding jumper from an earthing terminal bar or bus to which the dc supply system earthing electrode conductor is connected.**
- **This equipment shall be located in the same immediate area (such as, adjacent cabinets) as any other equipment that has a connection between the earthed conductor of the same dc supply circuit and the earthing conductor, and also the point of earthing of the dc system. The dc system shall not be earthed elsewhere.**
- **The dc supply source shall be located within the same premises as this equipment.**
- **Switching or disconnecting devices shall not be in the earthed circuit conductor between the dc source and the point of connection of the earthing electrode conductor.**

Statement 34

CAUTION:

To reduce the risk of electric shock or energy hazards:

- **This equipment must be installed by trained service personnel in a restricted-access location, as defined by the NEC and IEC 60950-1, First Edition, The Standard for Safety of Information Technology Equipment.**
- **Connect the equipment to a reliably grounded safety extra low voltage (SELV) source. An SELV source is a secondary circuit that is designed so that normal and single fault conditions do not cause the voltages to exceed a safe level (60 V direct current).**
- **Incorporate a readily available approved and rated disconnect device in the field wiring.**
- **See the specifications in the product documentation for the required circuit-breaker rating for branch circuit overcurrent protection.**
- **Use copper wire conductors only. See the specifications in the product documentation for the required wire size.**
- **See the specifications in the product documentation for the required torque values for the wiring-terminal nuts.**

The dc power supplies are customer replaceable units (CRUs) and do not require preventive maintenance. Use only the supported dc power supplies for the storage subsystem.

Each dc power supply has a built-in sensor that detects the following conditions:
- Over-voltage
- Over-current
- Overheated power supply

If any of these conditions occurs, one or both power supplies will shut down. If the power remains off (does not automatically restart), make sure that the environment is optimal (no overheating has occurred, the dc power source is working, and so on). For more information, see "Restoring power after an unexpected shutdown" on page 4-16.

If both dc power supplies fail or if the power supplies cannot maintain an internal temperature below 65°C (149°F), the power supplies will automatically shut down (an overtemperature condition). If this occurs, you must cool the storage subsystem and restart it. See "Restoring power after an unexpected shutdown" on page 4-16.

Attention: The fans in the dc power supplies draw in fresh air and force out hot air. The dc power supplies are hot-swappable and redundant; however, if the fans in one power supply fail, you must replace the entire failed power supply within 72 hours to maintain redundancy and optimum cooling. Do not remove the failed power supply until you have the replacement power supply. When you do remove the failed power supply, be sure to install the second power supply within 10 minutes to prevent any overheating due to the interruption to the air flow that cools the storage subsystem.

Do not run the storage subsystem without adequate ventilation and cooling, because it might cause damage to the internal components and circuitry.

Before you begin, ensure that you wear an anti-static wrist strap.

To replace a dc power supply, complete the following steps.

Attention: To prevent damage to the storage subsystem components from overheating, replace a failed power supply within 10 minutes of removal. If replacing it will take longer than 10 minutes, stop all I/O activity to the storage subsystem and turn off the power until you complete the replacement. Do not remove the failed power supply from the storage enclosure until you:

- Review the replacement procedure in this section.
- Have the replacement power supply and are ready to install it in the enclosure.

(L001)

1. If necessary, use the Storage Manager software to print a storage system profile.
2. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
3. Did the Recovery Guru direct you to replace a failed power supply?
   - **Yes:** Go to step 4.
   - **No:** Run the Recovery Guru to identify the failed component, and then go to step 4.
4. Unpack the new dc power supply. Save all packing material in case you have to return the failed power supply.
5. Turn off the power switch on the new unit.
6. Check the fault LED to locate the failed power supply. If a fault is detected, the amber fault LED is lit.
7. Make sure that the OK to remove LED is lit. Do not remove the power supply if the LED is off. For more information about the OK to remove LED, see "OK to remove LED" on page 5-1.

DANGER

When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard:

- Connect power to this unit only with the provided power cord. Do not use the provided power cord for any other product.
- Do not open or service any power supply assembly.
- Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.
- The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords.
- Connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate.
- Connect any equipment that will be attached to this product to properly wired outlets.
- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Disconnect the attached power cords, telecommunications systems, networks, and modems before you open the device covers, unless instructed otherwise in the installation and configuration procedures.
- Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices.

   To disconnect:

   a. Turn off everything (unless instructed otherwise).

   b. Remove the power cords from the outlets.

   c. Remove the signal cables from the connectors.

   d. Remove all cables from the devices.

   To connect:

   a. Turn off everything (unless instructed otherwise).

   b. Attach all cables to the devices.

   c. Attach the signal cables to the connectors.

   d. Attach the power cords to the outlets.

   e. Turn on the devices.

   (D005a)

8. Turn off the power switch and disconnect the dc power cable from the failed power supply.
9. Turn off the -48V disconnect device.
10. Remove the dc power supply from the bay

Figure 5-19. Replacing a power supply

   a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).

   b. Slide the dc power supply out of the bay and set it aside.

DANGER

> **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

11. Place the replacement dc power supply on a dry, static-free level surface.

12. Make sure that the release levers on the power supply are in the open position.

13. Slide the dc power supply into the bay until it stops.

14. Push the release levers to the closed position.

15. Connect the dc power cable and turn on the -48 V disconnect device, then; turn on the power-supply switch.

16. Check the power and fault LEDs on the new unit.

17. According to the status of the power and fault LEDs, use one of the following procedures:

   • **The fault LED is lit and the dc power in and dc power out power LEDs are off:** The new unit might be installed incorrectly. The power-supply switch might not be turned on. The dc power cable might not be fully inserted into the power connector. The disconnect device might be turned off or inoperative. The dc power source might be turned off or inoperative. The dc power cable might be faulty. Go to step 18.

   • **The fault and dc power in LEDs are lit but the dc power out LED is off:** The power supply is faulty. Turn off the power switch and contact your IBM technical-support representative for a replacement power supply.

   • **The dc power in and dc power out LEDs are lit but the fault LED is off:** Go to step 19 on page 5-33.

18. Perform the following task or tasks to solve the problem:

   • Make sure that the power switch is turned to the on position.

   • Make sure that there is power at the dc source and no disconnect device has tripped.

   • Make sure that the power cable is working and fully seated into the dc power connector.

   • Make sure that the dc power cable is properly connected to the dc power source.

   • Reinstall the power supply.

If these tasks do not solve the problem, contact your IBM technical-support representative.

19. Complete any remaining Recovery Guru procedures, if needed.

20. Check the status of each component in the storage subsystem.

21. Are any amber LEDs lit on any of the components?

    - **Yes :** Click **Recovery Guru** in the Subsystem Management window toolbar and complete the recovery procedure. If a problem is still indicated, contact your IBM technical-support representative.

    - **No:** Go to step 22.

22. Create, save, and print a new storage subsystem profile.

Replacing a battery

The controller in the storage subsystem contains a rechargeable battery backup unit that provides power to back up the cache memory onto flash drives in the event of a power failure. Each battery unit contains a sealed, rechargeable SMART lithium ion battery. The cache battery is the only replaceable battery in the storage subsystem.

Use the following procedure if the Storage Manager software instructs you to replace the battery because the current battery has failed. You can also use the Storage Manager software to check the status of the battery. Because write-caching is disabled when the battery fails, replace the failed battery as soon as possible to minimize any performance impact due to the disabling of the write-caching function.

Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see "Handling static-sensitive devices" on page 2-3.

Attention: To avoid overheating the storage enclosure and causing damage to its components, replace failed parts within 10 minutes. The Recovery Guru in the Storage Manager software identifies failed parts.

Do not remove the failed part from the storage enclosure until you:
- Review the replacement procedure for the failed part in this guide.
- Locate screw drivers or any other hand tools that you might need to replace the failed part.
- Receive the replacement part and are ready to install it in the enclosure.

Before you begin, ensure that you wear an anti-static wrist strap.

To replace a battery unit, complete the following steps:

1. Use the Storage Manager software to print a storage subsystem profile.

2. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.

3. Locate the controller that contains the failed battery unit (see "Controller LEDs" on page 4-9).

   Attention: Before you remove a controller in a single-controller DS3500, shut down the DS3500 to avoid data loss (see "Turning off the storage subsystem" on page 4-13).
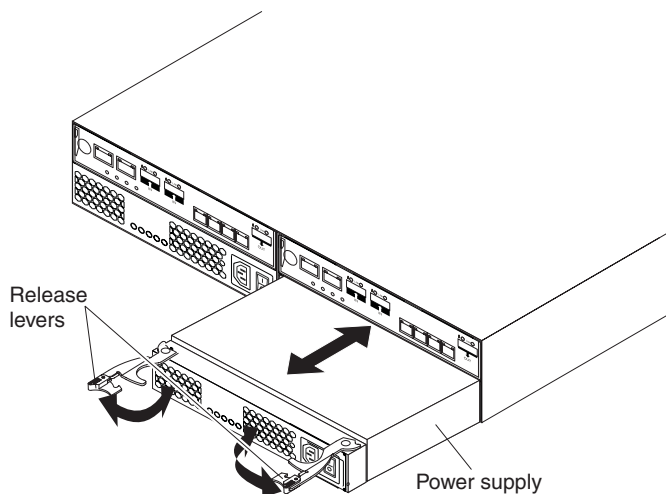
4. Remove the controller from the chassis.

Release
levers

Figure 5-20. Removing a controller

a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).

b. Pull the controller out of the bay.

DANGER

> **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

c. Place the controller on a dry, static-free level surface.

5. Remove the cover (see "Removing and installing a cover" on page 5-2).

6. Place the controller on a flat surface.

7. Remove the failed battery unit from the controller.

Battery connector
Memory cache battery
Captive fastener
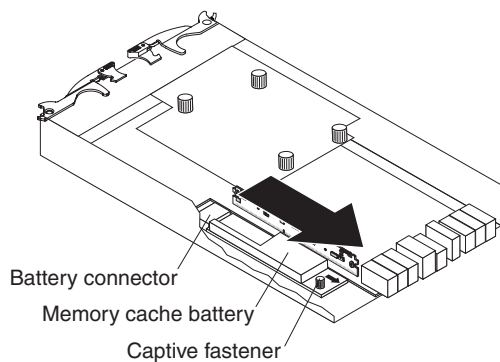
Figure 5-21. Removing a battery unit from the controller

a. Loosen the blue captive fastener until the battery can move in the direction that is indicated by the arrow.

b. Slide the battery unit out of the controller in the direction that is indicated by the arrow.

c. Dispose of the battery as required by local ordinances or regulations. For more information, see the *IBM Systems Environmental Notices and User's Guide* on the IBM Support DVD.

DANGER

> **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

8. Unpack the new battery unit. Set the new battery unit on a dry, static-free level surface.

    Save all packing materials in case you have to return the new battery unit.

9. Insert the new battery unit into the controller chassis:

    a. Slide the battery pack into the controller until the battery-pack connector pins are firmly seated in the controller battery connector.

    b. Tighten the captive fastener to secure the battery pack in place.

10. Install the cover (see "Removing and installing a cover" on page 5-2).

11. Insert the controller into the chassis.

    a. Make sure that the release levers on the controller are in the open position.

    b. Slide the controller into the bay until it stops.

    c. Push the release levers to the closed position.

After you replace a controller cache battery, reset the battery age timer. For information about resetting the batter age timer, see the Storage Manager software online help.

Replacing the memory cache DIMM

Attention: To avoid damage to the DIMM, you must first remove the memory cache battery and wait the required time period before you install or remove the DIMM. Follow the instructions in this procedure exactly.

Attention: To avoid overheating the storage enclosure and causing damage to its components, replace failed parts within 10 minutes. The Recovery Guru in the Storage Manager software identifies failed parts.

Do not remove the failed part from the storage enclosure until you:

• Review the replacement procedure for the failed part in this guide.

• Locate screw drivers or any other hand tools that you might need to replace the failed part.

• Receive the replacement part and are ready to install it in the enclosure.

Before you begin, ensure that you wear an anti-static wrist strap.

Use these procedures if you are replacing a failed DIMM or if you are removing and installing the DIMM as directed in "Replacing a controller" on page 5-5.

The following illustration shows the location of the memory cache DIMM.
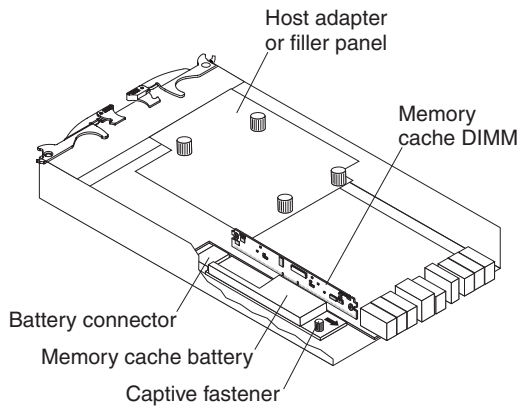
Figure 5-22. Memory cache DIMM location

Removing the DIMM

To remove the DIMM from the controller, complete the following steps:

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
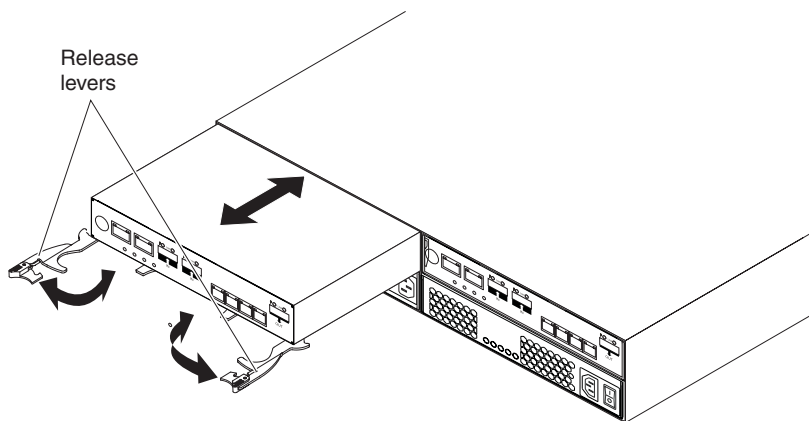2. Remove the controller from the chassis.
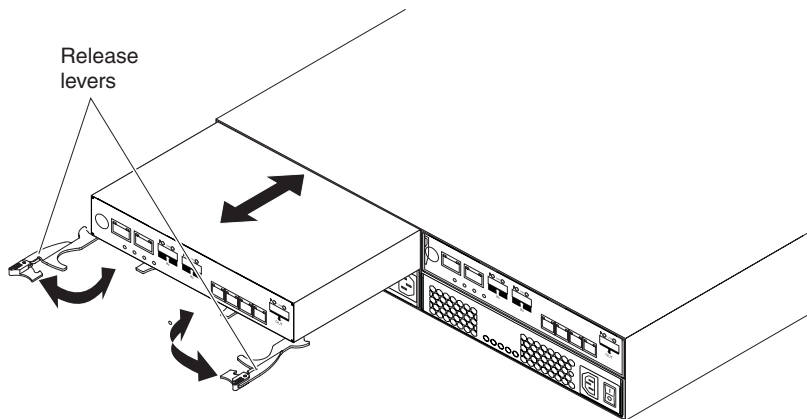
Figure 5-23. Removing a controller

   a. Open the two release levers as shown in the illustration. The controller moves out of the bay approximately 0.6 cm (0.25 inch).

   b. Pull the controller out of the bay.

    DANGER

> **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

   c. Place the controller on a dry, static-free level surface.

3. Remove the cover (see "Removing and installing a cover" on page 5-2).
4. Remove the DIMM from the connector.
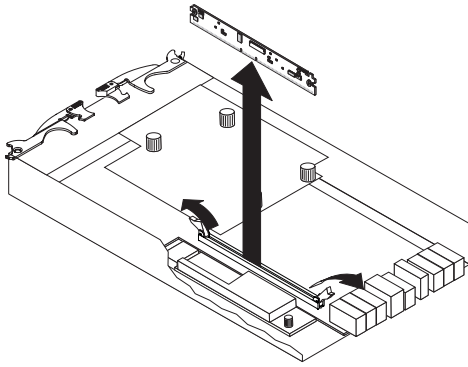
Figure 5-24. Removing the DIMM from the controller

    a. Open the retaining clip on each end of the DIMM connector.

    b. Lift the DIMM out of the connector.

5. If the DIMM is functional, place the DIMM in a static-protective package until you are ready to install it.

Installing the DIMM

Complete the following steps to install the DIMM in the controller:

1. Open the retaining clip on each end of the DIMM connector.

2. Touch the static-protective package that contains the DIMM to any unpainted metal surface on the storage subsystem. Then, remove the DIMM from the package.
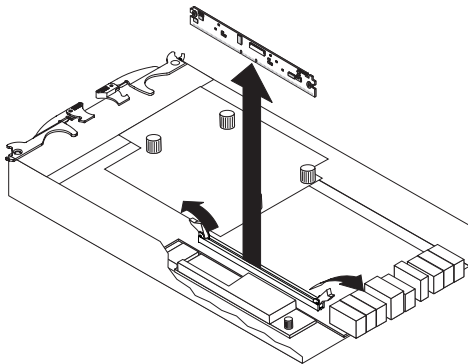
Figure 5-25. Installing the DIMM in the controller

3. Turn the DIMM so that the DIMM keys align correctly with the slot.

4. Match the angle of the DIMM with the angle of the connector.

5. Firmly press the DIMM into the connector. The retaining clips snap into the locked position when the DIMM is firmly seated in the connector. If there is a gap between the DIMM and the retaining clips, the DIMM has not been correctly inserted; open the retaining clips, remove the DIMM, and then reinsert it.

6. Install the cover (see "Removing and installing a cover" on page 5-2).

7. Insert the controller into the chassis.

    a. Make sure that the release levers on the controller are in the open position.

    b. Slide the controller into the bay until it stops.

    c. Push the release levers to the closed position.

Attention: After you remove a controller, wait 70 seconds before you reseat or replace the controller. Failure to do so might cause unpredictable results.

Replacing the bezels

This section describes how to remove and install the bezels.

Before you begin, ensure that you wear an anti-static wrist strap.

Removing the bezels
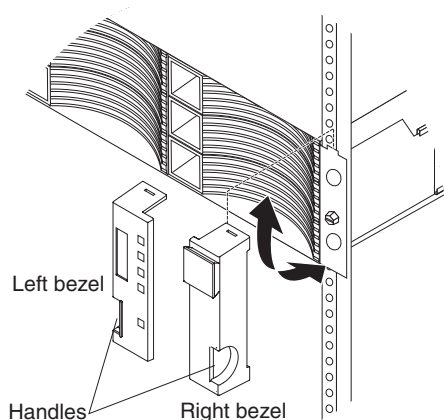
Figure 5-26. Removing the bezels

To remove either the left or right bezel, complete the following steps:

1. If the storage subsystem is on a table or other flat surface, elevate the storage subsystem front slightly or extend the front over the table edge.
2. Grasp the handle on the front of the bezel and pull until the bezel is clear of the bottom tab on the chassis flange.
3. Lift the bezel off the chassis flange.

Installing the bezels

To install either the left or right bezel, complete the following steps:

1. Fit the cutout that is on the top of the bezel over the tab on the chassis flange.
2. Rotate the bezel down until it snaps into place. Make sure that the inside surface of the bezel is flush with the chassis.

Working with environmental service modules

This section describes how to add or replace an ESM.

Attention: To avoid overheating the storage enclosure and causing damage to its components, replace failed parts within 10 minutes. The Recovery Guru in the Storage Manager software identifies failed parts.

Do not remove the failed part from the storage enclosure until you:
- Review the replacement procedure for the failed part in this guide.
- Locate screw drivers or any other hand tools that you might need to replace the failed part.

- Receive the replacement part and are ready to install it in the enclosure.

Before you begin, ensure that you wear an anti-static wrist strap.

Installing an additional ESM

The storage enclosure comes with one environmental services module (ESM). If your controller supports redundant drive paths (see the documentation that comes with the controller or the device that contains the controller), you can install a second ESM.

To install a second ESM, complete the following steps:

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
2. Remove the ESM filler panel from the rightmost ESM bay:
   a. Open the two release levers. The ESM filler panel moves out of the bay approximately 0.6 cm (0.25 inch).
   b. Slide the ESM filler panel out of the bay and set it aside.

DANGER

> **Electrical voltage and current from power cables are hazardous. To avoid a shock hazard, always place electrical equipment on dry, static-free level surfaces. Never turn on any electrical equipment when there is evidence of fire, water, or structural damage.**

3. Place the ESM on a dry, static-free level surface.
4. Make sure that the release levers on the ESM are in the open position.
5. Slide the ESM into the bay until it stops.
6. Push the release levers to the closed position.
7. Connect the SAS cable or cables to the ESM. See Chapter 3, "Cabling the storage subsystem and storage enclosure," on page 3-1 for more information.

Replacing an ESM

If you are replacing the only ESM in the EXP3500 storage enclosure, you must turn off power to the storage enclosure before you replace the ESM. See "Turning off the storage subsystem" on page 4-13 or see the documentation that comes with your controller for additional information and instructions.

To replace an ESM, complete the following steps:

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
2. If the EXP3500 storage enclosure contains only one ESM, turn off the power to the storage enclosure. See "Turning off the storage subsystem" on page 4-13 or see the documentation that comes with your controller for additional information and instructions.
3. Disconnect the cable from the ESM.
4. Open the two release levers. The ESM moves out of the bay approximately 0.6 cm (0.25 inch).
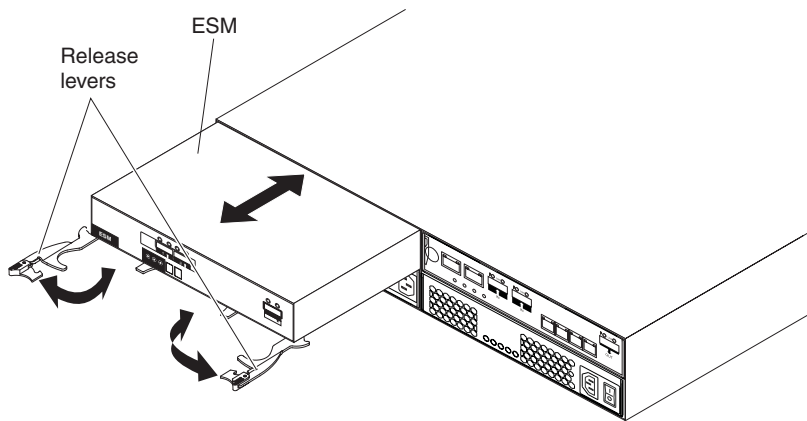
Figure 5-27. Removing an environmental service module

5. Slide the ESM out of the bay and set it aside.
6. Make sure that the release levers on the ESM are in the open position.
7. Slide the ESM into the bay until it stops.
8. Push the release levers to the closed position.
9. Connect the cable to the ESM.
10. Turn on the power. For more information, see "Turning on the storage subsystem" on page 4-2.
11. Go to http://www.ibm.com/servers/storage/support/ to check for ESM code updates. For more information, see the download instructions on page 1.

Replacing a midplane assembly

The midplane assembly must be replaced only by a trained service provider.

Before you begin, ensure that you wear an anti-static wrist strap.

To replace the midplane assembly, complete the following steps.

Attention: To prevent data loss, you must shut down the storage subsystem or storage enclosure before you begin the procedure to replace the midplane assembly.

1. Read the safety information that begins on page "Safety" on page xi and "Best practices guidelines" on page 1-7.
2. (DS3512 and DS3524) Turn off the storage subsystem (see "Turning off the storage subsystem" on page 4-13).
3. Remove the drives (see "Removing a hard disk drive" on page 5-15).
4. Remove the power supplies (see "Replacing an ac power supply" on page 5-24).
5. (DS3512 and DS3524) Remove the controllers (see "Removing a controller" on page 5-2).
6. (EXP3512 and EXP3524) Remove the ESMs (see "Replacing an ESM" on page 5-39).
7. (DS3512 AND EXP3512) Replace the midplane assembly.
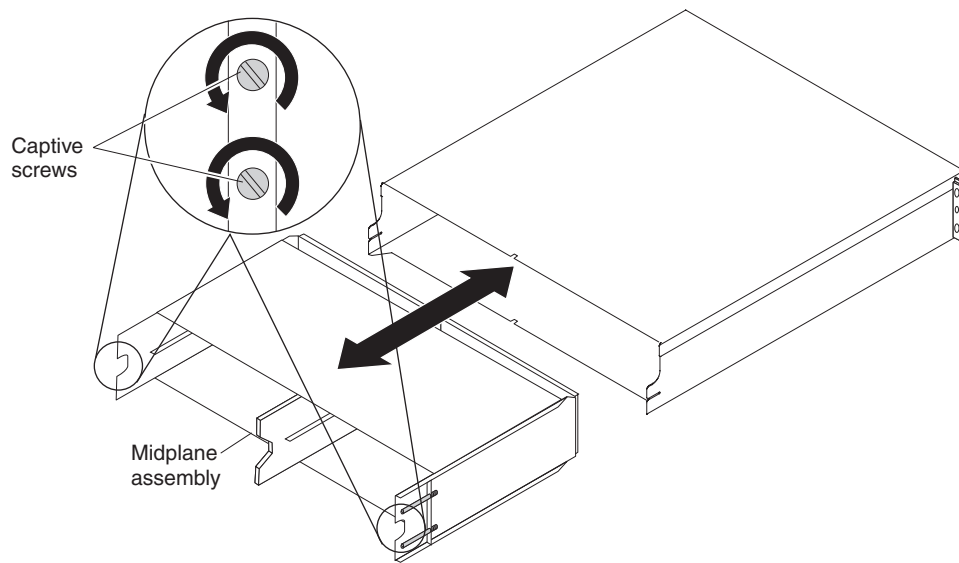
Figure 5-28. Replacing the midplane assembly in a DS3512 or EXP3512

    a. Loosen the four captive screws at the rear of the chassis.

    b. Remove the failed midplane from the chassis and insert the replacement midplane.

    c. Tighten the four captive screws.

 8. (DS3524 AND EXP3524) Replace the midplane assembly.
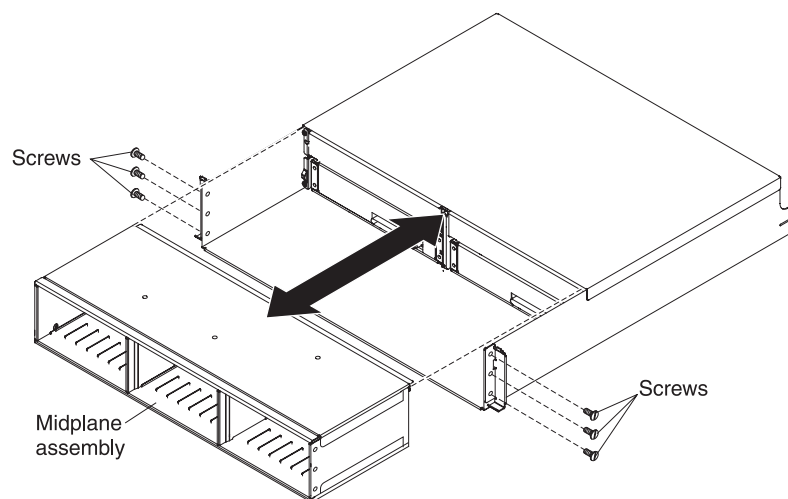
Figure 5-29. Replacing the midplane assembly in a DS3524 or EXP3524

    a. Remove the six screws from the sides of the chassis.

    b. Remove the failed midplane from the chassis and insert the replacement midplane.

    c. Secure with the six screws.

 9. (EXP3512 and EXP3524) Reinstall the ESMs (see "Replacing an ESM" on page 5-39).

10. (DS3512 and DS3524) Reinstall the controllers (see "Installing a controller" on page 5-3).

11. Label the cable connections and disconnect the cables from the enclosure.

12. Reinstall the power supplies (see "Replacing an ac power supply" on page 5-24).

13. Reinstall the drives (see "Installing a hard disk drive" on page 5-16).

14. Reconnect the cables to the controllers or the ESMs.

15. (DS3512 and DS3524) Turn on the storage subsystem (see "Turning on the storage subsystem" on page 4-2).

16. Check the LEDs to make sure that the storage subsystem or storage enclosure is fully operational (see "Checking the LEDs" on page 4-7).

Chapter 6. Solving problems

This section contains information to help you solve some of the problems that you might have with the storage subsystem or storage enclosure. It describes the problem indicators, error messages, and suggested actions.

Solving problems in the DS3500 storage subsystem

For instructions for obtaining service and technical assistance for the storage subsystem and other IBM products, see Appendix B, "Getting help and technical assistance," on page B-1.

Use the LEDs, the diagnostics and test information, the symptom-to-FRU index, and the connected server *Hardware Maintenance Manual* or *Problem Determination and Service Guide* to diagnose problems.

Use Table 6-1 on page 6-2 and the Storage Manager Recovery Guru to diagnose storage subsystem problems and component failures and find solutions to problems that have definite symptoms. Do not depend solely on Table 6-1 on page 6-2 for a replacement decision.

Table 6-1. Troubleshooting

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is lit	Drive (drive fault LED)	Drive failure	Replace the failed drive. See Chapter 5, "Replacing components," on page 5-1 for more information.
		Drive uncertified	Verify the drive and part number to make sure that it is supported by the DS3500. See http://www.ibm.com/systems/storage/disk/.
	storage controller (service action required LED)	controller failure	Replace the controller. See Chapter 5, "Replacing components," on page 5-1 for more information.
		The controller was placed offline by a user or the other controller.	Use the Subsystem Management window to place the controller back online. If the controller continues going to an offline state after being placed online, replace the controller.
	storage controller (battery fault LED)	Battery unit failure	Use the Storage Manager software to confirm the failure; then, replace the failed battery unit.
	storage controller (SAS link service action LED)	SAS cable failure	Replace the SAS cable.
		SAS host bus adapter failure	Check the SAS host bus adapter in the host and replace the adapter if necessary.
		SAS port failure	Replace the controller. See Chapter 5, "Replacing components," on page 5-1 for more information.
	Front bezel (system error LED)	General machine fault	A fault LED is lit somewhere on the storage subsystem (check for amber LEDs on components).
		General machine fault (continued)	Open the Subsystem Management window and click **Recovery Guru** to see problems in the DS3500 configuration. Some errors cause the system error LED to be lit but not cause any individual component fault LEDs to be lit. (Drive PFA exceeded or nominal temperature exceeded errors are examples.) Follow the corrective actions in the Recovery Guru window.

Table 6-1. Troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is lit (continued)	storage controller fault LED (service action LED may also be lit)	Unsupported controller	Controller configurations do not match. Check that host daughter card and cache memory are the same in both controllers.
	Front panel	Fibre Channel connection	Check that the CRUs are properly installed. If no amber LEDs are lit, suspect failure of the SFP module. Verify the failure using the Storage Manager Client.
			If all Fibre Channel connections failed, suspect failure of the Fibre Channel host daughter card.
		SAS connection	Check the SAS connection to verify that the CRUs are properly installed.
			If the SAS port LED is off, suspect failure of the SAS host daughter card.
		iSCSI connection	Check the iSCSI connection to verify that the CRUs are properly installed.
			If the iSCSI port LED is off, check the Ethernet cable or verify the link speed.
			If all the iSCSI port LEDs are off, suspect failure of the iSCSI host daughter card.
	Battery fault	Battery unit failure	Verify the failure using the Storage Manager Client and replace the failed battery.
Amber LED is lit and green LED is off	Power supply (Amber fault LED is lit and both power LEDs are not lit)	The power switch is turned off or there is an ac or dc power source failure.	Replace the failed power supply or turn on all power-supply switches. If this is a dc power supply, check the disconnect device to make sure that it is working and is in the on position.
Amber and green LEDs are lit	Power supply (Amber fault LED is lit and both power LEDs are not lit, AC power or DC IN LED is lit and DC power or DC out LED is not lit)	Power supply failure	Replace the failed power supply. See Chapter 5, "Replacing components," on page 5-1 for more information.
All amber and green LEDs are slowly flashing	All drives (activity and fault LEDs are not lit)	Check for and solve one of the following situations: • storage enclosures are not correctly connected to the DS3500. • DS3500 does not have the correct firmware version.	

Table 6-1. Troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
All green LEDs are off	All components	Subsystem power is off	Make sure that all storage subsystem power cables are connected and that the power-supply switches are on. If applicable, make sure that the main circuit breakers for the rack are turned on.
		Power failure	Check the main circuit breaker and ac receptacle (ac models). Check the -48 V dc power source and disconnect device (dc models).
		Power-supply failure	Replace the power supply.
		Operating environment is too hot	Cool down the environment.
Amber LED is flashing	Drives (fault LED is lit)	Drive identification is in process	No corrective action is needed.
One or more green LEDs are off	Power supplies	Power cable is disconnected or switches are turned off	Make sure that the power cables are connected (ac or dc) and that the disconnect device (dc only) and the power-supply switches are turned on.
	All drives	Midplane failure	Replace the DS3500. Contact your IBM technical-support representative.
	Several components	Hardware failure	Replace the affected components. If this does not correct the problem, replace the controllers. Contact your IBM technical-support representative.
		The DS3500 was not powered-on, or all SAS cable connections between the storage enclosures and the DS3500 storage subsystem failed.	Perform one of the following actions: • Power-on the storage subsystem. • Make sure that the SAS cable connections between the storage enclosures and the DS3500 storage subsystem are made.
	Front panel	Power supply problem	Make sure that the power cables are connected and that the power supplies are turned on.
		Hardware failure	If any other LEDs are lit, replace the midplane. Contact your IBM technical-support representative.
Green LED is flashing slowly (once every 2 seconds)	Drives	The DS3500 was not powered-on, or all SAS connections between the storage enclosures and the DS3500 storage subsystem have failed.	Perform one of the following actions: • Power-on the storage subsystem. • Make sure that the SAS connections between the storage enclosures and the DS3500 storage subsystem are made. • Make sure that all the storage enclosures in the same channel pair have the same enclosure speed setting.

Table 6-1. Troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
Intermittent or sporadic power loss to the storage subsystem	Some or all components	Defective power source or incorrectly connected power cable	Check the ac or dc power source. Reseat all installed power cables and power supplies. If applicable, check the power components (power supplies or uninterruptible power supply). Replace defective power cables.
		Power supply failure	Check the fault LED on the power supply. If the LED is lit, replace the failed component.
		Faulty disconnect device	Check and install a new 20 A rated disconnect device.
		Midplane failure	Replace the DS3500. Contact your IBM technical-support representative.
Unable to access drives	Drives	Incorrect storage subsystem ID settings	Make sure that the SAS cables are undamaged and correctly connected. Check the storage subsystem ID settings.
		controller failure	Replace one or both controllers. Contact an IBM technical-support representative.
		Drive failure	Replace the failed drive or drives.
Random errors	Subsystem	Midplane failure	Replace the DS3500. Contact your IBM technical-support representative.
drive is not visible in the Storage Manager software	Several components	Drive failure	Replace the failed drive or drives.
		SAS cable failed	Replace the SAS cable.
		controller failure	Replace controller. See Chapter 5, "Replacing components," on page 5-1 for more information.
		Midplane failure	Replace the DS3500. Contact your IBM technical-support representative.
		A drive has an interface problem with the ESM or controller.	Replace the drive. See Chapter 5, "Replacing components," on page 5-1 for more information.
		Incorrect firmware version	Make sure that the DS3500 has the correct firmware version. See "Software and hardware compatibility and upgrades" on page 1-14.
		In a dual-controller storage subsystem, one controller has failed, and in the drive channel that originates from the other (functioning) controller, an ESM has failed.	Replace the failed controller and ESM. See Chapter 5, "Replacing components," on page 5-1 for more information.
Storage enclosure is not detected	Storage subsystem	storage enclosure is not supported	Verify that the storage enclosure is supported by the DS3500 storage subsystem.
		SAS cable failed	Replace the SAS cable.

Solving problems in the EXP3500 storage enclosure

The following table contains troubleshooting information to help you solve some basic problems that you might have with the EXP3500 storage enclosure.

Table 6-2. Troubleshooting information

Component	Problem indicator	Possible cause	Possible solutions
Drive	Amber fault LED lit	Drive failure	Replace the failed drive. See Chapter 5, "Replacing components," on page 5-1 for more information.
ESM		Board failure	Replace the failed ESM. See Chapter 5, "Replacing components," on page 5-1 for more information.
Front panel		General machine fault	A status or fault LED is lit. Check for amber LEDs on components. See "Checking the LEDs" on page 4-7.
All components	All green LEDs off	The EXP3500 is turned off	Make sure that all power cables are connected and that the power is on. If applicable, make sure that the main circuit breakers for the rack are turned on.
		ac or dc power failure	Check the main circuit breaker and ac outlet (ac models). Check the -48 V dc power source and disconnect device (dc models).
		Power-supply failure	Replace the power supply. See Chapter 5, "Replacing components," on page 5-1 for more information.
		Midplane failure	Contact your IBM technical-support representative.
Drives	Amber fault LED flashing	Drive rebuild or identity in process	No action is required.
Power supply - ac	Amber fault LED lit; green dc power LED off	Power supply failure; power supply turned off	If the power-supply switch is on, turn off the power supply and then turn it on again. If the condition remains, replace the power supply.
Power supply - ac	Amber fault LED lit; green ac power LED off	No ac power to power supply	Check the ac power cord or breaker. • If ac power is good at the source, replace the power cord. • If the power supply has failed, replace the power supply.
Power supply - dc	Amber fault LED lit; green dc power out LED off	Power supply failure; power supply turned off	If the power-supply switch is on, turn off the power supply and then turn it on again. If the condition remains, replace the power supply.
Power supply - dc	Amber fault LED lit; green dc power in LED off	No -48 V dc power to power supply	Check the dc power cable or disconnect device. • If dc power is good at the source, replace the dc power cable or the 20 A disconnect device. • If the dc power cable and the disconnect device are working properly, replace the power supply.
ESM	Link fault amber LED lit	SAS communication failure	1. Reconnect the SAS cable. 2. Replace the SAS cable. 3. If the LED is still lit, replace either the ESM or the controller or device into which the other end of the SAS cable is connected.

Table 6-2. Troubleshooting information (continued)

Component	Problem indicator	Possible cause	Possible solutions
One or more drives	One or more green LEDs off	No activity to the drives	No action is required.
All drives		No activity to the drives	No action is required.
		Damaged or loose SAS cables	Check the SAS cables and connections.
		ESM failure	Use the controller management software to check the drive status. Replace the ESM.
		Midplane failure	Contact your IBM technical-support representative.
Front panel		Power supply	Make sure that the cables are connected and the power supplies are turned on.
		Hardware failure	If any other LEDs are lit, contact your IBM technical-support representative.
Some or all components	Intermittent or sporadic power loss	Defective ac or dc power source or partially connected power cord	1. Check the ac or dc power source. 2. Secure all installed power cables and power supplies. 3. If applicable, check the power components (power supplies, uninterruptible power supply, and so on). 4. Replace defective power cables.
		Power-supply failure	Check for a fault LED on the power supply and replace the failed power supply. See "Checking the LEDs" on page 4-7.
		Midplane failure	Contact your IBM technical-support representative.
Drives	Unable to access any drives	SAS cable	1. Make sure that the SAS cables are undamaged and correctly connected. 2. Replace the cables.
		ESM failure	Contact your IBM technical-support representative.
Subsystem	Random errors	Midplane failure	Contact your IBM technical-support representative.

Seven-segment display sequence codes and their causes

If an error occurs during the controller or ESM boot process and the Needs Attention LED is on, the numeric display shows diagnostic information as a sequence of 2-digit diagnostic code. The following figure shows the seven-segment alphanumeric characters.

Numbers	0	1	2	3	4	5	6	7	8	9
7-Segment Font	⊔			⊇	∃	⊔	⊆	⊑	⊓	⊟	⊎

Letters	A	b	C	d	E	F	H	L	n	O	o	P	r	S	U	u
7-Segment Font	A	b	C	d	E	F	H	L	n	O	o	P	r	S	U	u

Similar Letters and Numbers			
Upper-Case Letter "O"	O	O	Number "0"
Upper-Case Letter "S"	S	S	Number "5"
Lower-Case Letter "b"	b	6	Number "6"

Figure 6-1. Seven-segment alphanumeric characters

The following table lists the sequence category codes and their associated detail codes.

Startup errors and operational states are displayed in sequences. The numeric display not only helps to identify a component failure, but also provides information about the controller state in which the error occurred. The following table lists the different sequences and the corresponding errors.

Table 6-3. Seven-segment display sequence code definitions.

Category	Category Code	Detail Codes
		(Notation is described in Notes at the end of this table)
Startup Error	SE+	• SE+ Power-on default • dF+ Power-on diagnostic fault • Sx Power-on validation error
Operational Error	OE+	Lx+ Lockdown codes (See note 3)
Operational State	OS+	• OL+ Offline (See note 11.) • bb+ Battery backup (operating on batteries) • CF+ Component failure (See note 12)

Table 6-3. Seven-segment display sequence code definitions (continued).

Category	Category Code	Detail Codes
Component Failure	CF+	• dx+ Processor/Cache DIMM (x = location. See note 6.) • Cx+ Cache DIMM (x = location. See note 7.) • Px+ Processor DIMM (x = location. See note 8.) • Hx+ Host card (x = location) • Fx+ Flash drive (x = location) • b1+ Base controller card
Diagnostic Failure	dE+	Lx+ Lockdown code (See note 3)
Category Delimiter	dash+	Separator between category-detail code pairs (See notes 4 and 9)
End-Of-Sequence Delimiter	blank-	End-of-sequence indicator (See notes 5 and 10)

Notes:

1. xy+ Indicates that the diagnostic LED is lit.
2. xy- Indicates that the diagnostic LED is turned off.
3. Lx+ Lockdown codes (See Table 6-5 on page 6-10)
4. dash+ All segments are off except the middle segments and the diagnostic light is on.
5. blank- All segments are off and the diagnostic light is off.
6. dx+ Used when there is a single memory system for processor and data cache.
7. Cx+ Used when there are separate processor and data cache memory systems.
8. Px+ Used when there are separate processor and data cache memory systems.
9. Category-Detail separator is used when there is more than one category-detail pair in the sequence. For examples, see Table 6-4
10. End-of-sequence indicator is automatically inserted by hardware at the end of the sequence. Example: SE+ 88+ blank- (repeat)
11. If an enclosure ID is being displayed, this sequence is programmed to display. The controller is then held in reset.
12. The enclosure ID is nominally displayed during normal operation. This operational state is displayed if an internal controller component failure occurs while the controller is online. An additional detail code identifies the failed component as defined for the Component Failure category. This sequence will continue to display even if the controller is later placed offline (held in reset) to service the failed component.

Table 6-4. Repeating sequences on the seven-segment display and corresponding errors

Repeating Sequence	Startup and Operational Error
Controller power-on failure:	
SE+ 88+ blank-	• Initial phase of normal power-on controller insertion • Insertion of a controller while held in reset
Operational failure:	
xy- (static controller enclosure ID)	Normal operation, where xy is the ID of the enclosure
OS+ Sd+ blank-	During start-of-day (SOD) processing that is processing when the controller reaches a fully powered-up state

Table 6-4. Repeating sequences on the seven-segment display and corresponding errors (continued)

Repeating Sequence	Startup and Operational Error
OS+ OL+ blank-	Controller is placed in reset while displaying the enclosure ID
OS+ bb+ blank-	Controller is operating on batteries (cache backup)
OS+ OH+ blank-	The processor temperature exceeds the warning level
Component failure when the controller is operational:	
OS+ CF+ HX+ blank-	The host interface card failed
OS+ CF+ Fx+ blank-	The flash drive failed
Power-on diagnostic failure:	
SE+ dF+ blank-	Failure of a component that is not a field replaceable unit is detected
SE+ dF+ dash+ CF+ dx+ blank-	Failure of a processor DIMM or a cache memory DIMM is detected
SE+ dF+ dash+ CF+ Hx+ blank	Failure of a host interface card is detected
SE+ LC+ dash+ CF+ Fx+ blank-	An incorrect number of cache backup devices are detected
Controller is suspended and no other errors to report:	
OE+ Lu+ blank-	All lockdown conditions, where Lu is the lockdown code as shown in the table of diagnostic codes
Controller is suspended because of component errors:	
OE+ L2+ dash+ CF+ CX+ blank-	Persistent processor or cache DIMM ECC errors are detected
Controller is suspended as a result of persistent cache backup configuration errors:	
OE+ LC+ blank-	During cache restore, the write-protect switch is set
OE+ LC+ dd+ blank-	The memory size is changed with invalid data in the flash drives
Controller is suspended as a result of diagnostic errors:	
dE+ L2+ dash+ CF+ Cx + blank-	A cache memory diagnostic failure is detected
dE+ L3+ dash+ CF+ b1 + blank-	A base controller diagnostic failure is detected
dE+ L3+ dash+ CF+ b2 + blank-	A base controller IOC diagnostic failure is detected

The following tables list the ESM diagnostic codes.

Table 6-5. Controller numeric display diagnostic codes.

Value	Description
L0	Mismatched controller board ID
L1	Missing interconnect canister
L2	Persistent memory errors
L3	Persistent hardware errors
L4	Persistent data protection errors
L5	ACS failure
L6	Unsupported host card

Table 6-5. Controller numeric display diagnostic codes (continued).

Value	Description
L7	Submodel identifier not set or mismatched
L8	Memory configuration error
L9	Link speed mismatch
LA	Reserved
LB	Host card configuration error
LC	Persistent cache backup configuration error
LD	Mixed cache memory DIMMs
LE	Uncertified cache memory DIMM sizes
LF	Lockdown with limited SYMbol support
LH	Controller firmware mismatch

Table 6-6. ESM numeric display diagnostic codes.

Value	Description
_ _	ESM Boot Diagnostic is running
88	This ESM is being held in Reset by the other ESM
AA	ESM-A application is booting up
bb	ESM-B application is booting up
L0	Mismatched ESM types
L2	Persistent memory errors
L3	Persistent hardware errors
L9	Over Temperature
LL	Cannot read midplane EEPROMs
LP	Missing Drive Port Mapping table
Ln	ESM not valid for enclosure
H2	Invalid/Incomplete Configuration
LF	Lockdown with limited SYMbol support
LH	Controller firmware mismatch
H3	Maximum Reboot Attempts Exceeded
H4	Cannot Communicate with Other ESM
H5	Midplane Harness Failure
H6	Firmware Failure
H9	Non-Catastrophic HW. ESM operational, but in a degraded mode
J0	Incompatible module

Chapter 7. Parts listing, DS3500 storage subsystem and EXP3500 storage enclosure

The replaceable components that are available for the DS3500 storage subsystem and EXP3500 storage enclosure are described in this chapter. To check for an updated parts listing on the Web, complete the following steps:

1. Go to http://www.ibm.com/servers/storage/support/.
2. On the "Support for System Storage and TotalStorage products" page, under **Select your product**, in the **Product family** field, select **Disk systems**.
3. In the **Product** field, select **IBM System Storage DS3500**.
4. Click **Go**.
5. For documentation updates, click the **Install/Use** tab.

Replaceable components

Replaceable components are of three types:

- **Tier 1 customer replaceable unit (CRU):** Replacement of Tier 1 CRUs is your responsibility. If IBM installs a Tier 1 CRU at your request, you will be charged for the installation.
- **Tier 2 customer replaceable unit:** You may install a Tier 2 CRU yourself or request IBM to install it, at no additional charge, under the type of warranty service that is designated for your server.
- **Field replaceable unit (FRU):** FRUs must be installed only by trained service technicians.

For information about the terms of the warranty and getting service and assistance, see the *Warranty Information* document that comes with the storage subsystem and storage enclosure.

DS3512 storage subsystem and EXP3512 storage enclosure parts listing

Figure 7-1 on page 7-2 and the following table provide a parts listing for the DS3512 storage subsystem and EXP3512 storage enclosure.
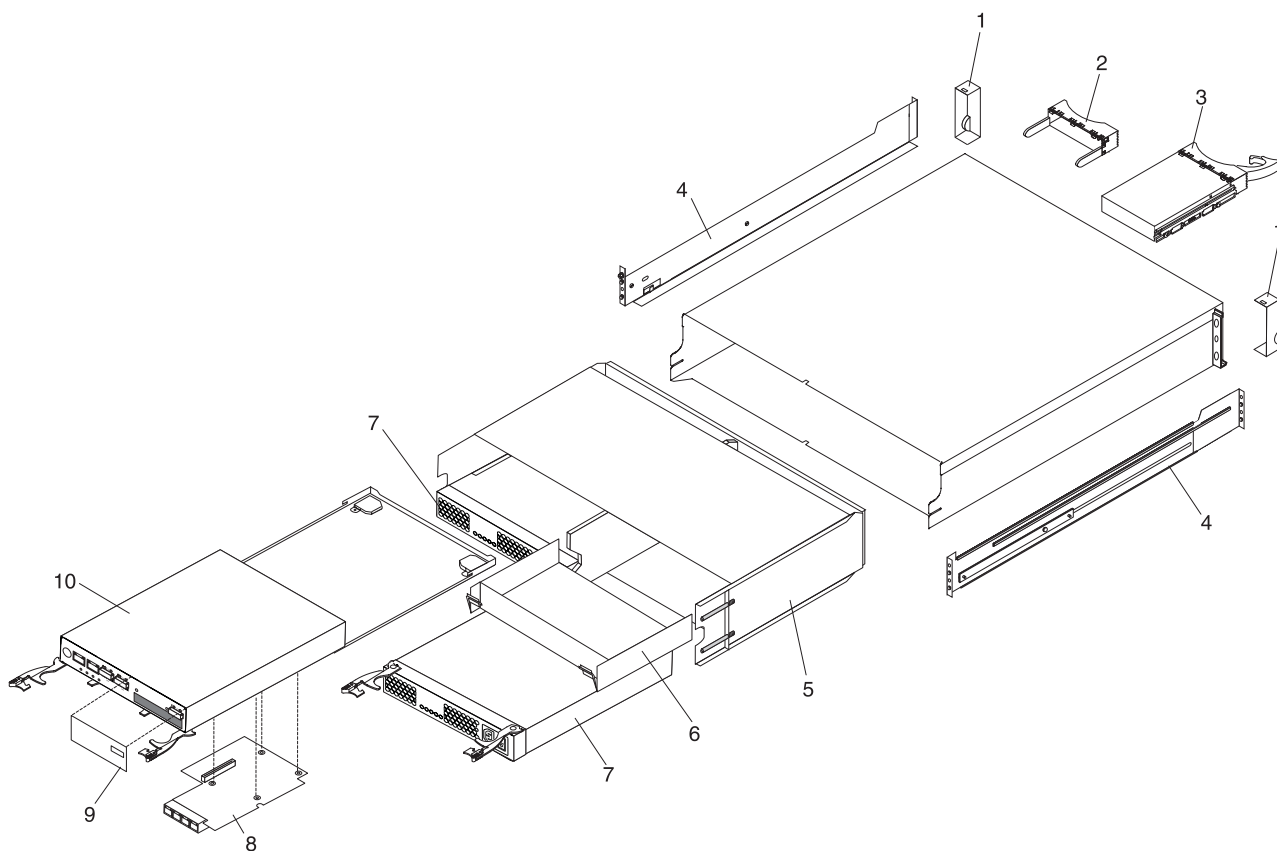
Figure 7-1. DS3512 storage subsystem and EXP3512 storage enclosure storage subsystem parts

Table 7-1. Parts listing for DS3500

Index	Description	CRU part number (Tier 1)	CRU part number (Tier 2)	FRU part number
1	DS3512 and EXP3512 bezel kit	69Y0203		
2	Filler panel, 3.5–inch drive	42D3315		
3	Hard disk drive, 2.5-inch 300 GB 10,000 rpm SFF SED PI formatted drive	00W1168		
3	Hard disk drive, 2.5-inch 300 GB 10,000 rpm SFF SAS PI formatted drive	90Y8999		
3	Hard disk drive, 3.5-inch 300 GB 15,000 rpm LFF SAS	49Y1860		
3	Hard disk drive, 3.5-inch 450 GB 15,000 rpm LFF SAS	49Y1865		
3	Hard disk drive, 2.5-inch 500 GB 7,500 rpm SFF SAS PI formatted drive	00W1173		
3	Hard disk drive, 2.5-inch 600 GB 10,000 rpm SFF SAS PI formatted drive	90Y9001		
3	Hard disk drive, 3.5-inch 600 GB 15,000 rpm LFF SAS	49Y1870		
3	Hard disk drive, 3.5-inch 600 GB 15,000 rpm LFF SAS SED	49Y1983		

Table 7-1. Parts listing for DS3500 (continued)

Index	Description	CRU part number (Tier 1)	CRU part number (Tier 2)	FRU part number
3	Hard disk drive, 2.5-inch 900 GB 10,000 rpm SFF SAS PI formatted drive	00W1240		
3	Hard disk drive, 3.5-inch 1 TB 7,200 rpm LFF SAS NL	49Y1880		
3	Hard disk drive, 3.5-inch 2 TB 7,200 rpm LFF SAS NL	49Y1875		
3	Hard disk drive, 3.5-inch 2 TB 7,200 rpm LFF SAS NL PI formatted drive	90Y9000		
3	Hard disk drive, 3.5-inch 3 TB 7,200 rpm LFF SAS NL	81Y9878		
4	2U rail kit	39R6550		
5	DS3512 and EXP3512 midplane			69Y0249
6	Controller or environmental service module filler panel	69Y0194		
7	DS3500 Power Supply Unit	00W1182		
7	Power supply, ac	69Y0201		
8	6 GB SAS 2–port host port adapter	69Y2840		
8	8 GB FC 4–port host port adapter	69Y2841		
8	1 GB iSCSI 4–port host port adapter	69Y2842		
8	10 GB iSCSI host 2–port adapter	81Y9943		
9	Filler panel, host port adapter	69Y2897		
10	Controller with 1 GB DIMM, no host port expansion adapter, no flash memory	68Y8481		
	DIMM, 2 GB cache memory	69Y2843		
	Backup battery module	69Y2926		
	IBM 1-meter mini-SAS cable	39R6530		
	IBM 3-meter mini-SAS cable	39R6532		
	Service cable			13N1932
	Power cord, rack jumper, 2.8-meter	39M5377		
	Miscellaneous rack mounting hardware kit	39R6551		
	Environmental service module	69Y0189		
	8 GB shortwave SFP transceiver	49Y4123		

DS3524 storage subsystem and EXP3524 storage enclosure parts listing

Figure 7-2 on page 7-4 and the following table provide a parts listing for the DS3524 storage subsystem and EXP3524 storage enclosure.
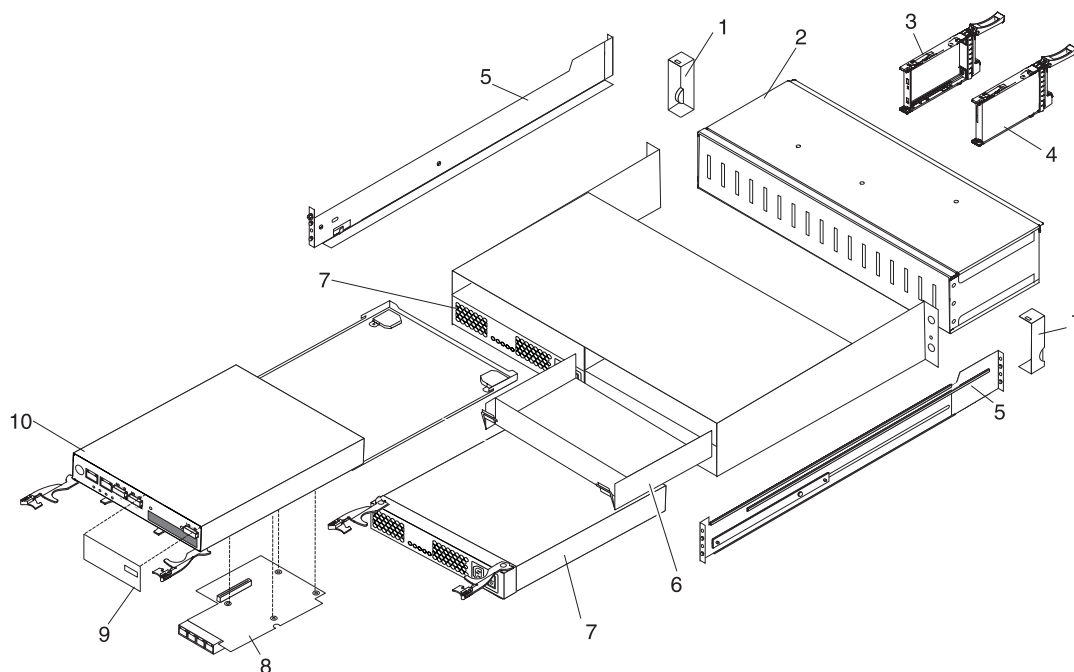
Figure 7-2. DS3524 storage subsystem and EXP3524 storage enclosure parts

Table 7-2. Parts listing for DS3500

Index	Description	CRU part number (Tier 1)	CRU part number (Tier 2)	FRU part number
1	DS3524 and EXP3524 bezel kit	69Y0213		
2	DS3524 and EXP3524 midplane assembly			69Y0259
3	Filler panel, 2.5–inch drive	68Y8493		
4	Hard disk drive, 2.5-inch 146 GB 15,000 rpm SAS	49Y1845		
4	Hard disk drive, 2.5-inch 200 GB SAS SSD	49Y2062		
4	Hard disk drive, 2.5-inch 300 GB 10,000 rpm SAS	49Y1840		
4	Hard disk drive, 2.5-inch 300 GB 10,000 rpm SAS SED	49Y1988		
4	Hard disk drive, 2.5-inch 400 GB SAS SSD	49Y2067		
4	Hard disk drive, 3.5-inch 300 GB 15,000 rpm SAS DDM	81Y9913		
4	Hard disk drive, 2.5-inch 500 GB 7,200 rpm SAS NL	49Y1855		
4	Hard disk drive, 2.5-inch 1000 GB 7,200 rpm SAS NL	81Y9875		
4	Hard disk drive, 2.5-inch 600 GB 10,000 rpm SAS	49Y2052		
4	Hard disk drive, 2.5-inch 900 GB 10,000 rpm SAS	81Y9893		
5	2U rail kit	39R6550		
6	Controller or environmental service module filler panel	69Y0194		
7	Power supply, ac (models C4A and E4A)	69Y0201		
7	Power supply, dc (models C4T and E4T)	90Y8512		
8	6 GB SAS 2–port host port adapter	69Y2840		
8	8 GB FC 4–port host port adapter	69Y2841		
8	1 GB iSCSI 4–port host port adapter	69Y2842		

Table 7-2. Parts listing for DS3500 (continued)

Index	Description	CRU part number (Tier 1)	CRU part number (Tier 2)	FRU part number
8	10 GB iSCSI host 2–port adapter	81Y9943		
9	Filler panel, host port adapter	69Y2897		
10	Controller with 1 GB DIMM, no host port expansion adapter, no flash memory	68Y8481		
	DIMM, 2 GB cache memory	69Y2843		
	Backup battery module	69Y2926		
	IBM 1-meter mini-SAS cable	39R6530		
	IBM 3-meter mini-SAS cable	39R6532		
	Service cable			13N1932
	Power cord, rack jumper, 2.8-meter (models C4A and E4A)	39M5377		
	Power cable, dc, 4.0-meter (models C4T and E4T)	81Y9590		
	Miscellaneous rack mounting hardware kit	39R6551		
	Environmental service module	69Y0189		
	8 GB shortwave SFP transceiver	49Y4123		

Power cords

For your safety, IBM provides a power cord with a grounded attachment plug to use with this IBM product. To avoid electrical shock, always use the power cord and plug with a properly grounded receptacle.

IBM power cords used in the United States and Canada are listed by Underwriter's Laboratories (UL) and certified by the Canadian Standards Association (CSA).

For units intended to be operated at 115 volts: Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a parallel blade, grounding-type attachment plug rated 15 amperes, 125 volts.

For units intended to be operated at 230 volts (U.S. use): Use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, Type SVT or SJT, three-conductor cord, a maximum of 15 feet in length and a tandem blade, grounding-type attachment plug rated 15 amperes, 250 volts.

For units intended to be operated at 230 volts (outside the U.S.): Use a cord set with a grounding-type attachment plug. The cord set should have the appropriate safety approvals for the country in which the equipment will be installed.

IBM power cords for a specific country or region are usually available only in that country or region.

Table 7-3. IBM power cords

IBM power cord part number	Used in these countries and regions
39M5206	China
39M5102	Australia, Fiji, Kiribati, Nauru, New Zealand, Papua New Guinea

Table 7-3. IBM power cords (continued)

IBM power cord part number	Used in these countries and regions
39M5123	Afghanistan, Albania, Algeria, Andorra, Angola, Armenia, Austria, Azerbaijan, Belarus, Belgium, Benin, Bosnia and Herzegovina, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Democratic Republic of), Congo (Republic of), Cote D'Ivoire (Ivory Coast), Croatia (Republic of), Czech Republic, Dahomey, Djibouti, Egypt, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Finland, France, French Guyana, French Polynesia, Germany, Greece, Guadeloupe, Guinea, Guinea Bissau, Hungary, Iceland, Indonesia, Iran, Kazakhstan, Kyrgyzstan, Laos (People's Democratic Republic of), Latvia, Lebanon, Lithuania, Luxembourg, Macedonia (former Yugoslav Republic of), Madagascar, Mali, Martinique, Mauritania, Mauritius, Mayotte, Moldova (Republic of), Monaco, Mongolia, Morocco, Mozambique, Netherlands, New Caledonia, Niger, Norway, Poland, Portugal, Reunion, Romania, Russian Federation, Rwanda, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Slovakia, Slovenia (Republic of), Somalia, Spain, Suriname, Sweden, Syrian Arab Republic, Tajikistan, Tahiti, Togo, Tunisia, Turkey, Turkmenistan, Ukraine, Upper Volta, Uzbekistan, Vanuatu, Vietnam, Wallis and Futuna, Yugoslavia (Federal Republic of), Zaire
39M5130	Denmark
39M5144	Bangladesh, Lesotho, Macao, Maldives, Namibia, Nepal, Pakistan, Samoa, South Africa, Sri Lanka, Swaziland, Uganda
39M5151	Abu Dhabi, Bahrain, Botswana, Brunei Darussalam, Channel Islands, China (Hong Kong S.A.R.), Cyprus, Dominica, Gambia, Ghana, Grenada, Iraq, Ireland, Jordan, Kenya, Kuwait, Liberia, Malawi, Malaysia, Malta, Myanmar (Burma), Nigeria, Oman, Polynesia, Qatar, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Sierra Leone, Singapore, Sudan, Tanzania (United Republic of), Trinidad and Tobago, United Arab Emirates (Dubai), United Kingdom, Yemen, Zambia, Zimbabwe
39M5158	Liechtenstein, Switzerland
39M5165	Chile, Italy, Libyan Arab Jamahiriya
39M5172	Israel
39M5095	220 - 240 V Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Caicos Islands, Canada, Cayman Islands, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Japan, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Taiwan, United States of America, Venezuela
39M5081	110 - 120 V Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Caicos Islands, Canada, Cayman Islands, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Thailand, Taiwan, United States of America, Venezuela
39M5219	Korea (Democratic People's Republic of), Korea (Republic of)
39M5199	Japan
39M5068	Argentina, Paraguay, Uruguay
39M5226	India
39M5233	Brazil

Determining basic information of drive FRUs

IBM might ship drive FRUs of higher capacity than that of the drive FRUs they replace. These new drives are programmed in manufacturing to give the same capacity as the drive FRUs being replaced.

The new drive FRUs have different model IDs than the ones printed on the drive manufacturer label. You can determine the model ID and other information of these drives by referring to one of the following windows of the DS Storage Manager software:

- Properties pane in the Hardware tab of the Subsystem Management window
- Storage Subsystem Profile window

You can also use the IBM hologram label to determine the drive capacity and the drive FRU part number. A sample IBM hologram label is shown in the following figure.

Figure 7-3. An IBM hologram label example

Appendix A. Records

Whenever you add optional devices to the DS3500 storage subsystem or EXP3500 storage enclosure, be sure to update the information in this appendix. Accurate, up-to-date records make it easier to add other devices and provide needed data whenever you contact your IBM technical-support representative.

Identification numbers

Record and retain the following information.

Table A-1. Product identification record

Product name	IBM System Storage DS3500 or EXP3500
Machine type	1746
Model number	
Serial number	

The serial number is on the label in the vertical recess on the left bezel. The serial number is also on the left chassis flange and on the rear of the chassis. A label that includes the machine type, model, and serial number is on the top front right chassis corner.

Serial number label

Product name

Machine type, model, and serial number label
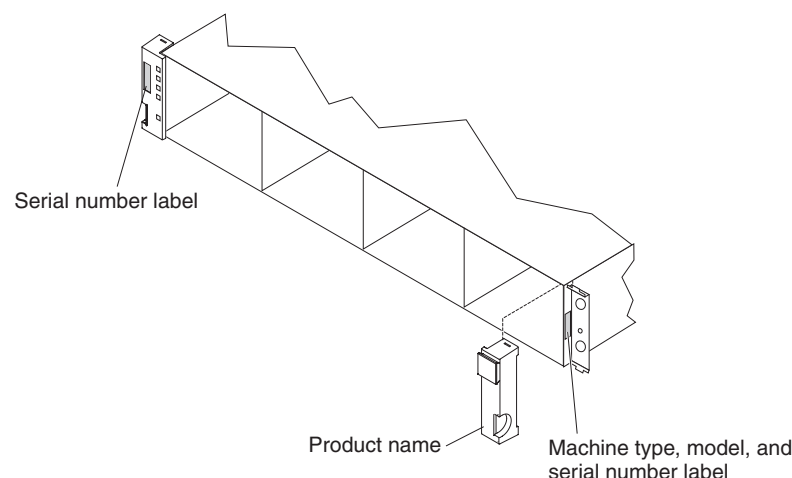
Figure A-1. Serial number location on the DS3500

Hard disk drive locations

Use Table A-2 to keep a record of the drives that are installed in or attached to the DS3500 or EXP3500. This information can be helpful when you install additional drives or if you have to report a hardware problem. Make a copy of this table before you record information in it, in case you need extra space to write new values later, or when you update the configuration.

Table A-2. Drive location information record

Drive location	Drive part and model number	Drive serial number
Bay 1		
Bay 2		
Bay 3		

Table A-2. Drive location information record (continued)

Drive location	Drive part and model number	Drive serial number
Bay 4		
Bay 5		
Bay 6		
Bay 7		
Bay 8		
Bay 9		
Bay 10		
Bay 11		
Bay 12		
Bay 13		
Bay 14		
Bay 15		
Bay 16		
Bay 17		
Bay 18		
Bay 19		
Bay 20		
Bay 21		
Bay 22		
Bay 23		
Bay 24		

Storage subsystem and controller information record

Table A-3 provides a data sheet for recording storage subsystem names, management types, Ethernet hardware addresses, and IP addresses. Make a copy of this table and complete the information for your storage subsystems and controllers. Use the information to set up the BOOTP table for the network server and the host or Domain Name System (DNS) table. The information is also helpful if you add storage subsystems after initial installation. See the Storage Manager documentation for detailed instructions for obtaining the information. For a sample information record, see Table A-4 on page A-3.

Table A-3. Storage subsystem and controller information record

Storage subsystem name	Management method	Controller Ethernet and IP addresses, and host name		Host IP address and host name
		Controller A	Controller B	

Table A-3. Storage subsystem and controller information record (continued)

Storage subsystem name	Management method	Controller Ethernet and IP addresses, and host name		Host IP address and host name
		Controller A	Controller B	

Table A-4 shows a sample information record. This network contains storage subsystems that are managed by using both the direct-management and host-agent-management method.

Table A-4. Sample information record

Storage subsystem name	Management method	Controller Ethernet and IP addresses, and host name		Host IP address and host name
		Controller A	Controller B	
Finance	Direct	Hardware Ethernet address = 00a0b8020420	Hardware Ethernet address = 00a0b80000d8	
		IP address = 192.168.128.101	IP address = 192.168.128.102	
		Host = Denver_a	Host = Denver_b	
Engineering	Host-agent			IP address = 192.168.2.22
				Host = Atlanta

Appendix B. Getting help and technical assistance

If you need help, service, or technical assistance or just want more information about IBM products, you will find a wide variety of sources available from IBM to assist you.

Use this information to obtain additional information about IBM and IBM products, determine what to do if you experience a problem with your IBM system or optional device, and determine whom to call for service, if it is necessary.

Before you call

Before you call, make sure that you have taken these steps to try to solve the problem yourself.

If you believe that you require IBM to perform warranty service on your IBM product, the IBM service technicians will be able to assist you more efficiently if you prepare before you call.

- Check for updated firmware and operating-system device drivers for your IBM product. The IBM Warranty terms and conditions state that you, the owner of the IBM product, are responsible for maintaining and updating all software and firmware for the product (unless it is covered by an additional maintenance contract). Your IBM service technician will request that you upgrade your software and firmware if the problem has a documented solution within a software upgrade.

  You can obtain the latest downloads for your IBM product from http://www.ibm.com/support/fixcentral/systemx/groupView?query.productGroup=ibm%2FSystemx ..

- If you have installed new hardware or software in your environment, check http://www.ibm.com/systems/info/x86servers/serverproven/compat/us/ to make sure that the hardware and software is supported by your IBM product.

- Use the troubleshooting information in your system documentation, and use the diagnostic tools that come with your IBM product. Information about diagnostic tools is in the *Problem Determination and Service Guide* on the IBM *Documentation* CD that comes with your product.

- Go to http://www.ibm.com/systems/support/ to check for information to help you solve the problem.

- Gather the following information to provide to IBM service. This data will help IBM service quickly provide a solution to your problem and ensure that you receive the level of service for which you might have contracted.

  – Hardware and Software Maintenance agreement contract numbers, if applicable
  – Machine type number (IBM 4-digit machine identifier)
  – Model number
  – Serial number
  – Current system UEFI (or BIOS) and firmware levels
  – Other pertinent information such as error messages and logs

- Go to http://www.ibm.com/support/electronic/ to submit an Electronic Service Request. Submitting an Electronic Service Request will start the process of determining a solution to your problem by making the pertinent information available to IBM service quickly and efficiently. IBM service technicians can start working on your solution as soon as you have completed and submitted an Electronic Service Request.

Using the documentation

Information about your IBM system and preinstalled software, if any, or optional device is available in the documentation that comes with the product. That documentation can include printed documents, online documents, readme files, and help files.

See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to http://www.ibm.com/systems/support/ .

You can find the most up-to-date information for System x® products at http://www.ibm.com/systems/x/ .

Getting help and information from the World Wide Web

On the World Wide Web, up-to-date information about IBM systems, optional devices, services, and support is available at http://www.ibm.com/systems/support/ .

You can find the most up-to-date product information for System x products at http://www.ibm.com/systems/x/ .

Software service and support

Through IBM Support Line, you can get telephone assistance, for a fee, with usage, configuration, and software problems with your IBM products.

For more information about Support Line and other IBM services, see http://www.ibm.com/services/us/index.wss or see http://www.ibm.com/planetwide/ for support telephone numbers. In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

Hardware service and support

You can receive hardware service through your IBM reseller or IBM Services.

To locate a reseller authorized by IBM to provide warranty service, go to http://www.ibm.com/partnerworld/ and click **Find Business Partners** on the right side of the page. For IBM support telephone numbers, see http://www.ibm.com/planetwide/ . In the U.S. and Canada, call 1-800-IBM-SERV (1-800-426-7378).

In the U.S. and Canada, hardware service and support is available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9 a.m. to 6 p.m.

Taiwan contact information

This topic contains the product service contact information for Taiwan.

```
IBM Taiwan Product Service Contact Information:
IBM Taiwan Corporation
3F, No 7, Song Ren Rd., Taipei Taiwan
Tel: 0800-016-888
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Processor speed indicates the internal clock speed of the microprocessor; other factors also affect application performance.

This product is not intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunications networks, nor is it intended to be used in a public services network.

CD or DVD drive speed is the variable read rate. Actual speeds vary and are often less than the possible maximum.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for 1024 bytes, MB stands for 1,048,576 bytes, and GB stands for 1,073,741,824 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1,000,000 bytes, and GB stands for 1,000,000,000 bytes. Total user-accessible capacity can vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard disk drive bays with the largest currently supported drives that are available from IBM.

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Attention: Airborne particulates (including metal flakes or particles) and reactive gases acting alone or in combination with other environmental factors such as humidity or temperature might pose a risk to the device that is described in this document.

Risks that are posed by the presence of excessive particulate levels or concentrations of harmful gases include damage that might cause the device to malfunction or cease functioning altogether. This specification sets forth limits for particulates and gases that are intended to avoid such damage. The limits must not be viewed or used as definitive limits, because numerous other factors, such as temperature or moisture content of the air, can influence the impact of particulates or environmental corrosives and gaseous contaminant transfer. In the absence of specific limits that are set forth in this document, you must implement practices that maintain particulate and gas levels that are consistent with the protection of human health and safety. If IBM determines that the levels of particulates or gases in your environment have caused damage to the device, IBM may condition provision of repair or replacement of devices or parts on implementation of appropriate remedial measures to mitigate such environmental contamination. Implementation of such remedial measures is a customer responsibility.

Table C-1. Limits for particulates and gases

Contaminant	Limits
Particulate	• The room air must be continuously filtered with 40% atmospheric dust spot efficiency (MERV 9) according to ASHRAE Standard 52.21. • Air that enters a data center must be filtered to 99.97% efficiency or greater, using high-efficiency particulate air (HEPA) filters that meet MIL-STD-282. • The deliquescent relative humidity of the particulate contamination must be more than 60%2. • The room must be free of conductive contamination such as zinc whiskers.
Gaseous	• Copper: Class G1 as per ANSI/ISA 71.04-19853 • Silver: Corrosion rate of less than 300 Å in 30 days
1 ASHRAE 52.2-2008 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 2 The deliquescent relative humidity of particulate contamination is the relative humidity at which the dust absorbs enough water to become wet and promote ionic conduction. 3 ANSI/ISA-71.04-1985. Environmental conditions for process measurement and control systems: Airborne contaminants. Instrument Society of America, Research Triangle Park, North Carolina, U.S.A.	

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Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors, or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device might not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

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This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conform à la norme NMB-003 du Canada.

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International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
914-499-1900

European community contact:

IBM Deutschland GmbH
Technical Regulations, Department M372
IBM-Allee 1, 71139 Ehningen, Germany
 Tele: +49 7032 15 2941
e-mail: lugi@de.ibm.com

Germany Electromagnetic compatibility directive

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Russia Electromagnetic Interference (EMI) Class A Statement

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People's Republic of China Class A Electronic Emission statement

中华人民共和国 "A类" 警告声明

声 明
此为A级产品，在生活环境中，该产品可能会造成无线电干扰。在这种情况下，
可能需要用户对其干扰采取切实可行的措施。

Taiwan Class A compliance statement

警告使用者:
這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

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