

IBM TotalStorage DS4300
Fibre Channel Storage Subsystem



Installation, User's, and Maintenance Guide

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Fibre Channel Storage Subsystem



Installation, User's, and Maintenance Guide

Note: Before using this information and the product it supports, be sure to read the safety information in “Safety” on page iii and general information in “Notices” on page 159.

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Safety

Before installing this product, read the Safety information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الأمنية

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 přečtěte 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 pečítajte 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.

The following Caution notices are printed in English throughout this document. For translations of these notices, refer to *IBM Safety Information*.

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.

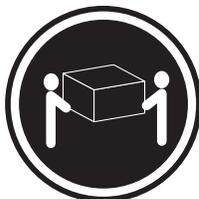
Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

Class 1 laser statement

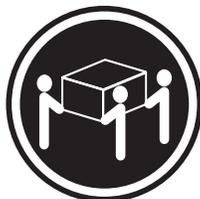
Class 1 Laser Product
Laser Klasse 1
Laser Klass 1
Luokan 1 Laserlaite
Appareil À Laser de Classe 1

IEC 825-1:1993 CENELEC EN 60 825

Statement 4



≥18 kg (37 lbs)



≥32 kg (70.5 lbs)



≥55 kg (121.2 lbs)

CAUTION:

Use safe practices when lifting.

Statement 5



CAUTION:

The power control button on the device and 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.

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About this document

This guide provides instructions on how to install and configure the IBM® TotalStorage® DS4300 Fibre Channel Storage Subsystem.

FAST product renaming

IBM has renamed some FAST family products. Table 1 identifies each DS4000 product name with its corresponding previous FAST product name. Note that this change of **product name only** indicates no change in functionality or warranty. All products listed below with new names are functionally-equivalent and fully-interoperable. Each DS4000 product retains full IBM service as outlined in service contracts issued for analogous FAST products.

Table 1. Mapping of FAST names to DS4000 Series names

Previous FAST Product Name	Current DS4000 Product Name
IBM TotalStorage FAST Storage Server	IBM TotalStorage DS4000
FAST	DS4000
FAST Family	DS4000 Mid-range Disk System
FAST Storage Manager vX.Y (for example v9.10)	DS4000 Storage Manager vX.Y (for example v9.10)
FAST100	DS4100
FAST600	DS4300
FAST600 with Turbo Feature	DS4300 Turbo
FAST700	DS4400
FAST900	DS4500
EXP700	DS4000 EXP700
EXP710	DS4000 EXP710
EXP100	DS4000 EXP100
FAST FlashCopy	FlashCopy for DS4000
FAST VolumeCopy	VolumeCopy for DS4000
FAST Remote Mirror (RM)	Enhanced Remote Mirroring for DS4000
FAST Synchronous Mirroring	Metro Mirroring for DS4000
	Global Copy for DS4000 (New Feature = Asynchronous Mirroring without Consistency Group)
	Global Mirroring for DS4000 (New Feature = Asynchronous Mirroring with Consistency Group)

Who should read this document

This document is intended for system operators and service technicians who have extensive knowledge of Fibre Channel and network technology.

How this document is organized

Chapter 1, “Introduction,” on page 1 describes the storage subsystem. This chapter includes an overview of the storage subsystem features and components.

Chapter 2, “Installing and configuring the storage subsystem,” on page 21 contains information about installing the storage subsystem configuration and gives Fibre Channel loop configuration examples.

Chapter 3, “Cabling the storage subsystem,” on page 29 contains information about cabling the storage subsystem to other devices.

Chapter 4, “Operating the storage subsystem,” on page 89 describes the tasks that are required to operate the storage subsystem, including the proper sequences for powering the storage subsystem on and off.

Chapter 5, “Installing and replacing components,” on page 105 contains step-by-step instructions for installing and removing the storage subsystem components.

Chapter 6, “Solving problems,” on page 145 contains storage subsystem problem symptoms and possible solutions.

Appendix A, “Records,” on page 155 provides a form on which you can record and update important information about the storage subsystem, including serial number and device records. When you add components to the storage subsystem, be sure to update the information in this appendix.

Appendix B, “Accessibility,” on page 157 provides information about DS4000 Storage Manager accessibility features, which help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

DS4000 Storage Subsystem installation tasks - General overview

Table 2 on page xix provides a sequential list of many installation and configuration tasks that are common to most DS4000 configurations. When you install and configure your DS4000 storage subsystem, refer to this table to find the documentation that explains how to complete each task.

See also: The *DS4000 Storage Server and Storage Expansion Enclosure Quick Start Guide* provides an excellent overview of the installation process.

Table 2. Where to find DS4000 installation and configuration procedures

	Installation task	Where to find information or procedures
1	Plan the installation	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Concepts Guide</i> • <i>DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Fibre Channel Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Subsystem Installation and Support Guide</i> • <i>DS4500 Fibre Channel Storage Subsystem Installation and Support Guide</i> • <i>DS4700 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>
2	Mount the DS4000 storage subsystem in the rack	<ul style="list-style-type: none"> • <i>DS4800 Installation, User's, and Maintenance Guide</i> • <i>DS4700 Installation, User's, and Maintenance Guide</i> • <i>DS4400 and DS4500 Rack Mounting Instructions</i> • <i>DS4300 Rack Mounting Instructions</i> • <i>DS4200 Express Installation, User's, and Maintenance Guide</i> • <i>DS4100 Installation, User's and Maintenance Guide</i>
3	Mount the DS4000 EXP storage expansion unit in the rack	<ul style="list-style-type: none"> • <i>DS4000 EXP100 Storage Expansion Unit Installation, User's and Maintenance Guide</i> • <i>DS4000 EXP420 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i> • <i>DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i> • <i>DS4000 EXP810 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i> • <i>FASiT EXP500 Installation and User's Guide</i>
4	Route the storage expansion unit Fibre Channel cables	<ul style="list-style-type: none"> • <i>DS4100 Fibre Channel Cabling Instructions</i> • <i>DS4200 Express Installation, User's, and Maintenance Guide</i> • <i>DS4300 Fibre Channel Cabling Instructions</i> • <i>DS4400 Fibre Channel Cabling Instructions</i> • <i>DS4500 Fibre Channel Cabling Instructions</i> • <i>DS4700 Installation, User's, and Maintenance Guide</i> • <i>DS4800 Installation, User's, and Maintenance Guide</i>

Table 2. Where to find DS4000 installation and configuration procedures (continued)

	Installation task	Where to find information or procedures
5	Route the host server Fibre Channel cables	<ul style="list-style-type: none"> • <i>DS4100 Fibre Channel Cabling Instructions</i> • <i>DS4200 Express Installation, User's, and Maintenance Guide</i> • <i>DS4300 Fibre Channel Cabling Instructions</i> • <i>DS4400 Fibre Channel Cabling Instructions</i> • <i>DS4500 Fibre Channel Cabling Instructions</i> • <i>DS4700 Installation, User's, and Maintenance Guide</i> • <i>DS4800 Installation, User's, and Maintenance Guide</i>
6	Power up the subsystem	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Fibre Channel Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Subsystem Installation and Support Guide</i> • <i>DS4500 Fibre Channel Storage Subsystem Installation and Support Guide</i> • <i>DS4700 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>
7	Configure DS4000 network settings	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Fibre Channel Storage Subsystem Installation, User's and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Subsystem Installation and Support Guide</i> • <i>DS4500 Fibre Channel Storage Subsystem Installation and Support Guide</i> • <i>DS4700 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>
8	Zone the fabric switch (SAN-attached only)	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i> • <i>DS4000 Storage Manager Copy Services Guide</i> (describes switch zoning for the Remote Mirror Option) • See also the documentation provided by the switch manufacturer

Table 2. Where to find DS4000 installation and configuration procedures (continued)

	Installation task	Where to find information or procedures
9	Install DS4000 Storage Manager software on the management station	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i> • DS4000 Storage Manager online help (for post-installation tasks)
10	Install host software (failover drivers) on host server	
11	Start DS4000 Storage Manager	
12	Set the DS4000 Storage Manager clock	
13	Set the DS4000 Storage Manager host default type	
14	Verify DS4000 subsystem health	<ul style="list-style-type: none"> • <i>DS4100 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4200 Express Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4300 Fibre Channel Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4400 Fibre Channel Storage Subsystem Installation and Support Guide</i> • <i>DS4500 Fibre Channel Storage Subsystem Installation and Support Guide</i> • <i>DS4700 Storage Subsystem Installation, User's, and Maintenance Guide</i> • <i>DS4800 Storage Subsystem Installation, User's, and Maintenance Guide</i>
15	Enable DS4000 Storage Manager premium feature keys	<p>Copy Services premium features <i>DS4000 Storage Manager Copy Services Guide</i></p> <p>FC/SATA Intermix premium feature <i>DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview</i></p> <p>Storage Partitioning (and general premium features information)</p> <ul style="list-style-type: none"> • <i>DS4000 Storage Manager Concepts Guide</i> • <i>DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i>
16	Configure arrays and logical drives	<ul style="list-style-type: none"> • <i>DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER</i> • <i>DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux</i> • DS4000 Storage Manager online help
17	Configure host partitions	
18	Verify host access to DS4000 storage	

Notices used in this document

This document contains the following notices designed to highlight key information:

- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information that might help you avoid inconvenient or problem situations.
- **Attention:** These notices indicate possible damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage could 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.

Figures used in this document

The figures used in this document are for illustrative purposes only. In some cases, the actual device might look different from the figure.

Note: This applies particularly in cases where the DS4300 single-controller storage subsystem (model 6LU/6LX) differs from the DS4300 dual-controller storage subsystem (model 60U/60X).

Getting information, help, and service

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. This section contains information about where to go for additional information about IBM and IBM products, what to do if you experience a problem with your IBM @server xSeries® or IntelliStation® system, and 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:

- Check all cables to make sure that they are connected.
- Check the power switches to make sure that the system is turned on.
- Use the troubleshooting information in your system documentation and use the diagnostic tools that come with your system.
- Check for technical information, hints, tips, and new device drivers at the following Web sites:

<http://www-1.ibm.com/servers/storage/support/disk/>
www.pc.ibm.com/support

- Use an IBM discussion forum on the IBM Web site to ask questions.

You can solve many problems without outside assistance by following the troubleshooting procedures that IBM provides in the online help or in the documents

that are provided with your system and software. The information that comes with your system also describes the diagnostic tests that you can perform. Most xSeries and IntelliStation systems, operating systems, and programs come with information that contains troubleshooting procedures and explanations of error messages and error codes. If you suspect a software problem, see the information for the operating system or program.

Using the documentation

Information about the xSeries or IntelliStation system and preinstalled software, if any, is available in the documents that come with your system. This includes 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.

Web sites

IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates.

- For DS4000 information, go to the following Web site:

www-1.ibm.com/servers/storage/support/index.html

The support page has many sources of information and ways for you to solve problems, including:

- Diagnosing problems, using the IBM Online Assistant
 - Downloading the latest device drivers and updates for your products
 - Viewing frequently asked questions (FAQ)
 - Viewing hints and tips to help you solve problems
 - Participating in IBM discussion forums
 - Setting up e-mail notification of technical updates about your products
- You can order publications through the IBM Publications Ordering System at:
www.elink.ibm.com/public/applications/publications/cgibin/pbi.cgi/
 - For the latest information about IBM xSeries products, services, and support, go to the following Web site:
www.ibm.com/eserver/xseries/
 - For the latest information about IBM @server pSeries® products, services, and support, go to the following Web site:
www.ibm.com/eserver/pseries/
 - For the latest information about the IBM IntelliStation information, go to the following Web site:
www.ibm.com/pc/intellistation/
 - For the latest information about operating system and host bus adapter (HBA) support, clustering support, SAN fabric support, and Storage Manager feature support, see the TotalStorage DS4000 Interoperability Matrix at the following Web site:

www-1.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

Software service and support

Through IBM Support Line, for a fee you can get telephone assistance with usage, configuration, and software problems with xSeries servers, IntelliStation workstations, and appliances. For information about which products are supported by Support Line in your country or region, go to the following Web site:

www.ibm.com/services/sl/products/

For more information about the IBM Support Line and other IBM services, go to the following Web sites:

- www.ibm.com/services/
- www.ibm.com/planetwide/

Hardware service and support

You can receive hardware service through IBM Integrated Technology Services or through your IBM reseller, if your reseller is authorized by IBM to provide warranty service. Go to the following Web site for support telephone numbers:

www.ibm.com/planetwide/

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.

Fire suppression systems

A fire suppression system is the responsibility of the customer. The customer's own insurance underwriter, local fire marshal, or a local building inspector, or both, should be consulted in selecting a fire suppression system that provides the correct level of coverage and protection. IBM designs and manufactures equipment to internal and external standards that require certain environments for reliable operation. Because IBM does not test any equipment for compatibility with fire suppression systems, IBM does not make compatibility claims of any kind nor does IBM provide recommendations on fire suppression systems.

Table 7 on page 18 lists the environmental specifications for the DS4300 storage subsystem.

How to send your comments

Your feedback is important to help us provide the highest quality information. If you have any comments about this document, you can submit them in one of the following ways:

- E-mail

Submit your comments electronically to:

starpubs@us.ibm.com

Be sure to include the name and order number of the document and, if applicable, the specific location of the text that you are commenting on, such as a page number or table number.

- Mail or fax

Fill out the Readers' Comments form (RCF) at the back of this document and return it by mail or fax (1-800-426-6209) or give it to an IBM representative. If the RCF has been removed, you can address your comments to:

International Business Machines Corporation
Information Development
Department GZW
9000 South Rita Road
Tucson, Arizona 85744-0001
U.S.A

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Chapter 1. Introduction

IBM TotalStorage DS4000 storage solutions support the large and growing data storage requirements of business-critical applications. These scalable IBM DS4000 solutions offer you data access and protection to meet your existing enterprise storage requirements and prepare for the future.

Fibre Channel is a device interconnect technology, similar to a high-speed network, that you can use to connect large amounts of disk storage to a server or cluster of servers. Fibre Channel technology supports increased performance, scalability, availability, and distance for attaching storage subsystems to network servers. The storage subsystem provides for the attachment of Fibre Channel disk drives to give superior performance and redundancy.

Fibre Channel technology supports applications that require large amounts of disk storage that is shared by two or more servers. With Fibre Channel, you can see a higher throughput rate over longer distances than is possible with Small Computer System Interface (SCSI) or with serial storage architecture (SSA) technology.

This document describes how to install and configure the following types of IBM TotalStorage DS4300 storage subsystems:

- “IBM DS4300 Model 6LU/6LX” on page 2
- “DS4300 Model 60U/60X” on page 3
- “IBM DS4300 Model 60U/60X with Turbo option” on page 4

After you review the introductory information that is provided in this chapter, go to Chapter 2, “Installing and configuring the storage subsystem,” on page 21 to begin the installation process.

Note: The figures used in this document are for illustrative purposes only. In some cases, the actual device might look different from the figure.

This applies particularly in cases where the DS4300 single-controller storage subsystem (Model 6LU/6LX) differs from the DS4300 dual-controller storage subsystem (Model 60U/60X).

Product updates

Important

In order to keep your system up to date with the latest firmware and other product updates, use the information below to register and use the **My support** Web site.

Download the latest versions of the DS4000 Storage Manager host software, DS4000 storage server controller firmware, DS4000 drive expansion enclosure ESM firmware, and drive firmware at the time of the initial installation and when product updates become available.

To be notified of important product updates, you must first register at the IBM Support and Download Web site:

www-1.ibm.com/servers/storage/support/disk/index.html

In the Additional Support section of the Web page, click **My support**. On the next page, if you have not already done so, register to use the site by clicking **Register now**.

Perform the following steps to receive product updates:

1. After you have registered, type your user ID and password to log into the site. The **My support** page opens.
2. Click **Add products**. A pull-down menu displays.
3. In the pull-down menu, select **Storage**. Another pull-down menu displays.
4. In the new pull-down menu, and in the subsequent pull-down menus that display, select the following topics:
 - **Computer Storage**
 - **Disk Storage Systems**
 - **TotalStorage DS4000 Midrange Disk Systems & FASt Stor Svrs**

Note: During this process a check list displays. Do not check any of the items in the check list until you complete the selections in the pull-down menus.

5. When you finish selecting the menu topics, place a check in the box for the machine type of your DS4000 series product, as well as any other attached DS4000 series product(s) for which you would like to receive information, then click **Add products**. The My Support page opens again.
6. On the My Support page, click the **Edit profile** tab, then click **Subscribe to email**. A pull-down menu displays.
7. In the pull-down menu, select **Storage**. A check list displays.
8. Place a check in each of the following boxes:
 - a. **Please send these documents by weekly email**
 - b. **Downloads and drivers**
 - c. **Flashes**
 - d. Any other topics that you may be interested inThen, click **Update**.
9. Click **Sign out** to log out of My Support.

IBM DS4300 Model 6LU/6LX

The DS4300 single-controller storage subsystem (Model 6LU/6LX) includes one RAID controller, one power supply, and two cooling units. It also includes fourteen hot-swap internal disk drive slots, which support over 4 TBs of storage capacity when using 300 GB Fibre Channel disk drives. It does not support storage capacity expansion using external storage expansion enclosures.

The latest version of the IBM DS4000 host software and the DS4000 controller firmware on the DS4000 System Storage Support Web site, which support the DS4300 single-controller Model 6LU/6LX storage subsystem are version 9 and 5.34.xx.xx, respectively.

You can use the following products to upgrade the DS4300 storage subsystem (Model 6LU/6LX):

IBM DS4300 Model 6LU/6LX Upgrade (IBM P/N 24P8963)

Use this product to upgrade to the DS4300 Model 60U/60X, which provides

dual redundant RAID controllers and power supplies, and supports storage capacity expansion using external DS4000 EXP storage expansion enclosures.

Note: This upgrade does not come with any entitlements to attach DS4000 EXP storage expansion enclosures. Once the DS4300 storage subsystem is upgraded, you can purchase up to three DS4000 EXP storage expansion enclosure attachment entitlements to provide additional storage capacity beyond the DS4300 internal drive lots.

IBM DS4300 Model 6LU/6LX Turbo Upgrade (IBM P/N 24P8964)

Use this product to upgrade to the DS4300 Turbo option, which provides dual redundant RAID controllers and power supplies in addition to the following features:

- RAID controllers with 1 GB of memory, instead of the standard 256-MB memory
- Support for IBM DS4000 Storage Manager and DS4300 controller firmware version 6.12.xx.xx and higher.
- Ability to connect up to seven 14-drive DS4000 EXP storage expansion enclosures

Note: If there are any DS4000 EXP 16-drive storage expansion enclosures (such as the EXP810) in the DS4300 drive loop, the maximum number of storage expansion enclosures that can be attached to the DS4300 storage subsystem is reduced to 6 instead of 7. See “Connecting storage expansion enclosures to the DS4300” on page 45 for more information.

- Entitlement for eight partitions using the Storage Partitioning premium feature

DS4300 Model 60U/60X

The DS4300 dual-controller storage subsystem (Model 60U/60X) includes two RAID controllers, two power supplies, and two cooling units and provides dual, redundant controllers, redundant cooling, redundant power, and battery backup of the RAID controller cache.

This DS4300 storage subsystem is designed to provide maximum host- and drive-side redundancy. Each RAID controller supports direct attachment of up to two hosts containing two fibre channel host adapters.

Note: You must make Fibre Channel connections to both DS4300 controllers to ensure full host-side redundancy.

The latest versions of the IBM DS4000 host software and the DS4000 controller firmware on the DS4000 System Storage Support Web site that support the DS4300 dual-controller Model 60U/60X storage subsystem are version 9 and 6.19.xx.xx, respectively.

Utilizing these features with the 14 internal disk drive expansion enclosures (EXP700/EXP710/EXP100), up to 112 disk drives can be attached to the DS4300 with individual fibre channel disk drive module (DDM) capacities ranging from 36.4 to 300 GB or individual SATA disk drive module (DDM) capacities ranging from 250 GB to 400 GB. In addition, the DS4300 can be attached to six 16 internal disk drive expansion enclosures (EXP810), allowing a max of 110 disk drives can be attached

to the DS4300 with individual fibre channel disk drive module capacities ranging from 36.4 to 300 GB and individual SATA disk drive module capacities of 500 GB.

Note: The maximum of 112 drives in a DS4300 storage subsystem is achieved only when all of the attached drive expansion enclosures are of 14 drive storage expansion enclosures type (EXP100/EXP700/EXP710). When using the 16 drive storage expansion enclosure type (EXP810) or intermixing the 14 drive and 16 drive storage expansion enclosure types behind the DS4300 controller, the maximum number of drives supported in the DS4300 controller drive loop is 110. Please refer to Table 3 on page 6 for the maximum number of drives supported in a DS4300 with various combinations of the 14 drive and 16 drive storage expansion enclosures types.

Attention: The disk drive modules for the DS4300 storage subsystem and the EXP700 and the EXP710 storage expansion enclosures (DS4300/EXP700/EXP710) are not the same as the SATA disk drive modules (DDMs) for the EXP100 nor the FC or SATA enhanced disk drives modules (E-DDMs) for the EXP810. The DS4300/EXP700/EXP710, EXP100 and EXP810 use different non-interchangeable drive options and CRUs. Please order the correct options/CRUs for the enclosures in your configuration. Force-fitting insertion of the incorrect disk drive modules can cause damage to the drive CRUs or the enclosure chassis slots /backplane. IBM does not sell or provide replacement parts to change the drive CRU form factors.

IBM DS4300 Model 60U/60X with Turbo option

The standard DS4300 dual-controller storage subsystem (Model 60U/60X) supports a maximum of three EXP storage expansion enclosures. In order to support up to seven EXP units, you must purchase the DS4300 Turbo option.

The DS4300 dual-controller storage subsystem (Model 60U/60X) with Turbo option will be referred to as the DS4300 dual-controller Turbo Model 60U/60X in IBM publications and Readme files. The Turbo option can be purchased in the initial order or at a later time as IBM DS4300 Model 60U/60X Turbo Upgrade option (IBM P/Ns 24P8215 for models 60U and 24P8216 for models 60X).

The latest versions of the IBM DS4000 host software and the DS4000 controller firmware on the DS4000 System Storage Support Web site that support the DS4300 dual-controller Turbo Model 60U/60X storage subsystem are version 9 and 6.19.xx.xx, respectively.

The DS4300 Turbo option consists of the following:

- Two 1-GB memory RAID controllers
- License for connecting up to seven 14 drive EXP storage expansion enclosures or six 16 drive EXP storage expansion enclosures or a combination of up to six 14 and 16 drive EXP storage expansion enclosures
- Entitlement for eight partitions using the Storage Partitioning premium feature

DS4000 EXP storage expansion enclosures

You can add up to seven 14 drive DS4000 EXP storage expansion enclosures to the DS4300 dual-controller storage subsystem (Model 60U/60X) or six 16 drive DS4000 EXP storage expansion enclosures to the DS4300 dual-controller storage subsystem (Model 60U/60X).

Note: For the EXP100 only, if there are not any drives inserted in the DS4300 chassis, up to eight EXP100 enclosures can be attached to the DS4300 controller. This is the only case where eight EXP100 drive expansion enclosures can be attached to the DS4300.

Similarly, up to seven EXP810s with SATA enhanced disk drive modules (E-DDMs) *only* can be attached to the DS4300 with no drives inserted in the DS4300 drive slots. This is the only case where seven EXP810 drive expansion enclosures can be attached to the DS4300.

Attention: The DS4300/EXP700/EXP710, EXP100 and EXP810 use different non-interchangeable drive options and CRUs. Please order the correct options/CRUs for the enclosures in your configuration. Force-fitting insertion of the incorrect disk drive modules may cause damage to the drive CRUs or the enclosure chassis slots /backplane.

Notes:

1. The DS4300 single-controller storage subsystem (Model 6LU/6LX) does not support DS4000 EXP storage expansion enclosures.
2. You do not need to purchase optional DS4000 storage expansion enclosure entitlements to attach DS4000 EXP drive storage expansion enclosures to DS4300 Turbo storage subsystems.
3. You can now intermix fibre channel drives (the DS4300 Turbo storage subsystem, the EXP700 and/or the EXP710 storage expansion enclosures, and/or the EXP810 with FC enhanced disk drive modules (E-DDMs) storage expansion enclosures) and SATA drives (the EXP100 storage expansion enclosures and/or the EXP810 with SATA enhanced disk drive modules (E-DDMs) storage expansion enclosures) if the following conditions are met:
 - You have purchased and installed the FC/SATA Enclosure Intermix premium feature.
 - You are installing the appropriate version of the controller firmware version 6.19.xx.xx or later on your DS4300 storage subsystems with the appropriate DS4000 Storage Manager host software version 9.1x installed in the host/management servers.
 - EXP700 enclosures must be upgraded to EXP710 with the DS4000 EXP700 Models 1RU/1RX Switched-ESM Option Upgrade Kit for them to be intermixed with the EXP810 enclosures. EXP700s can only be intermixed with EXP100s and EXP710s.
 - EXP810 enclosures can be intermixed with EXP710 and EXP100 enclosures only.

For more information on the cabling firmware requirements and best practices for intermixing EXP100s, EXP710s, EXP700s and EXP810s in the same DS4000 storage subsystem configuration, see the *IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview* that ships with the FC/SATA Enclosure Intermix premium feature. You can also refer to the *IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*.

4. Not all combinations of supported drive expansion enclosures are allowed in a given DS4300 drive loop. Table 9 on page 47 shows the supported drive expansion enclosure intermix.

For information about DS4000 storage expansion enclosures, see the following documents:

- *IBM TotalStorage DS4000 EXP100 Storage Expansion Enclosure Installation and User's Guide*
- *IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Unit Installation, User's, and Maintenance Guide*
- *IBM System Storage DS4000 EXP810 Storage Expansion Enclosure Installation, User's and Maintenance Guide*

You can also refer to "Connecting storage expansion enclosures to the DS4300" on page 45.

Table 3 shows the optional storage expansion enclosure attachment option/features for the DS4300 dual-controller storage subsystem (Model 60U/60X) without the Turbo option.

Table 3. Additional EXP700/EXP710 storage features available for the DS4300 storage subsystem

Expansion Units	Number of Drives¹	Feature Number	Part No.
Two storage expansion units	15 to 42 drives (or up to 46 if both of the expansion enclosures are EXP810s)	7360	24P8066
First additional storage expansion unit	15 to 28 drives (or up to 30 if the expansion enclosure is an EXP810)	7361	24P8149
Second additional storage expansion unit	29 to 42 drives (or up to 46 if both of the expansion enclosures are EXP810s), can be purchased only after Feature number 7361	7362	24P8151
Third additional storage expansion unit	43 to 56 drives (or up to 62 if all of the expansion enclosures are EXP810s), can be purchased only after Feature number 7362	7363	24P8183
Three storage expansion units	15 to 56 drives (or up to 62 if all of the expansion enclosures are EXP810s)	7368	24P8180

Table 3. Additional EXP700/EXP710 storage features available for the DS4300 storage subsystem (continued)

Expansion Units	Number of Drives ¹	Feature Number	Part No.
<p>Seven storage expansion units</p> <p>Note: If one of the attached enclosures is an EXP810, the maximum number of enclosures that can be attached behind a DS4300 is reduced to six, resulting in the maximum number of drives being less than 112. Table 9 on page 47 for the maximum number of enclosures.</p> <p>Also include 1-GB memory controller upgrade and Storage Manager 9.1x client and controller firmware.</p>	15 to 112 drives	2000 (for the 1722–60U) or 2010 (for the 1722–60X)	<p>24P8215 (for the 1722–60U)</p> <p>24P8216 (for the 1722–60X)</p>

Note: ¹The maximum number of supported drives varies depending on the number of EXPs with 16 drives in the configuration versus the number of EXPs with 14 drives in the configuration.

To attach DS4000 EXP drive expansion enclosures to a DS4300, refer to the *IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* for the latest information on the required version of the DS4300 controller firmware and the supported combination of enclosure types intermix behind a DS4300 subsystem. In addition, you must purchase the FC/SATA Enclosure Intermix premium option to combine SATA disk drives with fibre channel drives in the same DS4300 Storage Subsystem configuration.

Features at a glance

Table 4 on page 8 summarizes the features of the storage subsystem. For a list of the operating specifications, such as weight, height, and heat output, see Table 7 on page 18.

Table 4. Features at a glance

<p>General</p> <ul style="list-style-type: none"> • Modular components: <ul style="list-style-type: none"> – High-capacity Fibre Channel disk drives – RAID controllers – Power supplies – Cooling fans • Technology: <ul style="list-style-type: none"> – Support for disk arrays – Support for clustering – Fibre-channel host interface – Redundant data storage, cooling system, power system, and RAID controllers (Model 60U/60X only) – Hot-swap technology for power supplies and RAID controllers (Model 60U/60X only) – Hot-swap technology for fibre-channel hard drives and fans (all models). <p>Attention: You will lose data if you attempt to hot swap the controller and power supply components in a DS4300 single-controller storage subsystem (Model 6LU/6LX).</p>	<ul style="list-style-type: none"> • User interface: <ul style="list-style-type: none"> – Built-in power, activity, and fault light emitting diodes (LEDs) – Identification labeling on customer replaceable units (CRUs), rear LEDs, switches, and connectors – Easy-to-replace drives, power supplies, RAID controllers, and fans <p>Disk drive storage</p> <p>2-Gbps Fibre Channel enclosure Maximum drives per storage subsystem: 14</p> <p>Attached storage expansion enclosures</p> <ul style="list-style-type: none"> • For Model 60U/60X, attachment of DS4000 EXP storage expansion enclosures requires one or more EXP storage expansion enclosure Attachment option (or feature) upgrades for the DS4300 • 2-Gbps connection only 	<p>RAID controllers</p> <ul style="list-style-type: none"> • Technology and interfaces: <ul style="list-style-type: none"> – Fibre Channel: 40-pin fibre-channel disk drives – Fibre Channel interface: <ul style="list-style-type: none"> - For Model 60U/60X, six small form-factor pluggable (SFP) modules for incoming and outgoing fibre-channel cables (three SFPs on each RAID controller). - For Model 6LU/6LX, two SFP modules for incoming fibre-channel cables (two SFPs on the RAID controller). – Two auto-negotiate 1 Gbps/2 Gbps fibre-channel host-side connections per controller
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Clustering support

Clustering is a means of sharing array groups among controllers to provide redundancy of controllers and servers. This redundancy is important if a hardware component fails. If a hardware component failure occurs in a cluster, another server takes ownership of the array group.

Clustering requires software specific to your operating system. For more information about clustering, go to the following Web sites:

www.pc.ibm.com/us/compat/nos/matrix.shtml

www.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

Inventory checklist

After you unpack the storage subsystem, verify that you have the following items:

Hardware

IBM DS4300 storage subsystem comes with the following components:

- RAID controllers:
 - 2 controllers on Model 60U/60X
 - 1 controller on Model 6LU/6LX
- Power supplies:
 - 2 power supplies on Model 60U/60X
 - 1 power supply on Model 6LU/6LX
- Power cords:
 - Two power cords on Model 60U/60X

- One power cord on Model 6LU/6LX
- Two fan units.
- 14 filler panels.
- Rack-mounting hardware kit (1):
 - Two rails (right and left assembly)
 - Ten M6 screws
 - Ten M6 cage nuts
 - Ten M6 clip nuts
- LC wrap plug and coupler kit for Fibre Channel link diagnostics. (For more information, see the *DS4000 Problem Determination Guide*.)

Software and documentation:

- IBM DS4000 Storage Manager software:
Version CD including client and firmware, and online help and publications in Adobe Acrobat Portable Document Format (PDF).
For a list of available IBM DS4000 publications, see Table 2 on page xix.
The latest version of the DS4000 Storage Manager software and the DS4000 product publications are available at the DS4000 System Storage support Web site:

<http://www-1.ibm.com/servers/storage/support/disk/>

- Rack Mounting Assembly kit, including:
 - *IBM TotalStorage DS4300 Installation, User's, and Maintenance Guide*
 - *IBM TotalStorage DS4300 Storage Subsystem Cabling Guide*
 - Statement of Limited Warranty
 - IBM Machine Code License Agreement
 - IBM Safety Manual
 - Rack mounting installation instructions
 - Rack mounting template (for aligning the rails properly)
 - White tape dots for marking the holes in the rack

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

If you have not already done so, record your storage subsystem serial number in the table in Appendix A, "Records," on page 155.

Handling static-sensitive devices

Attention: Static electricity can damage electronic devices and your system. To avoid damage, keep static-sensitive devices in their static-protective package until you are ready to install them.

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

- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully. Hold it by its edges or its frame.
- Do not touch solder joints, pins, or exposed printed circuitry.

- Do not leave the device where others can handle and possibly damage the device.
- While the device is still in its static-protective package, you should hold the device and touch an unpainted metal part of the system unit for at least two seconds. This drains static electricity from the package and from your body.
- Remove the device from its package and install it directly into your system unit without setting it down. If it is necessary to set the device down, place it in its static-protective package. Do not place the device on your system unit cover or on a metal table.
- Take additional care when handling devices during cold weather because heating reduces indoor humidity and increases static electricity.

Best practices guidelines

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

- Back up the data on your storage drives periodically.
- Before any planned system shutdown or after any system changes (additions, removals, or modifications), save controller subsystem profiles as explained in the *IBM DS4000 Storage Manager Installation and User's Guide* for your operating system.
- Ensure that your system is in an optimal state before shutting down. Never turn the power off if any fault light is lit; be sure to resolve any error conditions before you shut down the system.
- During any maintenance or attended power-up procedure, carefully follow the power-up sequence listed in “Turning on the storage subsystem” on page 92. Each component of the subsystem should be checked that it is powered-on in the proper order during this entire power-up procedure to ensure the controller will be able to optimally access all of your storage subsystems.
- The storage subsystem supports simultaneous power-up to the system components; however, you should always follow the power-up sequence listed in “Turning on the storage subsystem” on page 92 during any attended power-up procedure.
- A storage system 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 IBM support if any of the following conditions occur:
 - The storage subsystem logical drives and arrays are not displayed in the Storage Manager graphical user interface (GUI).
 - The storage subsystem logical drives and arrays do not come online.
 - The storage subsystem logical drives and arrays seem to be degraded.
- Using the DS4000 Storage Manager client, save the DS4000 subsystem configuration profile to a disk that is not affected every time you make changes to the DS4000 subsystem configuration (such as logical drive creation or modification, or storage partitioning changes).
- **DS4300 Model 60U/60X only:** To maintain power redundancy, plug the DS4300 dual-controller storage subsystem's right and left power supplies into two independent external power circuits through ac distribution units inside a rack cabinet or directly into external receptacles. Similarly, the right and left power supplies of the DS4000 storage expansion enclosures attached to the DS4300 storage subsystem should be plugged into the same two independent external power circuits as the DS4300 storage subsystem. This ensures that the DS4300

storage subsystem and all its attached storage expansion enclosures will have power if only one power circuit is available. In addition, having all the right or all the left power supplies plugged into the same power circuit will enable the components in the storage subsystem to power on simultaneously during an unattended restoration of power. See Figure 72 on page 86 for an example of redundant power connections.

Storage subsystem components

The following sections show the components of the DS4300 storage subsystem.

Note: The graphics used in this document are for illustrative purposes only. The appearance of the actual device may differ from the graphic.

All DS4300 storage subsystem models support hot-swap fibre channel hard drive CRUs and cooling fan CRUs, so you can remove and replace these components without turning off the storage subsystem. In addition, the DS4300 storage subsystem models 60X and 60U support hot-swap power supplies and RAID controller CRUs.

Attention: The DS4300 single-controller storage subsystem (model 6LU and 6LX) has one power supply and one controller; therefore, you cannot hot swap these components.

Front view

Figure 1 shows the components and controls on the front of the DS4300 storage subsystem.

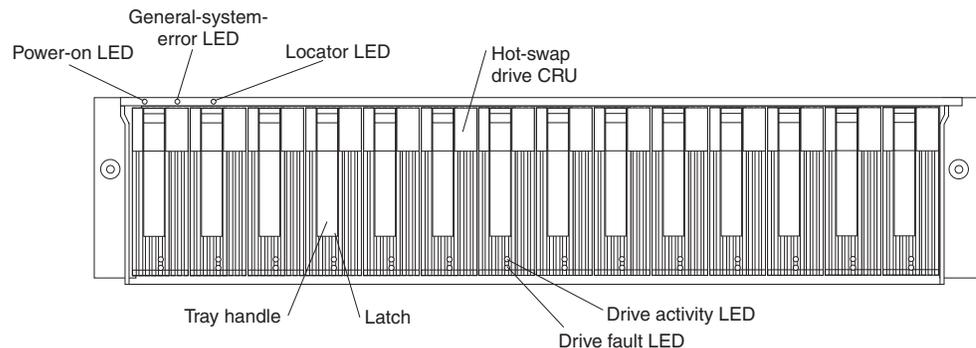


Figure 1. DS4300 storage subsystem front controls and components

Note: The graphics used in this document are for illustrative purposes only. The appearance of the actual device may differ from the graphic.

Power-on LED

When on, this green light indicates that the unit has good dc power.

The DS4300 single-controller storage subsystem (model 6LU and 6LX) has a single power supply therefore; when the power supply fails, the General-system-error LED and the Power-on LED are not lit.

General-system-error LED

When on, this amber LED indicates that the storage subsystem has a fault, such as in a power supply, fan unit, or hard disk drive.

The DS4300 single-controller storage subsystem (model 6LU and 6LX) has a single power supply therefore; when the power supply fails, the General-system-error LED and the Power-on LED are not lit.

Note: If the General-system-error LED is on continuously (not flashing), there is a problem with the storage subsystem. Use the storage management software to diagnose and repair the problem. For more information, see “Checking the LEDs” on page 97.

Locator LED

When on, this blue light indicates the storage management software is locating the server.

Hot-swap drive CRU

You can install up to 14 hot-swap drive *customer replaceable units* (CRUs) in the storage subsystem. Each drive CRU consists of a hard disk drive and tray. The drive CRU is also referred to as disk drive modules (DDM).

Note: The DS4300 drive CRU does not have the same form factor as the EXP100 or the EXP810 storage expansion enclosure drive CRUs.

Filler panel

The storage subsystem comes without drives installed and contains filler panels in the unused drive bays. Before installing new drives, you must remove the filler panels and save them. Each of the 14 bays must always contain either a filler panel or a drive FRU. Each filler panel contains a filler piece for use with a slim drive.

Drive activity LED

Each drive CRU has a green Drive activity LED. When flashing, this green LED indicates drive activity. When on continuously, this green LED indicates that the drive is properly installed.

Drive fault LED

Each drive CRU has an amber Drive fault LED. When on, this amber LED indicates a drive failure. When flashing, this amber LED indicates that a drive identify is in progress.

Latch This multipurpose blue latch releases or locks the drive CRU in place.

Tray handle

You can use this multipurpose handle to insert and remove a drive CRU in the bay.

For information on how to install and replace drive CRUs, see “Working with hot-swap drives” on page 120. For more information about the LEDs, see “Checking the LEDs” on page 97.

Back view

Figure 2 on page 13 shows the components at the back of the DS4300 dual-controller storage subsystem (model 60U and 60X).

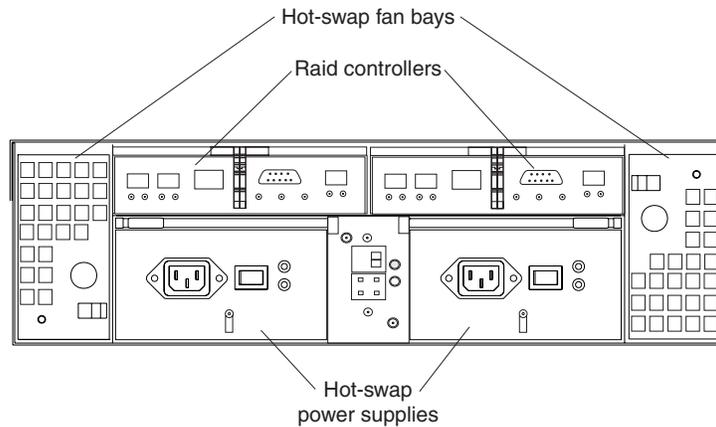


Figure 2. DS4300 dual-controller storage subsystem (model 60U and 60X) back view

Figure 3 shows the components at the back of the DS4300 single-controller storage subsystem (model 6LU and 6LX).

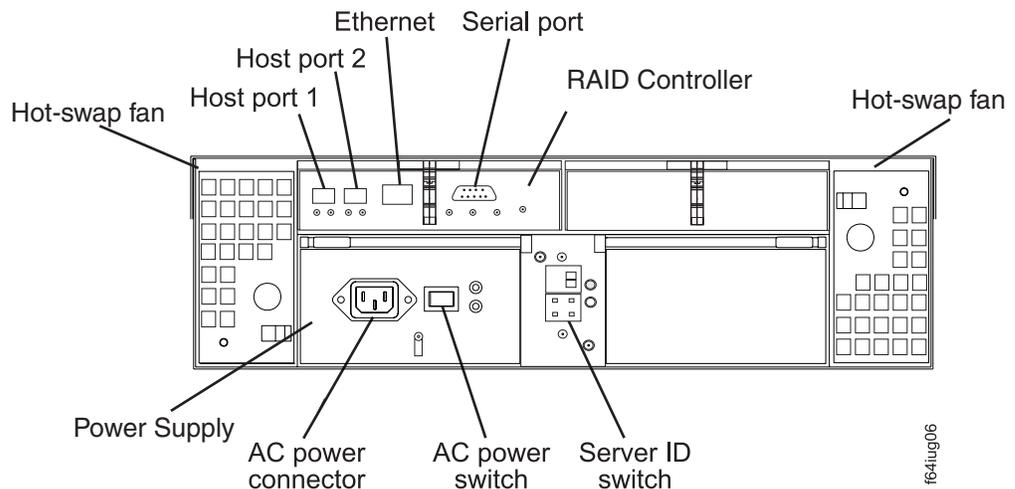


Figure 3. DS4300 single-controller storage subsystem (model 6LU and 6LX) back view

Note: The graphics used in this document are for illustrative purposes only. The appearance of the actual device may differ from the graphic.

RAID controller

Each RAID controller contains three ports for SFP modules that connect to the fibre channel cables. Two of the ports, which are labeled Host 1 and Host 2, are used to connect to host servers. The third port, which is labeled Expansion and is available on the DS4300 model 60U and 60X controllers only, is used to connect additional expansion units to the storage subsystem.

Each RAID controller also contains a battery to maintain cache data in the event of a power failure. For more information, see “Cache memory and RAID controller battery” on page 101.

Note: The DS4300 single-controller storage subsystem (model 6LU and 6LX) contains only one RAID controller. You must keep the second controller bay cover on to maintain proper cooling.

|
|
|

Hot-swap fans

The storage subsystem has two interchangeable hot-swap and redundant fan FRUs. Each fan FRU contains two fans. If one fan FRU fails, the second fan FRU continues to operate. Both fan FRUs must be installed to maintain proper cooling within your storage subsystem, even if one fan FRU is not operational.

Hot-swap power supplies

The DS4300 dual-controller storage subsystem (model 60U and 60X) comes with two hot-swap power supplies. Both power supplies must be installed to maintain proper cooling.

Note: The DS4300 single-controller storage subsystem (model 6LU and 6LX) comes with one power supply. You must keep the second power supply bay cover on to maintain proper cooling.

Interface ports and switches

Figure 4 shows the ports and switches on the back of the storage subsystem.

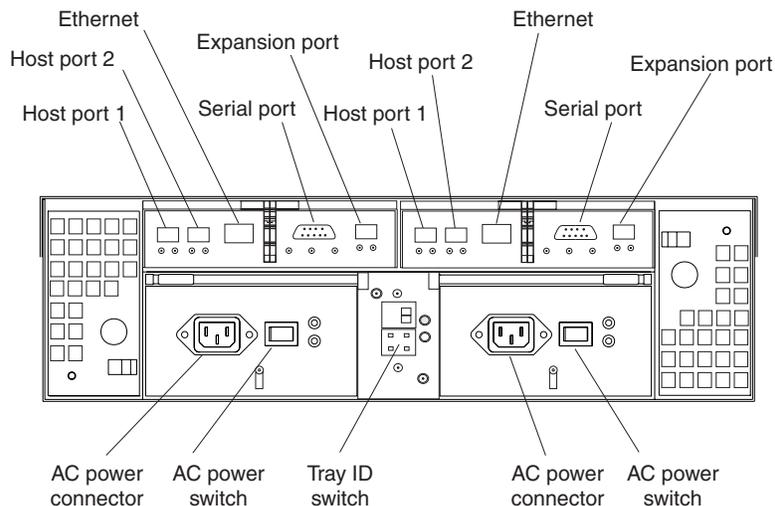


Figure 4. DS4300 dual-controller storage subsystem (model 60U and 60X) interface ports and switches

For a similar view of the DS4300 model 6LU and 6LX, see Figure 3 on page 13.

RAID controller

Each RAID controller contains several connectors and LEDs. Each controller has two host ports and one expansion port for connecting the storage subsystem to hosts or expansion units. You first insert SFPs into the ports and then connect the fibre channel cables.

Note: The DS4300 single-controller storage subsystem (model 6LU and 6LX) contains only one RAID controller and does not contain any expansion ports.

Host ports

The host ports are used to connect a fibre channel cable from the host systems. You first insert an SFP into the port and then connect a fibre

channel cable. The two host ports in each controller are independent. They are not connected in the controller module as they would be in a hub configuration.

Ethernet port

The Ethernet port is for an RJ-45 10BASE-T or 100BASE-T Ethernet connection. Use the Ethernet connection to directly manage storage subsystems.

Expansion port

The expansion port is used to connect additional expansion units to the RAID controllers. You first insert an SFP into the port and then connect a fibre channel cable.

Note: There are no expansion ports on the DS4300 single-controller storage subsystem (model 6LU and 6LX).

Serial port

The serial port is used by service personnel to perform diagnostic operations on the RAID controller or controllers.

Tray ID switch

The Tray ID switch settings range from 0 through 7, and unique IDs ranging from 00 through 77 can be set.

This switch is also referred to as enclosure IDs in other IBM DS4000 publications.

Note: For controller firmware version 05.33.xx.xx, both host and expansion ports operate at 2 Gbps only. For controller firmware versions 05.4x.xx.xx and higher, the host ports can operate at either 1 or 2 Gbps (the expansion port speed is still locked at 2 Gbps only).

Software and hardware compatibility and upgrades

The latest DS4000 controller firmware and NVSRAM, the storage expansion enclosure drive enclosure ESM firmware, and the fibre channel drive CRUs firmware must be installed to ensure optimal functionality, manageability, and reliability.

Software and firmware support code upgrades

To enable support for the DS4300, you must ensure that your system’s software and firmware are at the levels shown in Table 5.

Table 5. Software and firmware levels for the DS4300 storage subsystem

Software/firmware	Level
DS4000 Storage Manager software	9.19
DS4300 dual-controller firmware and NVSRAM (Standard and Turbo models)	06.19.xx.xx or higher
DS4300 single-controller firmware and NVSRAM	5.34.xx.xx only
ESM firmware for attached storage expansion enclosures	
EXP810	9878 or higher
EXP710	9640 or higher
EXP100	9565 or higher

Table 5. Software and firmware levels for the DS4300 storage subsystem (continued)

Software/firmware	Level
EXP700	9330 or higher
Drive firmware	You can find the latest drive firmware at the IBM DS4000 TotalStorage Support Web site: http://www-1.ibm.com/servers/storage/support/disk/

You can find the latest DS4000 Storage Manager software, DS4300 controller firmware, and NVSRAM firmware at the IBM DS4000 System Storage Support Web site: <http://www-1.ibm.com/servers/storage/support/disk/>.

See the *IBM System Storage DS4000 Storage Manager 9.19 Installation and Support Guide* for your operating system for instructions that describe how to install the DS4000 Storage Manager 9.19 host software. The DS4300 dual controller models are shipped with controller firmware version 6.19.xx.xx, which supports EXP810, EXP710, and EXP100 storage expansion enclosures only. If you need further assistance, please contact your IBM reseller or IBM representative.

DS4300 hardware and software compatibility

Table 6 lists the DS4300 hardware and software compatibility. In the latest release of the DS4300 controller firmware version 6.19.xx.xx, you can connect EXP810 to the DS4300 storage subsystem.

Note: For the latest information about supported servers and operating systems, refer to the interoperability matrix at the following Web site:
www.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

Table 6. DS4300 hardware and software compatibility

Drive expansion enclosure	Storage management software	Controller firmware	Notes
EXP810, EXP710, EXP100	IBM DS4000 Storage Manager Version 9.19 or later	06.19.xx.xx or higher	The EXP700 is not supported by 06.19.xx.xx. The EXP700 can be upgraded by using the DS4000 EXP700 Models 1RU/1RX Switched-ESM Option Upgrade Kit to make it compatible with 06.19.xx.xx and to intermix with the EXP810.
EXP710, EXP700, EXP100	IBM DS4000 Storage Manager Version 9.19 or later	06.12.xx.xx	06.12.xx.xx is the latest version of DS4300 controller firmware that supports the EXP700.
EXP100	IBM DS4000 Storage Manager Version 9.19 or later	05.41.xx.xx or higher (06.19.xx.xx is recommended.)	05.41.xx.xx supports the EXP100 enclosures only. In addition, the DS4300 storage subsystem must not have any FC drives installed in its internal drive slots.

Table 6. DS4300 hardware and software compatibility (continued)

Drive expansion enclosure	Storage management software	Controller firmware	Notes
EXP700	IBM DS4000 Storage Manager Version 9.16 or later	05.33.xx.xx or 05.34.xx.xx (for Turbo version of the model 60X, 60U only, 5.40.xx.xx)	05.33.xx.xx/05.34.xx.xx or 04.xx.xx are the starting controller firmware release threads that support the DS4300 dual controller model and the DS4300 dual controller Turbo model, respectively. The latest controller firmware version 6.12.xx.xx or 6.19.xx.xx is strongly recommended. Important: The DS4300 single-controller support controller firmware version 5.34.xx.xx only.

Determining firmware levels

There are two different methods to determine the DS4000 storage subsystem and firmware versions. Each method uses the DS4000 Storage Manager client that manages the DS4300 storage subsystem.

Method One: Go to the Subsystem Management window and select **View → Storage Subsystem Profile**. When the Storage Subsystem Profile window opens, select the **All** tab and scroll through the Profile For Storage Subsystem list to locate the following information.

Note: The Profile For Storage Subsystem list contains all the profile information for the entire subsystem. Therefore, it may be necessary to scroll through a large amount of information to locate the firmware version numbers.

DS4000 Storage Subsystem

- NVSRAM version
- Appware version
- Bootware version

Drives

- Drive Firmware version
- ATA translator card firmware for EXP810 SATA enhanced disk drive module (E-DDM)

ESM

- ESM card firmware version

Method Two: Complete the appropriate procedure to obtain the specified firmware version.

To obtain the controller firmware version: Right-click the **Controller** icon in the Physical View pane of the Subsystem Management window and select **Properties**. The Controller Enclosure properties window opens and displays the properties for that controller. You must perform this step for each individual controller.

To obtain the drive firmware (and ATA translator card firmware, if appropriate) version: Right-click the **Drive** icon in the Physical View pane of the Subsystem Management window and select **Properties**. The Drive Properties window opens and displays the properties for that drive. You must perform this step for each individual drive.

To obtain the drive enclosure component ESM firmware version: In the Physical View pane of the Subsystem Management window, click the **Drive Enclosure Component** icon, which is the icon furthest to the right. The Drive Enclosure Component Information window opens. Click the **ESM** icon in the left pane. The ESM information displays in the right pane of the Drive Enclosure Component Information window. Locate the firmware version of each ESM in the drive enclosure.

Specifications

Table 7 summarizes the operating specifications of the controller unit.

Table 7. DS4300 storage subsystem operating specifications

<p>Size (with front panel and without mounting rails)</p> <ul style="list-style-type: none"> Depth: 59.7 cm (23.6 in.) Height: 13.2 cm (5.2 in.) Width: 48 cm (18.9 in.) <p>Heat output</p> <ul style="list-style-type: none"> 390 watts (1330 BTU/hr) <p>Weight</p> <ul style="list-style-type: none"> Standard storage subsystem as shipped: <ul style="list-style-type: none"> Model 60U/60X: 39.10 kg (86.2 lb) Model 6LU/6LX: 34.34 kg (75.7 lb) Unit weight: <ul style="list-style-type: none"> Model 60U/60X: 31.48 kg (69.4 lb) Model 6LU/6LX: 26.71 kg (58.9 lb) <p>Electrical input</p> <ul style="list-style-type: none"> Sine-wave input (50 to 60 Hz) is required Input voltage: <ul style="list-style-type: none"> Low range: <ul style="list-style-type: none"> Minimum: 90 V ac Maximum: 136 V ac High range: <ul style="list-style-type: none"> Minimum: 198 V ac Maximum: 264 V ac Input kilovolt-amperes (kVA) approximately: <ul style="list-style-type: none"> Minimum configuration: 0.06 kVA Maximum configuration: 0.37 kVA 	<p>Environment</p> <ul style="list-style-type: none"> Air temperature: <ul style="list-style-type: none"> storage subsystem on: 10° to 35°C (50° to 95°F) Altitude: 0 to 914 m (3000 ft.) storage subsystem on: 10° to 32°C (50° to 90°F) Altitude: 914 m (3000 ft.) to 2133 m (7000 ft.) Humidity: <ul style="list-style-type: none"> 8% to 80% Noncondensing 	<p>Acoustical noise emissions values For open bay (0 drives installed) and typical system configurations (14 hard disk drives installed).</p> <ul style="list-style-type: none"> Sound power (idling): <ul style="list-style-type: none"> 6.3 bels (open bay) 6.5 bels (typical) Sound power (operating): <ul style="list-style-type: none"> 6.3 bels (open bay) 6.8 bels (typical) Sound pressure (idling): <ul style="list-style-type: none"> 47 dBA (open bay) 49 dBA (typical) Sound pressure (operating): <ul style="list-style-type: none"> 47 dBA (open bay) 53 dBA (typical) <p>These levels are measured in controlled acoustical environments according to ISO 7779 and are reported in accordance with ISO 9296. The declared sound power levels indicate an upper limit, below which a large portion of machines operate. Sound pressure levels in your location might exceed the average 1-meter values stated because of room reflections and other nearby noise.</p>
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Shock and vibration requirements

Operational Shock: The DS4000 product will be able to withstand the following shock. Subjecting the equipment to a single shock pulse with the following characteristics will simulate this level of shock:

- Velocity change = 20 inches per second
- Wave form = Triangular, 10g @ 3.75 ms

Operational Vibration (Random): While in its normal operating position, the DS4000 product will continue operating when subjected to a random vibration test using the criteria shown in Table 8. This test uses the indicated spectral power density for 30 minutes in each of the three axes.

Table 8. Random Vibration Power Spectral Density

	Hz	5	17	45	48	62	65	150	200	500
The DS4000 subsystem	g ² /Hz	2.0x10 ⁻⁷	2.2x10 ⁻⁵							

Heat output, airflow, and cooling

The maximum heat output of the DS4300 is 390 watts (1330 BTU/hr). Each DS4300 (Model 60U/60X) and DS4000 EXP storage expansion enclosures rack-mounted unit requires an airflow of 2.5 m³ per minute (87 ft³ per minute). The input air temperature to all racks is recommended to be in the range 10°C through 35°C (50°F through 95°F), with a recommended operating temperature of 22°C (72°F).

When racks that contain many DS4300 units are to be installed together, the following requirements must be met to ensure that the DS4300 units 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, racks must be positioned in alternate rows, back-to-back and front-to-front. This arrangement is known as “Cold Aisle / Hot Aisle” and is shown in Figure 5 on page 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 DS4300 units that are in that rack. It is recommended that Suite Attach Kits be used to completely seal any gaps that remain between the racks. For details of Suite Attach Kits, contact your marketing representative.
- Where racks are in rows front-to-front or back-to-back, a gap of at least 1220 mm (48 in.) must separate the rows across the cold aisle.
- To ensure 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 DS4300 units.

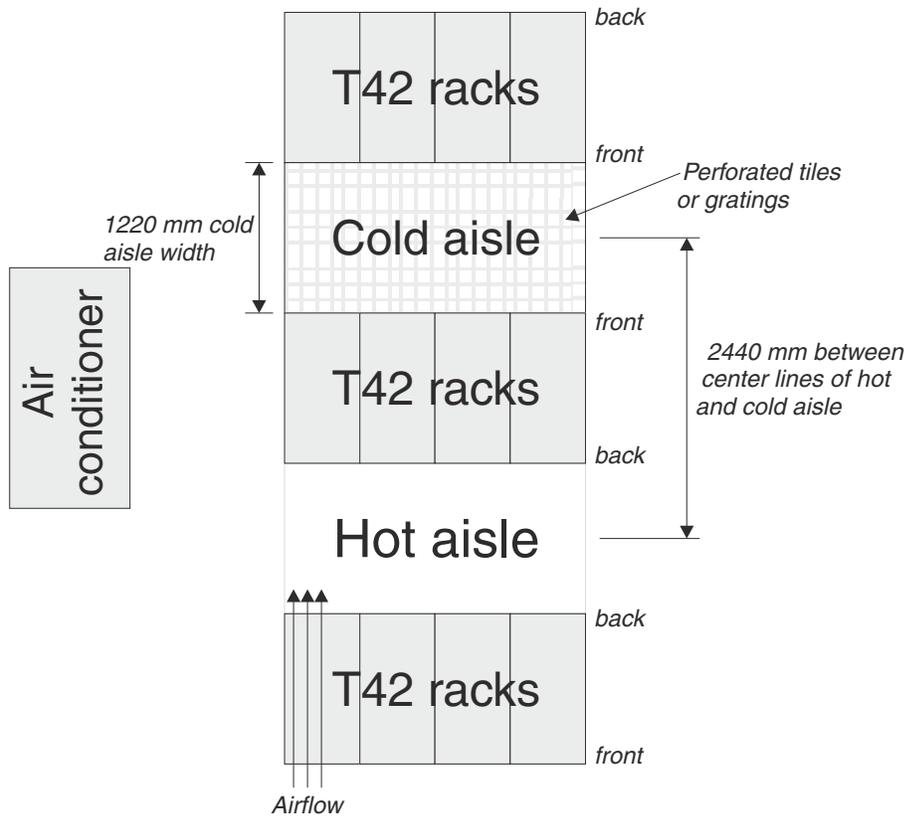


Figure 5. Example of Cold Aisle/Hot Aisle Rack Configuration

Chapter 2. Installing and configuring the storage subsystem

This chapter contains information about how to prepare, install, and configure the storage subsystem.

Getting started

Use the following list to prepare a storage subsystem for installation:

1. Prepare the site to meet all area, environmental, power, and site requirements. For more information, see “Specifications” on page 18.
2. Move the storage subsystem and its rack cabinet to the site.
3. Remove the storage subsystem from its shipping container and check the contents. (For a list of items, see “Inventory checklist” on page 8.) If any items are missing, contact your IBM reseller before you proceed.
4. Assemble the tools and equipment that you will need for installation. These might include the following:
 - Power cords (come with the storage subsystem)
 - Screwdrivers (medium flat-blade and #2 Phillips)
 - Antistatic protection (such as a grounding wrist strap)
 - SFPs
 - Fibre channel and Ethernet interface cables and cable straps
 - Rack-mounting hardware (comes with the storage subsystem)
 - Storage-management software to configure the storage subsystems (comes with the storage subsystem on the IBM TotalStorage DS4000 Storage Manager installation CD or from the IBM DS4000 System Storage Support Web site)

Rack mounting instructions and a template for aligning the holes in the rails and the rack come with the storage subsystem. If you have misplaced these items, see “Rack mounting template and instructions.”

After you install the storage subsystem in the rack and configure the storage subsystem, go to Chapter 3, “Cabling the storage subsystem,” on page 29.

Rack mounting template and instructions

A rack mounting template and instructions come with the storage subsystem. If you have misplaced these items, use the following template and instructions.

FRONT Rack Mounting Template

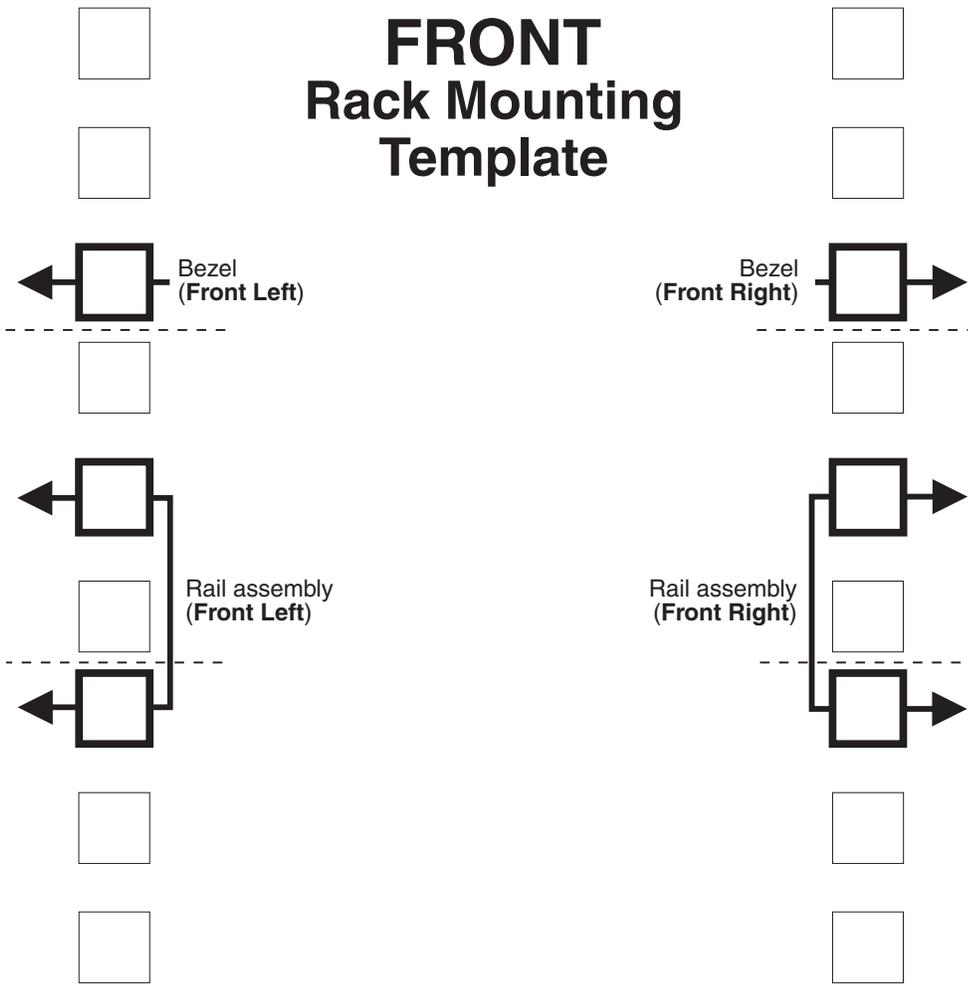


Figure 6. Front rack mounting template

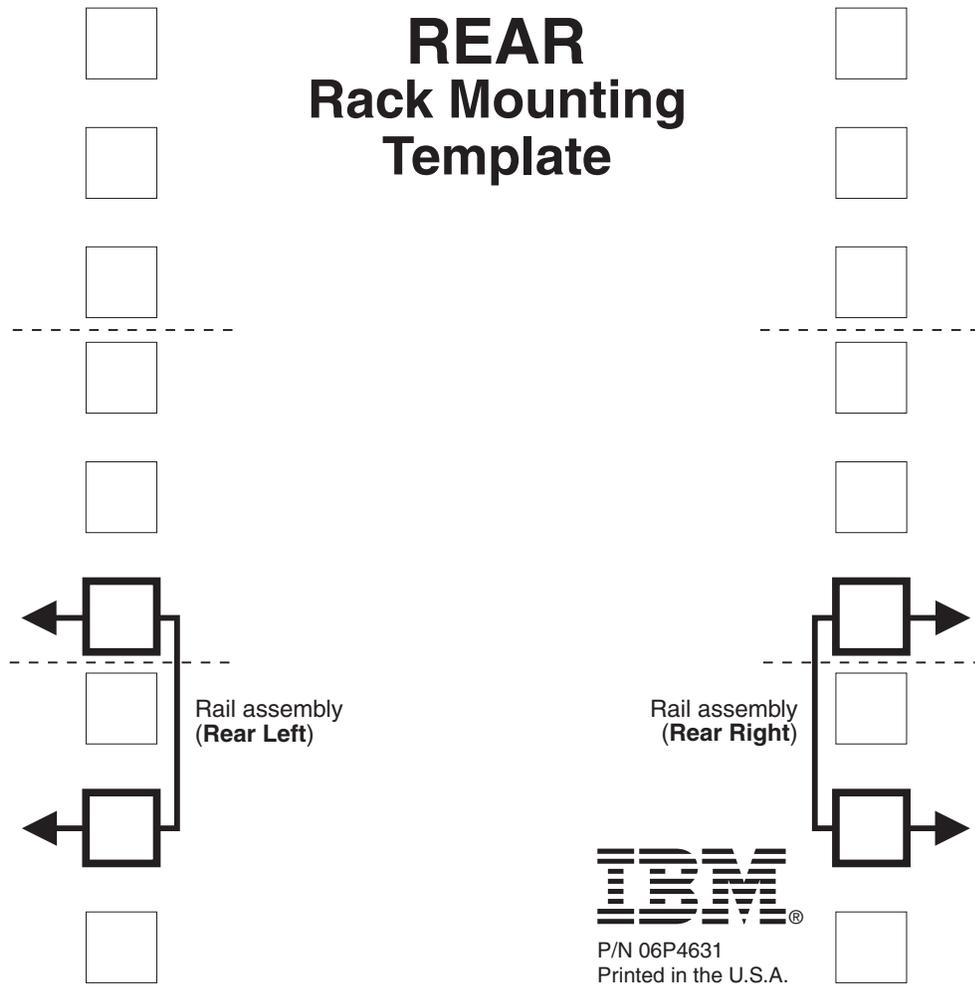


Figure 7. Rear rack mounting template

Installing the storage subsystem in a rack

Review the documentation that comes with the rack cabinet for safety and cabling information. When you install the storage subsystem in a rack, consider the following factors:

- Ensure that the room air temperature is below 35°C (95°F).
- Do not block any air vents. Usually, leaving 15 cm (6 in.) of air space provides proper airflow.
- Plan the device installation starting from the bottom of the rack.
- Do not extend more than one device out of the rack at the same time.
- Remove the rack doors and side panels to provide easier access during installation.
- Connect all power cords to properly wired and grounded electrical outlets.
- Take precautions to prevent overloading the power outlets when you install multiple devices in a rack.

Statement 4:



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

CAUTION:

Use safe practices when lifting.

You will need a flat-blade and a Phillips screwdriver during the installation. The following items come with your option. If any items are missing or damaged, contact your place of purchase.

- Cage nuts (10)
- Clip nuts (10)
- M6 screws (10)
- Side rails (2)

Perform the following steps to install the storage subsystem in a rack.

Before you begin: A DS4300 storage subsystem with 14 drives installed can weigh up to 41 kg (92 lb). At least three people are required to properly lift the storage subsystem from the shipping box and place it in the rack. For safety reasons, it is recommended you remove the CRUs from the DS4300 chassis to lighten the load for ease in moving the DS4300 unit. If you do not have enough people, follow the recommendation to perform the first four steps for the installation procedure, which involve removing some components from the storage subsystem in order to reduce the weight of the storage subsystem for easier installation.

1. Use the attached template and stickers to mark the appropriate holes on the rack; then install clip nuts or cage nuts as required for the rack cabinet.

Note: Use the cage-nut-insertion tool or a flat-blade screwdriver to install cage nuts.

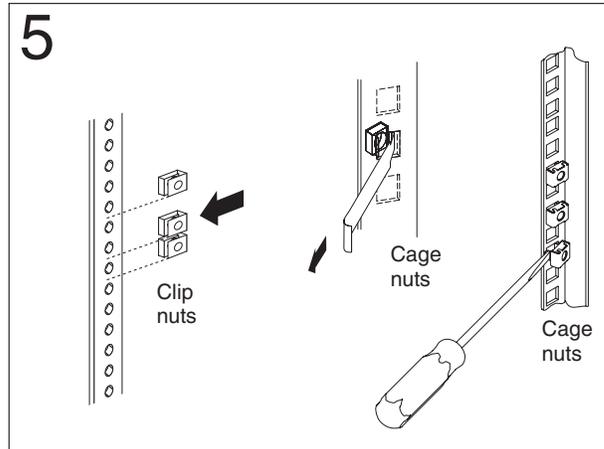


Figure 8. Rack nut installation

2. On the rail marked **R**, remove the 6/32 in. screw **3** and loosen the four screws **2**; then hold the front of the rail against the outside of the right rack-mounting-flange and loosely install two M6 screws **1**.

Extend the rear of the rail outside of the rear rack-mounting-flange; then install and tighten two M6 screws **4**. Tighten the front screws **1** and repeat this step for the other rail.

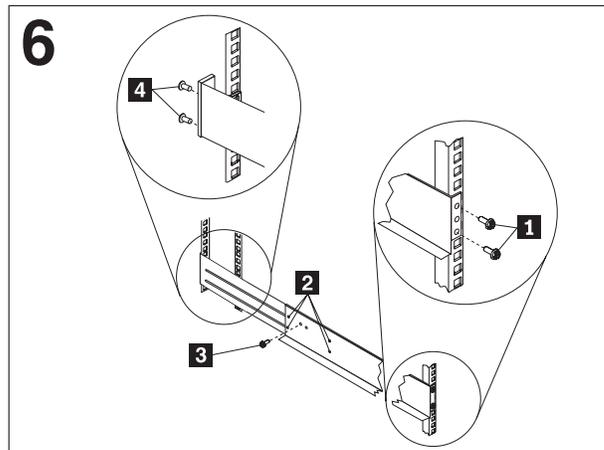


Figure 9. Rail extension

3. Tighten the rail adjustment screws **1** on both rails.

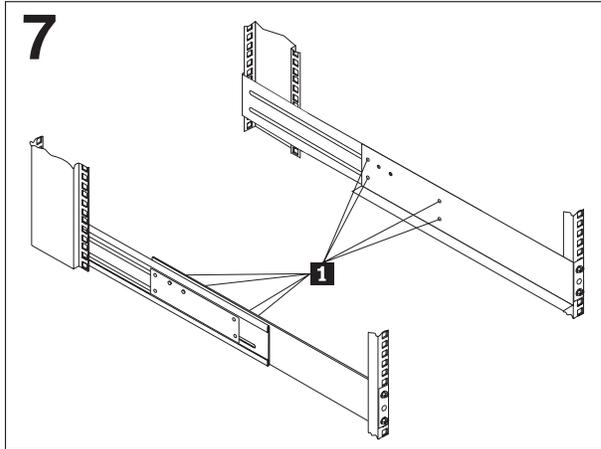


Figure 10. Rail adjustment screws

4. To remove a RAID controller, push down on the latch centered on the controller; then, grasp the pull-rings on the levers and pull them to remove the RAID controller and set it aside for later installation.

If you have a second RAID controller, repeat this step for the second controller.

Attention: Observe ESD procedures when removing CRUs from the DS4300 storage subsystem. See the storage subsystem documentation for handling guidelines before removing any ESD-sensitive devices.

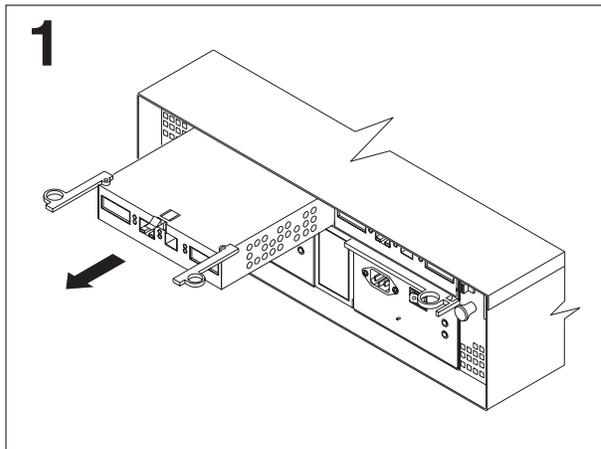


Figure 11. RAID controller removal

5. To remove a hot-swap fan, slide the latch on the fan to unlock it; then pull the handle and remove the fan from the storage subsystem.

Repeat this step for the other fan and set both fans aside for later installation.

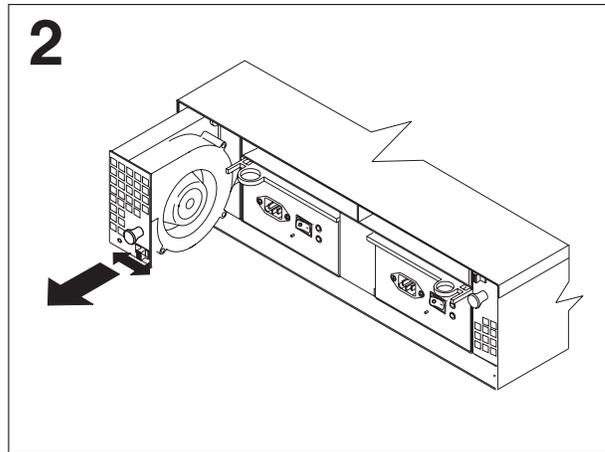


Figure 12. Hot-swap fan removal

6. To remove a power supply, grasp the pull-ring on the power supply lever and squeeze to release it; then pull the lever fully open and remove the power supply from the storage subsystem.

Repeat this step for the other power supply; then set both power supplies aside for later installation.

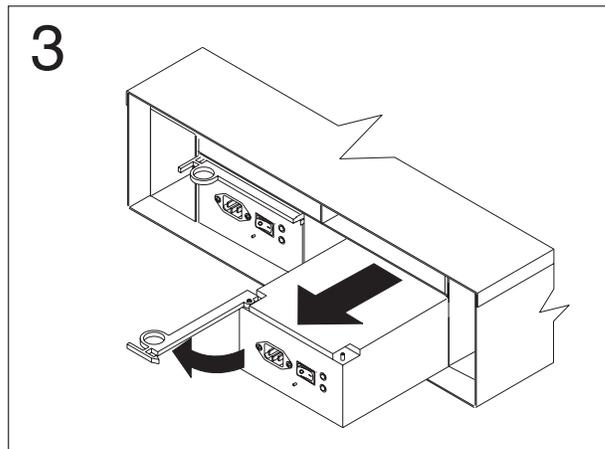


Figure 13. Power supply removal

7. To remove a hard disk drive **2**, press the blue latch **3** and pull the handle **1** upwards; then carefully pull the drive from the storage subsystem.

Attention: Place the removed drives in a horizontal position, with the printed circuit boards facing down. Do not stack the drives on top of each other. Protect from vibrations or sudden shocks.

Note: Before you remove any hard disk drives, make sure that you mark their location so that you can reinstall them in the same location.

Repeat this step for all hard disk drives.

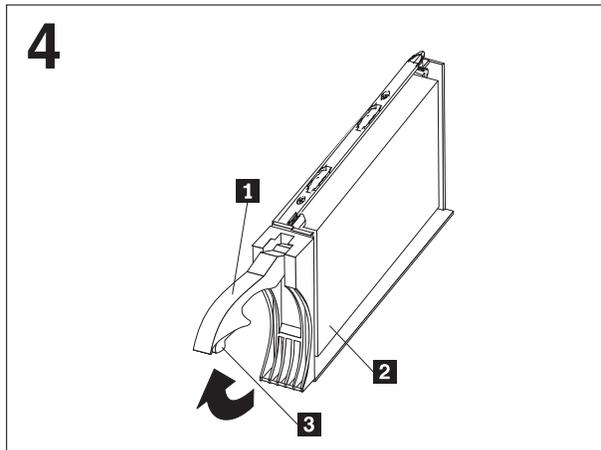


Figure 14. Hard disk drive removal

8. Remove the white screws and nuts **1** from the storage subsystem bezel; then slide the storage subsystem into the rack. Align the bezel locator pins and attach the bezel with two M6 screws **2**; then install and tighten the 6-32 in. screws **3**.

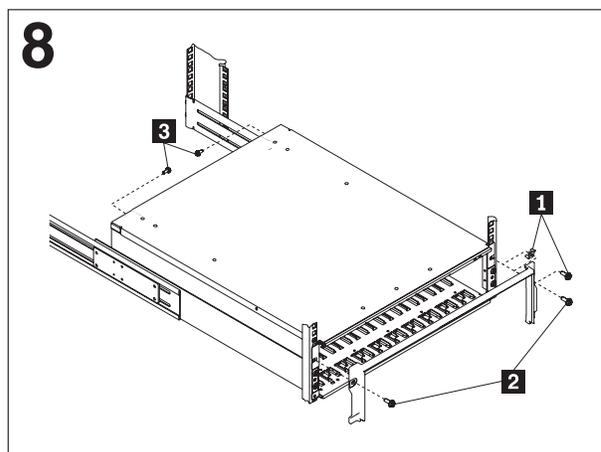


Figure 15. Server installation

9. Reverse step 1 through step 4 to reinstall the components that you removed. To cable the DS4300 to the host and the storage expansion enclosure, see Chapter 3, "Cabling the storage subsystem," on page 29.

Chapter 3. Cabling the storage subsystem

This chapter provides fibre channel and power cabling information for the storage subsystem in the following sections:

- “Setting server/tray ID settings”
- “Working with SFPs and fiber-optic cables” on page 30
- “Connecting storage expansion enclosures to the DS4300” on page 45
- “Configuring the drive loops with storage expansion enclosures” on page 61
- “Host fibre channel connections” on page 74
- “Connecting hosts to the RAID controllers” on page 80
- “Configuring the storage subsystem” on page 82
- “Connecting secondary interface cables” on page 84
- “Power cabling” on page 85
- “Installing the storage-management software” on page 86

After you attach the storage subsystem power cables, use the instructions that are provided in “Turning the storage subsystem on and off” on page 92 for the initial startup of the storage subsystem.

Setting server/tray ID settings

The DS4300 storage subsystem comes with a server ID switch that is used to identify the DS4300 on a fibre channel loop. The server ID switch is located on the back of the unit, as shown in Figure 16 on page 30.

Note: The Server ID switch is sometimes referred to as an *Enclosure ID* switch.

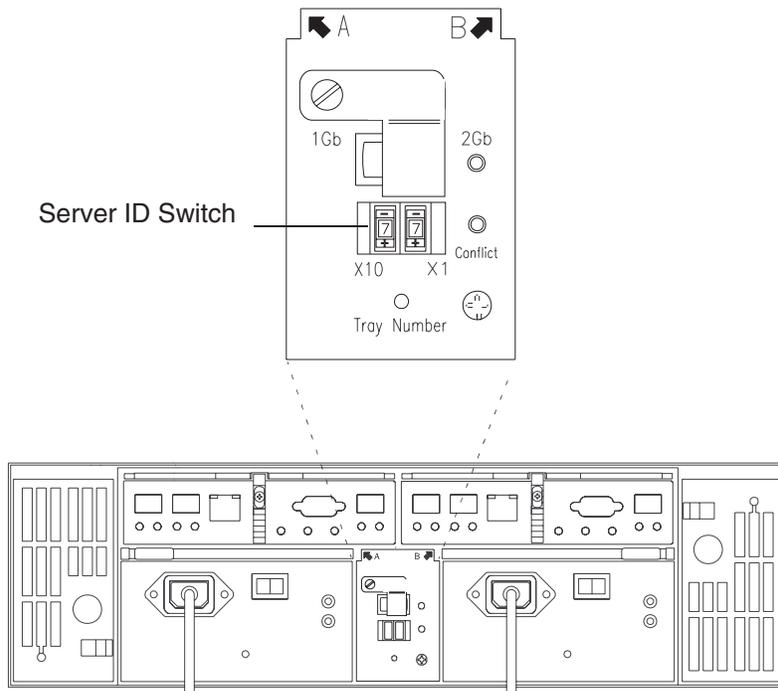


Figure 16. Setting the Server ID

Server ID switch settings set the server ID to a value from 00 - 77. Server ID switch X1 is for setting the ones position, and Server ID switch X10 is for setting the tens position. The settings of the two server ID switches, when used together, provide a two-digit ID of the server unit. The storage-management software uses the server ID to provide a correlation between the storage-management graphics and the physical storage unit. The ID indicates which physical unit corresponds to the storage-management software status.

Use Server ID switches X10 and X1 to set the server-unit ID to any value from 00 through 77.

Note: Each server unit should have a unique ID if it is going to be connected to other DS4000 EXP storage expansion enclosures through the storage expansion enclosure loop ports. The Server ID setting is only valid for the drive loop. The amber Conflict LED (located on the right-side of the switch) will be lit if there is another unit in the drive loop that has the same ID setting as the server ID. See your storage subsystem documentation for more information.

Working with SFPs and fiber-optic cables

Each RAID controller CRU contains ports for SFP modules that connect to the fiber-optic cables. Two of the SFP ports are for host server attachment. On the DS4300 Model 60U/60X, each RAID controller also has an additional port that connects DS4000 EXP storage expansion enclosures to the storage subsystem.

First, insert the SFP into the port, and then insert a fiber-optic cable into the SFP. The other end of the fiber-optic cable connects to an external device. Note that SFPs are laser products.

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.

Types of interface ports

The following sections briefly discuss the types of interface ports.

Host ports

DS4300 controller host ports are used for data transfer between hosts (servers) and the RAID controllers in the DS4300 Storage Subsystem. Each controller has two independent host ports in a *switched* (not a hub) implementation. To ensure redundancy, you must connect each host to both controllers through the appropriate port. The DS4300 with dual controllers (model 60X/U) support a maximum of two hosts redundantly directly connected to it. To support more host connections, one can connected the DS4300 host ports and the servers to the FC switches in a SAN. The DS4300 single controller supports a maximum of two hosts non-redundantly connected to it.

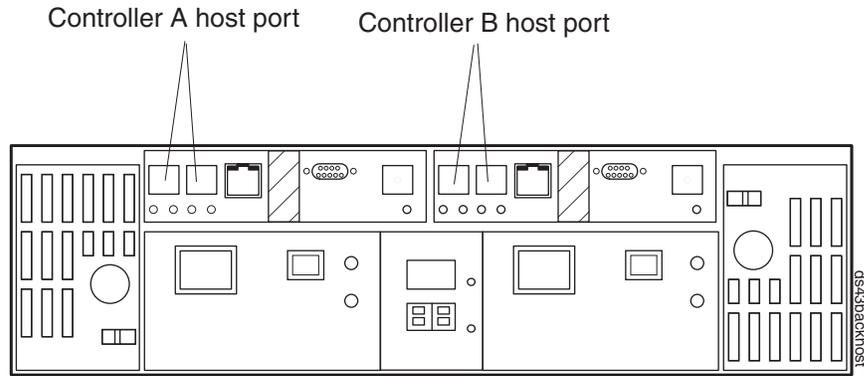


Figure 17. Location of host ports

Expansion ports (also referred to as drive ports)

The DS4300 controller drive/expansion ports are used for extending the storage capacity from the internal DS4300 chassis. They are used for data transfer between the drives in the DS4000 storage expansion enclosures and the RAID controllers in the DS4300 Storage Subsystem. There is only one drive/expansion port per controller. The drive/expansion port from each controller must be connected to the same set of DS4000 storage expansion enclosures to support redundant drive loop configurations (two data paths per storage expansion enclosure). DS4300 Storage Subsystems support only one redundant drive-loop pair. The DS4300 single controller model does not have any expansion ports.

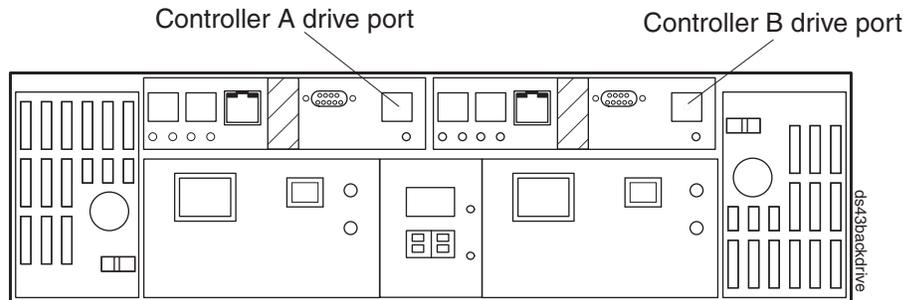


Figure 18. Location of drive ports

Ethernet ports

There are two Ethernet interface ports, one for each controller (Controller A and Controller B). Use the Ethernet ports to directly manage (also referred to as *out-of-band management*) DS4300 storage subsystems. With controller firmware version 6.xx.xx.xx, the default IP addresses for controllers A and B Ethernet ports are 192.168.128.101 and 192.168.128.102, respectively. The default subnet masks for these ports are 255.255.255.0. The DS4300 single controller model has only one Ethernet port (because it has only one controller).

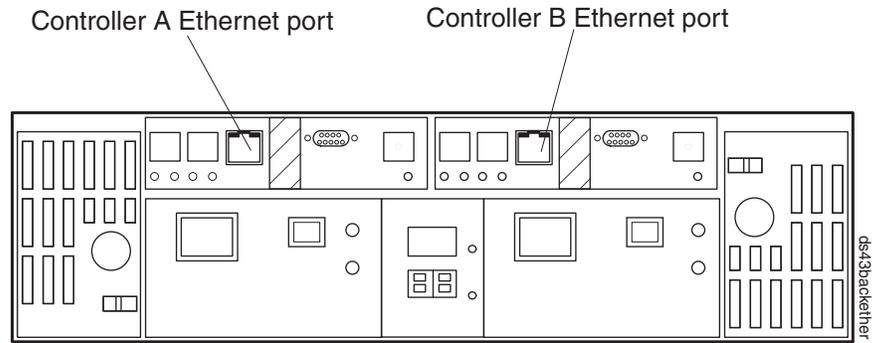


Figure 19. Location of Ethernet ports

Handling fiber-optic cables

Before using fiber-optic cables, read the following precautions.

Attention: To avoid damage to the fiber-optic cables, follow these guidelines:

- Do not route the cable along a folding cable-management arm.
- When attaching to a device on slide rails, leave enough slack in the cable so that it does not bend to a radius of less than 38 mm (1.5 in.) when extended or become pinched when retracted.
- Route the cable away from places where it can be snagged by other devices in the rack.
- Do not overtighten the cable straps or bend the cables to a radius of less than 38 mm (1.5 in.).
- Do not put excess weight on the cable at the connection point. Be sure that the cable is well supported.

Installing SFP modules

The DS4300 storage subsystem host ports require SFP modules. SFP modules are used to convert electrical signals to optical signals that are required for Fibre Channel transmission to and from RAID controllers. The DS4300 storage subsystem supports two types of SFP modules; one with a plastic pull-tab latch and one with a metal or plastic wire latch. After you install the SFP modules, you will use fiber-optic cables to connect the DS4300 storage subsystem to other fibre channel devices.

Before you install SFP modules and fiber-optic cables, read the following information:

- The SFP module housing has an integral guide key designed to prevent you from inserting the SFP module improperly.
- Use minimal pressure when you insert the SFP module into a port. Forcing the SFP module into a port could cause damage to the SFP module or the port.
- You can insert or remove the SFP module while the port is powered on.
- The operational 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 35 for more information.
- Do not mix long-wave SFPs and short-wave SFPs on a single storage subsystem. Use only short-wave SFPs; the DS4300 subsystems do not support long-wave SFPs. You can use the DS4000 Storage Manager client to view the Storage Subsystem Profile in order to verify that you are not mixing long-wave and short-wave SFPs.

To install an SFP module, complete the following steps.

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.

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 9.

1. Remove the SFP module from its static-protective package.
2. Remove the protective cap from the SFP module, as shown in Figure 20 on page 35. Save the protective cap for future use.

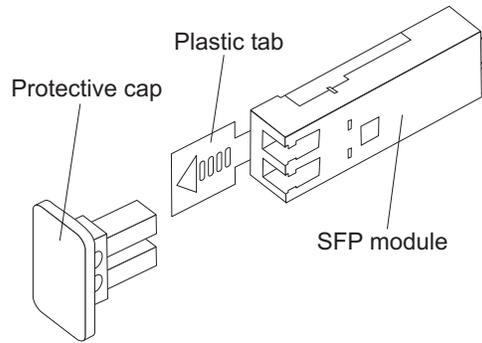


Figure 20. SFP Module

3. Remove the protective cap from the host port. Save the protective cap for future use.
4. Insert the SFP module into the host port until it clicks into place. See Figure 21.

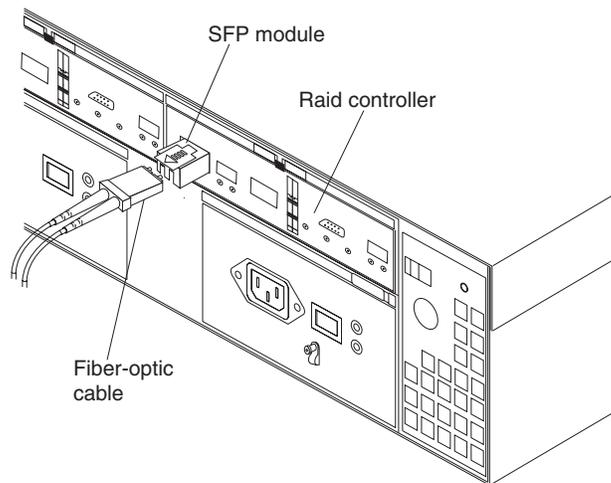


Figure 21. Installing an SFP module into the host port

5. Connect a fibre channel cable.

Removing SFP modules

To remove the SFP module from the host port, perform the following steps.

Attention: To avoid damage to the cable or the SFP module, make sure you unplug 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 “Handling fiber-optic cables” on page 33.
2. Unlock the SFP module latch:
 - For SFP modules containing plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 22 on page 36.

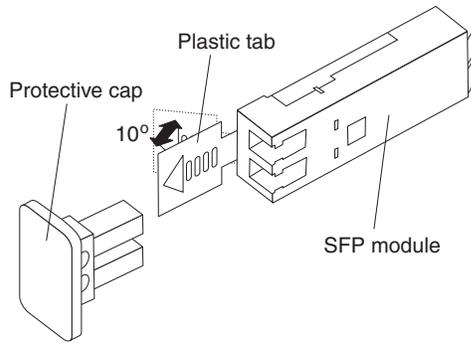


Figure 22. Unlocking the SFP module latch - plastic variety

- For SFP modules containing wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 23.

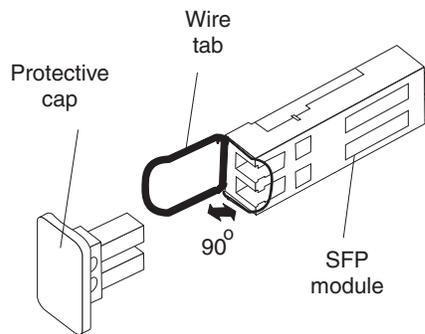


Figure 23. Unlocking the SFP module latch - wire variety

3. With the SFP latch in the unlocked position, extract the SFP module.
 - For SFP modules containing plastic tabs, slide the SFP module out of the port.
 - For SFP modules containing wire tabs, grasp the wire latch and pull the SFP module out of the minihub 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 port.

Using LC-LC fibre-channel cables

The LC-LC fibre-channel cable is a fiber-optic cable that you use to connect DS4700 fibre channel ports into one of the following devices:

- An SFP module installed in a fibre channel switch port
- An SFP module of the host bus adapter port
- An SFP module installed in an IBM® DS4000 storage expansion enclosure

See Figure 24 on page 37 for an illustration of the LC-LC fibre-channel cable.

For more information about cabling these devices, see the documentation that comes with the LC-LC fibre-channel cable.

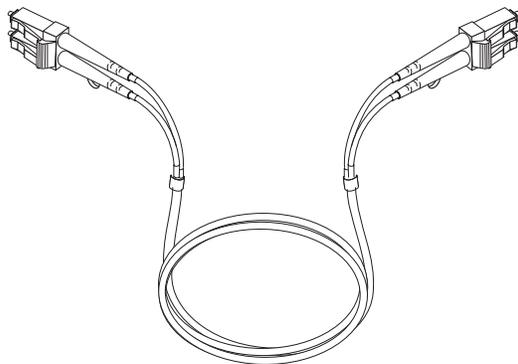


Figure 24. LC-LC fibre-channel cable

Connecting an LC-LC cable to an SFP module

Complete the following steps to connect an LC-LC fibre-channel cable to an SFP module:

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.

1. Read the information in “Handling fiber-optic cables” on page 33.
2. If necessary, remove the protective cap from the SFP module, as shown in Figure 20 on page 35. 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 25 on page 38. Save the protective caps for future use.

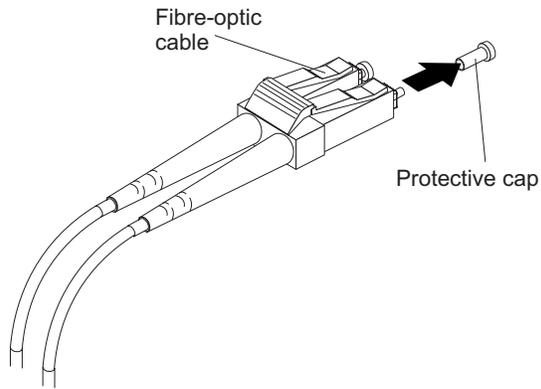


Figure 25. Removing fiber-optic cable protective caps

4. Carefully insert this end of the LC-LC cable into an SFP module that is installed in the DS4700. The cable connector is keyed to ensure it is inserted into the SFP module correctly. Holding the connector, push in the cable until it clicks into place, as shown in Figure 26.

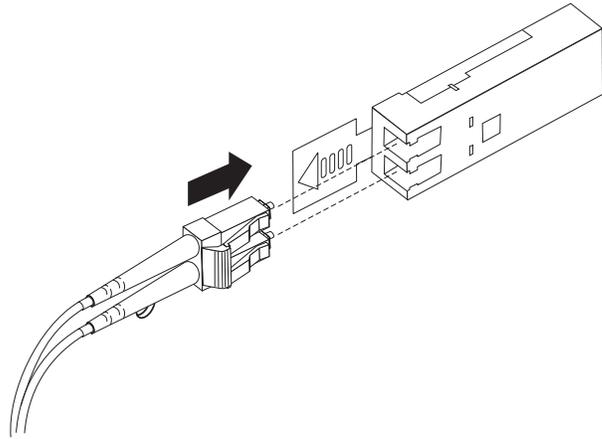


Figure 26. Inserting an LC-LC fibre-channel cable into an SFP module

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 separate IBM DS4000 EXP storage expansion enclosure
 - 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

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.

Complete the following steps to remove an LC-LC fibre-channel cable:

1. On 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 27.

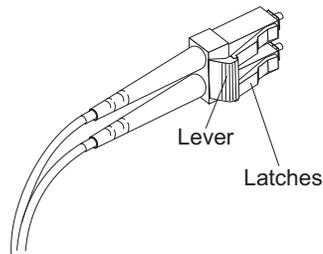


Figure 27. LC-LC fibre-channel cable lever and latches

2. While pressing down the cable lever, carefully pull on the connector to remove the cable from the SFP module, as shown in Figure 28.

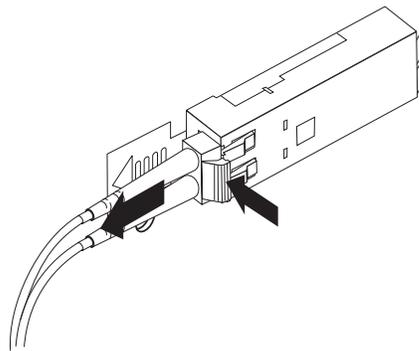


Figure 28. Removing the LC-LC fibre-channel cable

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 into one of the following devices that require SC connectors:

- 1-Gbps fibre channel switch
- Fibre channel host bus adapter

Attention: The DS4700 does not support the attachment of storage expansion enclosures that operate at 1 Gbps, such as the EXP500.

For more information about connecting to these devices, see the documentation that comes with the LC-SC fibre-channel cable adapter.

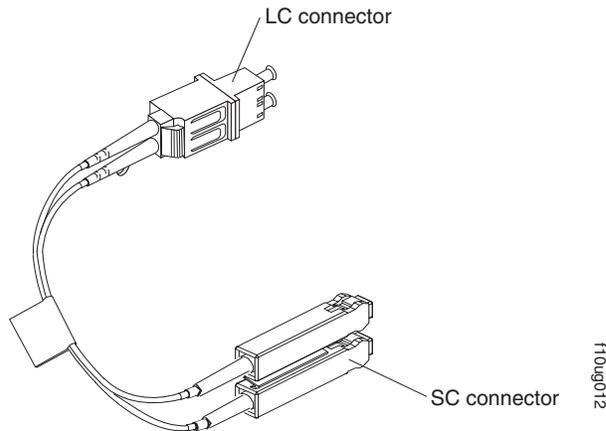


Figure 29. LC-SC fibre-channel cable adapter

The following sections provide the procedures for properly connecting and removing an LC-SC fibre-channel cable.

Connecting an LC-SC cable adapter to a device

Complete the following steps to connect an LC-SC fibre-channel cable adapter to a device:

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.

1. Read the information in “Handling fiber-optic cables” on page 33.

2. Connect one end of an LC-LC cable to an SFP module in the DS4700. For instructions, see “Using LC-LC fibre-channel cables” on page 36.
3. Remove the two protective caps from the LC connector end of the LC-SC cable adapter as shown in Figure 30. Save the protective caps for future use.

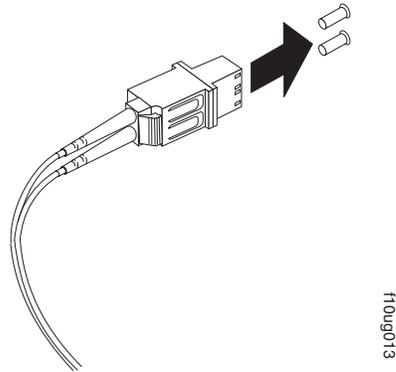


Figure 30. Removing the LC-SC cable adapter protective caps

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 31. Push in the connector until it clicks into place.

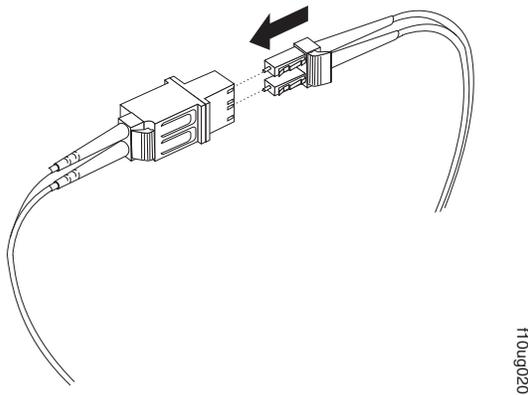


Figure 31. Connecting an LC-LC cable into the LC-SC cable adapter

5. If you are connecting the DS4700 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 comes with the device.

Removing an LC-LC cable from an LC-SC cable adapter

Attention: To avoid damaging the LC-LC cable, make sure you press and hold the lever to release the latches before you remove the cable from an LC-SC cable adapter. Ensure that both levers are in the released position when removing the cable. When removing the cable from the SFP module, make sure you do not grasp the SFP module plastic tab.

Complete the following steps to remove an LC-LC cable from an LC-SC cable adapter:

1. On 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 32 shows the location of the lever and latches.

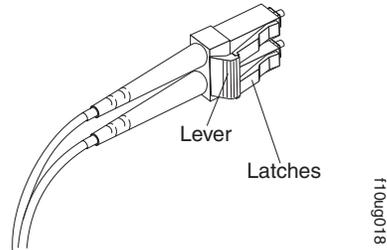


Figure 32. LC-LC fibre-channel cable lever and latches

2. Carefully pull on the connector to remove it. Make sure you grasp the connector and not the cable when removing the LC-LC cable from the LC-SC cable adapter as shown in Figure 33.

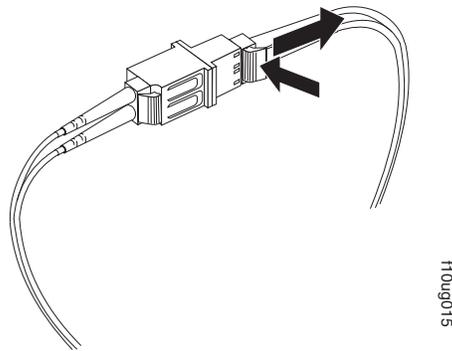


Figure 33. Removing the LC-LC fibre-channel cable from an LC-SC fibre-channel cable adapter

3. Replace the protective caps on the cable ends.

Installing fiber-optic cables

To connect the fiber-optic cables, perform the following steps:

1. Remove the protective cap from the fiber-optic cable. See Figure 34 on page 43.

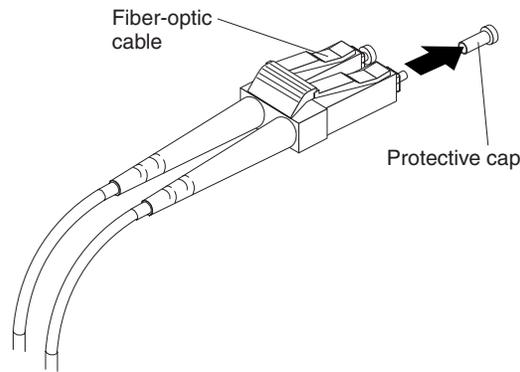


Figure 34. Removing caps from fiber-optic cables

2. Connect the fiber-optic cable to the installed SFP, as shown in Figure 35, using the instructions as describe in “Connecting an LC-LC cable to an SFP module” on page 37.

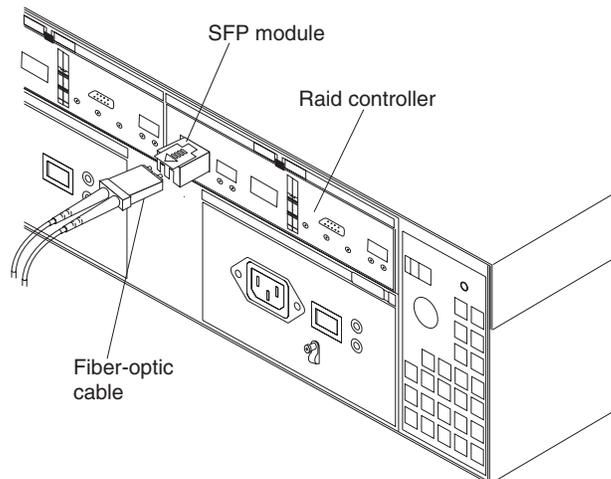


Figure 35. Connecting cables to the installed SFP

3. Check the LEDs on the RAID controller. When the RAID controller is operating properly, the amber Fault LED is off. For information about the status of the RAID controller LEDs, see Table 14 on page 99.
4. To remove the fiber-optic cables, refer to the instructions described in “Removing an LC-LC fibre-channel cable” on page 39.

Fibre channel connections

DS4300 Fibre Channel connections consist of two host fibre channel loops and up to one drive fibre channel loop, depending on the storage subsystem model. These fibre channel connections are made through three SFP ports, which are labeled “Host 1,” “Host 2,” and “Expansion.”

Exception: The DS4300 single-controller storage subsystem (Model 6LU/6LX) does not support drive loops or storage expansion enclosures.

The host fibre channel loop provides the fibre path for host attachment. It can consist of fibre channel cables, SFPs, host bus adapters, fibre channel switches,

and RAID controllers. The expansion drive (or storage expansion enclosure) fibre channel loop provides the fibre path to the hard disk drives (HDDs) that are outside the DS4300 storage subsystem chassis. The drive fibre channel loop consists of fibre channel HDDs and optional DS4000 EXP storage expansion enclosures, fibre channel cables, and SFPs.

The DS4300 dual-controller storage subsystem (Model 60U/60X) supports redundant disk-drive-loop configurations. You can build a redundant drive loop by connecting one or more DS4000 EXP storage expansion enclosures to the redundant RAID controllers. Then, use dual fiber-optic cables to connect one storage expansion enclosure to another in a daisy-chain. For more information about adding storage expansion enclosures, see “Connecting storage expansion enclosures to the DS4300” on page 45.

Redundant drive loop cabling overview

The DS4300 with dual controllers storage subsystem supports one redundant drive loop. A redundant drive loop consists of one or more storage expansion enclosures connected to a controller using two sets of fibre channel cables. If one data path fails, the controller uses the other data path to maintain the connection to the drive group.

Figure 36 shows a storage subsystem containing one storage subsystem and one redundant drive loops with four storage expansion enclosures. Each storage expansion enclosures group uses redundant drive loops to connect to the DS4300 Storage Subsystem.

Attention: To prevent loss of storage expansion enclosure redundancy, connect the storage expansion enclosures as shown in Figure 36.

Note: The illustrations in this document might differ slightly from the hardware.

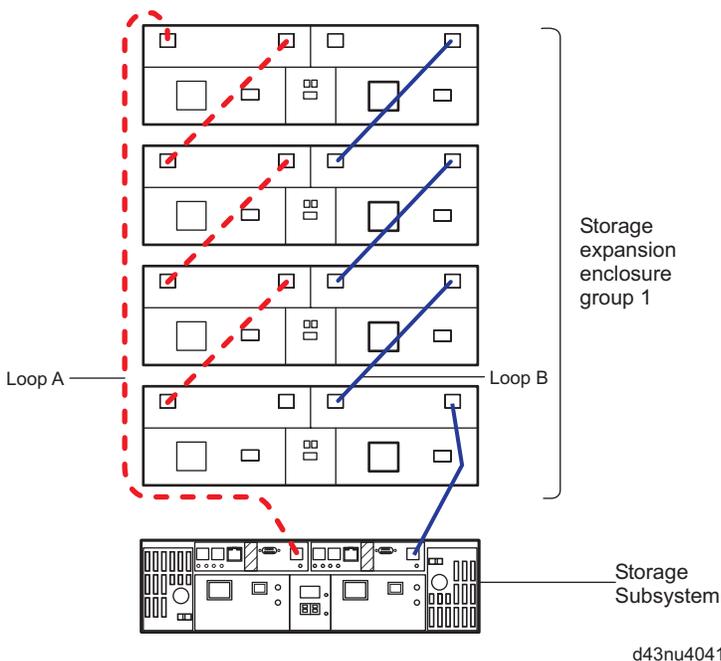


Figure 36. Redundant drive loop cabling overview

For specific information about how to cable the storage subsystem and storage expansion enclosures, see “Connecting storage expansion enclosures to the DS4300.”

Connecting storage expansion enclosures to the DS4300

Attention: Before powering on the DS4300 storage subsystem, it must be populated with at least two drives. If at least two drives are not installed in each attached storage expansion enclosure or DS4300 storage subsystem, when you power on the DS4300 and its attached storage expansion enclosures, your standard storage partition key might be lost and must be regenerated using instructions on the IBM DS4000 Solutions and Premium Features Web site:

<http://www-912.ibm.com/PremiumFeatures/>

In addition, the resulting insufficient load to the enclosure power supplies might cause them to intermittently appear as failed, falsely indicating the power supplies are bad. All drives in the DS4300 storage subsystem and the connected storage expansion enclosure or enclosures must contain no prior configuration data.

After you install the DS4300 dual-controller storage subsystem (Model 60U/60X), you can connect DS4000 EXP storage expansion enclosures.

Note: You cannot connect storage expansion enclosures to the DS4300 single-controller storage subsystem (Model 6LU/6LX). If you are using the DS4300 single-controller storage subsystem, skip this section.

You can connect storage expansion enclosures any time after you install the storage subsystem, even while it is turned on and processing data. You can even install one storage expansion enclosure now and an additional storage expansion enclosure later.

Up to 112 drives (including the 14 drives inside the DS4300 chassis) can be supported by the DS4300 dual controller storage subsystems. The maximum number of drives in a DS4300 subsystem depends on the models. (See the Notes below for more information.)

In addition, if there is a mix of 14-drive (EXP7x0/EXP100) and 16-drive (EXP810) storage expansion enclosures behind a DS4300, the maximum number of drives in the drive loop will be decrease depending on the combinations/mix of 14-drive (EXP7x0/EXP100) and 16-drive (EXP810) storage expansion enclosures. See Table 11 on page 50.

Important

1. The DS4300 single controller model 6LX/6LU does not support any storage expansion enclosures. The DS4300 dual controller standard model 60U/60X supports up to three storage expansion enclosures by purchasing up to three storage expansion enclosure attachment entitlements. The DS4300 dual controller Turbo model 60U/60X comes with the entitlement to support up to a maximum of seven storage expansion enclosures.
2. If you want to connect up to seven storage expansion enclosures to the DS4300 dual controller standard model 60U/60X, you must purchase the Turbo option or buy the seven enclosure attachment license. Furthermore, to add storage expansion enclosure attachment capability to the DS4300 single controller model 6LX/6LU, you must either purchase the DS4300 controller upgrade to Turbo controller option or the DS4300 controller upgrade to the standard dual-controller and up to three additional storage expansion attachment entitlements. Contact your IBM resellers or marketing representatives for more information.
3. You can add only *new* storage expansion enclosures to the initial/new installation of the DS4300 storage subsystem. This means that there must be no existing configuration information in the drives installed in the storage expansion enclosure or the DS4300 storage subsystem that you want to install. If the drives in the DS4300 storage subsystem or the storage expansion enclosure that you want to install currently contains logical drives or configured hot spares, and you want them to be part of the DS4300 storage subsystem, refer to the *IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*. Improper drive migration might cause loss of configuration and other storage subsystem problems.
4. In addition to the information and procedures in this chapter, you can also refer to the *IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* for the latest required controller firmware versions and the supported combinations of enclosure types that you can intermix behind a DS4300 subsystem.

Note: You must purchase the IBM System Storage FC/SATA Intermix premium feature to combine SATA enclosures (DS4000 EXP100s or EXP810s with SATA enhanced disk drive modules) with fibre channel enclosures (DS4000 EXP700s, EXP710s, or EXP810s that have fibre channel drives) in the same DS4300 Storage Subsystem configuration.

5. The EXP700 expansion enclosure must be upgraded to an EXP710 expansion enclosure by using the *DS4000 EXP700 Models 1RU/1RX Switched-ESM Option Upgrade Kit* for intermixing with the EXP810 expansion enclosures. In addition, the DS4300 controller firmware must be at 06.19.xx.xx or higher.

The following DS4000 storage expansion enclosure types are supported by the DS4300 Storage Subsystem:

- DS4000 EXP700
- DS4000 EXP710
- DS4000 EXP100
- DS4000 EXP810

Supported storage expansion enclosure configurations and intermix combinations

Although the DS4300 Storage Subsystem supports various types of DS4000 storage expansion enclosures, not all combinations of these supported storage expansion enclosures are possible or supported as storage expansion enclosures intermixed within a DS4300 Storage Subsystem configuration. In addition, if you intermix storage expansion enclosures with SATA and FC drives within a DS4300 Storage Subsystem configuration, an FC/SATA intermix premium feature must be purchased for that DS4300 Storage Subsystem. For additional information about Intermix configurations, see the *IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview* (GC26-7713-01).

For the DS4300 dual-controller standard model, the maximum number of storage expansion enclosures in a DS4300 drive loop is three no matter what type of storage expansion enclosures used or whether there is a mix of 14-drive and 16-drive storage expansion enclosure in the drive loop or not when the three expansion attachment entitlement was purchased. Otherwise, the maximum number of storage expansion enclosures in the drive loop is equaled to the number indicated in the purchased storage expansion enclosure attachment entitlement (one or two).

For the DS4300 dual-controller Turbo model, the maximum number of storage expansion enclosures in a DS4300 drive loop depending on whether the attached storage expansion enclosures are of 14-drive enclosures or 16-drive enclosures only or of a combination of the 14-drive or 16-drive enclosures. Table 9 shows the maximum number of enclosures in a DS4300 drive loop for various supported DS4000 storage expansion enclosures, as well as the maximum number of enclosures in the drive loop when intermixing supported enclosure models.

Table 9. Storage expansion enclosure configurations for DS4300 dual-controller Turbo models only

	EXP100	EXP700	EXP710	EXP810
Maximum number of enclosures in a DS4300 drive loop	7 (or 8 ²)	7	7	6 (or 7 ³)
Maximum number of enclosures in a DS4300 drive loop when intermixing with EXP700	7	7	7	Not supported ¹
Maximum number of enclosures in a DS4300 drive loop when intermixing with EXP100	7	7	7	6

Table 9. Storage expansion enclosure configurations for DS4300 dual-controller Turbo models only (continued)

	EXP100	EXP700	EXP710	EXP810
Maximum number of enclosures in a DS4300 drive loop when intermixing with EXP710	7	7	7	6
Maximum number of enclosures in a DS4300 drive loop when intermixing with EXP810	6	Not supported ¹	6	6
Maximum number of enclosures in a DS4300 drive loop when intermixing with EXP700 and EXP100	7	7	7	Not supported ¹
Maximum number of enclosures in a DS4300 drive loop when intermixing with EXP700 and EXP710	7	7	7	Not supported ¹
Maximum number of enclosures in a DS4300 drive loop when intermixing with EXP100 and EXP810	6	Not supported ¹	6	6
Maximum number of enclosures in a DS4300 drive loop when intermixing with EXP710 and EXP810	6	Not supported ¹	6	6

Table 9. Storage expansion enclosure configurations for DS4300 dual-controller Turbo models only (continued)

	EXP100	EXP700	EXP710	EXP810
Notes:				
1. Only when the EXP700 is upgraded to an EXP710 with the <i>DS4000 EXP700 Models 1RU/1RX Switched-ESM Option Upgrade Kit</i> .				
2. If there are no drives in the DS4300 subsystem internal drive slots and the only enclosures connected are EXP100s, up to eight EXP100 storage expansion enclosures can be connected to the DS4300 when using the special DS4300 NVSRAM file to disable the DS4300 internal drive slots. This is the only configuration where eight 14 drive storage expansion enclosures can be attached to the DS4300.				
3. If there are no drives in the DS4300 subsystem internal drive slots and the only enclosures connected are EXP810s, up to seven EXP810 storage expansion enclosures can be connected to the DS4300 when using the special DS4300 NVSRAM file to disable the DS4300 internal drive slots. This is the configuration where seven 16 drive storage expansion enclosures can be attached to the DS4300.				

DS4000 storage expansion enclosure models can be mixed in the same pair of redundant drive loops. Table 10 shows whether an existing storage expansion enclosure within a DS4300 redundant drive loop can support the addition of new storage expansion enclosures of another model type. Table 11 on page 50 lists possible 14-drive (EXP710/EXP100) and 16-drive (EXP810) storage expansion enclosure intermix combinations, as well as total number of drives for each combination for a DS4300 dual controller Turbo model.

Note: Since the maximum number of drives that can be supported in the DS4300 dual controller Turbo models redundant drive loop pair is 112, IBM does not support the use of partially filled drive enclosures when intermixing storage expansion enclosures of different drive slot capacities to prevent the possibility of going over the maximum of 112 drives in a drive loop. Intermixing drive expansion enclosures with different a number of drive slots will reduce the maximum number of drives that can be configured in a redundant drive loop pair, as shown in Table 11 on page 50.

Table 10. Support for new storage expansion enclosures within a DS4300 drive loop

Existing EXP drive expansion enclosure in drive loop	New EXP drive expansion enclosure ¹			
	EXP100	EXP700	EXP710	EXP810 (FC or SATA)
EXP100	Yes ³	Yes ^{3, 6}	Yes ^{3, 4, 6}	Yes ^{5, 6}
EXP700	Yes ^{3, 6}	Yes ²	Yes ⁴	No ⁷
EXP710	Yes ^{3, 4, 6}	Yes ⁴	Yes ⁴	Yes ^{5, 6, 8}
EXP810 (FC or SATA)	Yes ^{5, 6}	No ⁷	Yes ^{5, 6, 8}	Yes ^{5, 6, 8}

Table 10. Support for new storage expansion enclosures within a DS4300 drive loop (continued)

Notes:	
1.	The EXP100 and EXP710 operate at 2 Gbps FC speed only. Because the EXP810 operates at 2 Gbps and 4 Gbps FC speed, its enclosure speed must be set at 2 Gbps before connecting to the DS4300 drive loop. Similarly, the EXP700 enclosure speed switch must be set at 2 Gbps before connecting to the DS4300 drive loop.
2.	Requires DS4300 controller firmware version 5.3x.xx.xx or 6.12.xx.xx.
3.	The EXP100 requires DS4300 controller firmware version 5.41.xx.xx or higher. Controller firmware version 6.12.xx.xx is required for intermixing EXP100, EXP700, and EXP710 storage enclosures behind a DS4300 Storage Subsystem. It is recommended that you use the latest general released firmware version 6.19.xx.xx if you do not have the EXP700 storage expansion enclosures in the DS4300 drive loop.
4.	The EXP710 requires DS4300 controller firmware version 6.12.xx.xx or higher. It is recommended that you use the latest general released firmware version 6.19.xx.xx if you do not have the EXP700 storage expansion enclosures in the DS4300 drive loop.
5.	The EXP810 requires DS4300 controller firmware version 6.19.xx.xx or higher.
6.	The FC/SATA intermix premium feature is required if there is a mix of FC and SATA drives in the DS4300 Storage Subsystem.
7.	The EXP700 requires the purchase of the <i>DS4000 EXP700 Models 1RU/1RX Switched-ESM Option Upgrade Kit</i> if it is to be attached to EXP810s.
8.	The EXP810 speed switch must be set to 2 Gbps.

Table 11. Possible combinations of 14-drive and 16-drive storage expansion enclosures per drive loop for DS4300 dual controller Turbo models only

Number of EXP810s (16 drives/unit)	Total number of drives in EXP810s	Number of EXP710/EXP100s (14 drives/unit)	Total number of drives in EXP710/EXP100s	Total number of drives in the DS4300		Total number of drives in a mix EXP710s and EXP810s drive loop	Notes
0	0	7	98	14	=	112	
1	16	5	70	14	=	100	
2	32	4	56	14	=	102	
3	48	3	42	14	=	104	
4	64	2	28	14	=	106	
5	80	1	14	14	=	108	
6	96	0	0	14	=	110	

Table 12. Possible combinations of 14-drive and 16-drive storage expansion enclosures per drive loop for DS4300 standard model

Number of EXP810s (16 drives/unit)	Total number of drives in EXP810s	Number of EXP710/EXP100s (14 drives/unit)	Total number of drives in EXP710/EXP100s	Total number of drives in the DS4300		Total number of drives in a mix EXP710s and EXP810s drive loop	Notes
0	0	3	42	14	=	56	
1	16	2	28	14	=	58	
2	32	1	14	14	=	60	
3	48	0	0	14	=	62	

For the latest information on requirements such as enclosure cabling schemes, the minimum version of the controller, or enclosure ESM firmware required for intermixing DS4000 storage expansion enclosures, refer to the *IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*.

Overview: Connecting storage expansion enclosures to a storage subsystem

This section contains the following topics:

- “General rules and recommendations for cabling storage expansion enclosures”
- “Storage expansion enclosure cabling diagrams” on page 53
- “Steps for connecting storage expansion enclosures to a storage subsystem” on page 60

General rules and recommendations for cabling storage expansion enclosures

Refer to these general rules and recommendations when you complete the steps described in “Steps for connecting storage expansion enclosures to a storage subsystem” on page 60.

Note: This section also refers to the cabling diagrams in “Storage expansion enclosure cabling diagrams” on page 53.

The following are general rules or limitations to follow as a guideline when you connect storage expansion enclosures to the storage subsystem:

- The DS4300 Storage Subsystem supports the connection of a maximum of one redundant drive loop pairs. The maximum number of drive enclosures per drive loop depends on the type of storage expansion enclosure and whether intermixing storage expansion enclosures of different drive slots. For detailed information, see Table 10 on page 49 and Table 11 on page 50.
- The DS4300 currently supports a maximum of 112 drives in either seven 14-drive or a maximum of 110 drives with six 16-drive storage expansion enclosures per drive loop in each controller. Two drive loops from the DS4300 expansion ports (one from each controller) must be connected to the same set of storage expansion enclosures to provide drive loop redundancy.

- When mixing different types of storage expansion enclosures in the same drive channel pair, the Link Rate Setting must be set at 2 Gbps for each storage expansion enclosure. IBM does not support different enclosure speed settings in the same drive loop.

In addition to the previously outlined general rules, it is strongly recommended that you observe the following rules when connecting storage expansion enclosures to the storage subsystem:

- Ensure that the enclosure ID of all enclosures in a DS4300 storage subsystem configuration (including the DS4300 storage subsystem) is unique. Enclosure IDs (sometimes known as tray IDs) consist of two digits (x10 and x1). In 14-drive expansion enclosures, the enclosure ID must be set manually. In 16-drive expansion enclosures, the enclosure ID is set automatically. Refer to the Installation, User's, and Maintenance Guide for your appropriate enclosure for information on how to manually set the switches. If the enclosure IDs are not unique, an error will be posted in the DS4300 subsystem Major Event Log (MEL) and the ID conflict LED on the enclosure with same enclosure ID will be lit.

In addition, ensure that the single digit (x1) of the enclosure ID for every enclosure (including the DS4300 storage subsystem) in a redundant drive loop pair is unique. If you do not set the single digit of the enclosure IDs to be unique among enclosures in a redundant drive loop pair, then drive loop errors might be randomly posted in the DS4300 subsystem Major Event Log (MEL).

For example, with four enclosures attached to the DS4300, the correct enclosure ID settings should be x1, x2, x3, and x4 (where x can be any digit that can be set). Examples of incorrect settings would be 11, 21, 31, and 41 or 12, 22, 32, and 62. These examples are incorrect because the x1 digits are the same in all enclosure IDs (either 1 or 2).

Important: Changing enclosure IDs on 14-drive enclosures with the mechanical enclosure ID switch requires the power cycle of the DS4300 subsystem and all enclosures in the configuration to activate the new settings. Changing the enclosure IDs on 16-drive enclosures (EXP810s) does not require the power cycle of all enclosures and the DS4300 subsystem.

If the enclosure IDs in your DS4000 subsystem configuration are not currently set to have unique single digit values for the enclosures in the same redundant drive loop pair, make the changes to the enclosure IDs in the next maintenance schedule. This will prevent unnecessary downtime when you add enclosures of different type (especially EXP810s) to the existing enclosures in the redundant drive loop pair.

- When mixing EXP810 and EXP710 enclosures in the same drive loop with EXP100 enclosures, all of the EXP810s and EXP710s must be grouped together with the EXP100 connected to either end of the EXP810/EXP710 drive expansion enclosure group. The primary reason for this grouping is because the controller firmware considers the EXP810s and EXP710s to be the same enclosure type (switched disk expansion unit type which have an ESM-embedded fibre channel loop switch) despite being different models. These two enclosure models must be grouped together if they are contained within a drive loop.

Note: When grouping the EXP810s and EXP710s together, you must cable all of the EXP810s together, followed by all of the EXP710s or vice versa. Do not randomly cable the EXP710s and EXP810s together in the drive loop.

Figure 37 on page 54 and Figure 38 on page 55 are examples of correctly cabling the intermix of EXP100 with EXP810 and EXP710 enclosures. Figure 39 on page 56 and Figure 40 on page 57 are examples of incorrectly cabling the

| intermix of these enclosures. One shows the EXP100s cabled between the
| EXP810s and EXP710s, while the other shows the EXP810s and EXP710s
| intermingled, not with the EXP810s grouped separately from the EXP710s as
| recommended.

- Figure 41 on page 58 is an example of correctly cabling a 14 drive expansion enclosures to the DS4300. The Controller A drive port should be connected to the IN port in the left ESM of the last expansion enclosure when cabling as shown in Figure 41 on page 58. The Controller B drive port should be connected to the OUT port in the right ESM of the first expansion enclosure when cabling as shown in Figure 42 on page 59. Refer to Figure 45 on page 62 for the port labeling.
- The DS4300 expansion (or drive) port must always be connected to the EXP810 port 1B, regardless of whether the port is on the EXP810 ESM A or ESM B. See Figure 42 on page 59 is an example of correctly cabling the EXP810 ESM ports, labeled 1B, to the DS4300 expansion port. Figure 43 on page 60 is an example of incorrect cabling showing the connection from the DS4300 expansion port to the incorrect EXP810 ESM port, labeled 1A. Refer to Figure 51 on page 67 for the port labeling.

Storage expansion enclosure cabling diagrams

| These diagrams help show the information that is listed in “General rules and
| recommendations for cabling storage expansion enclosures” on page 51.
|

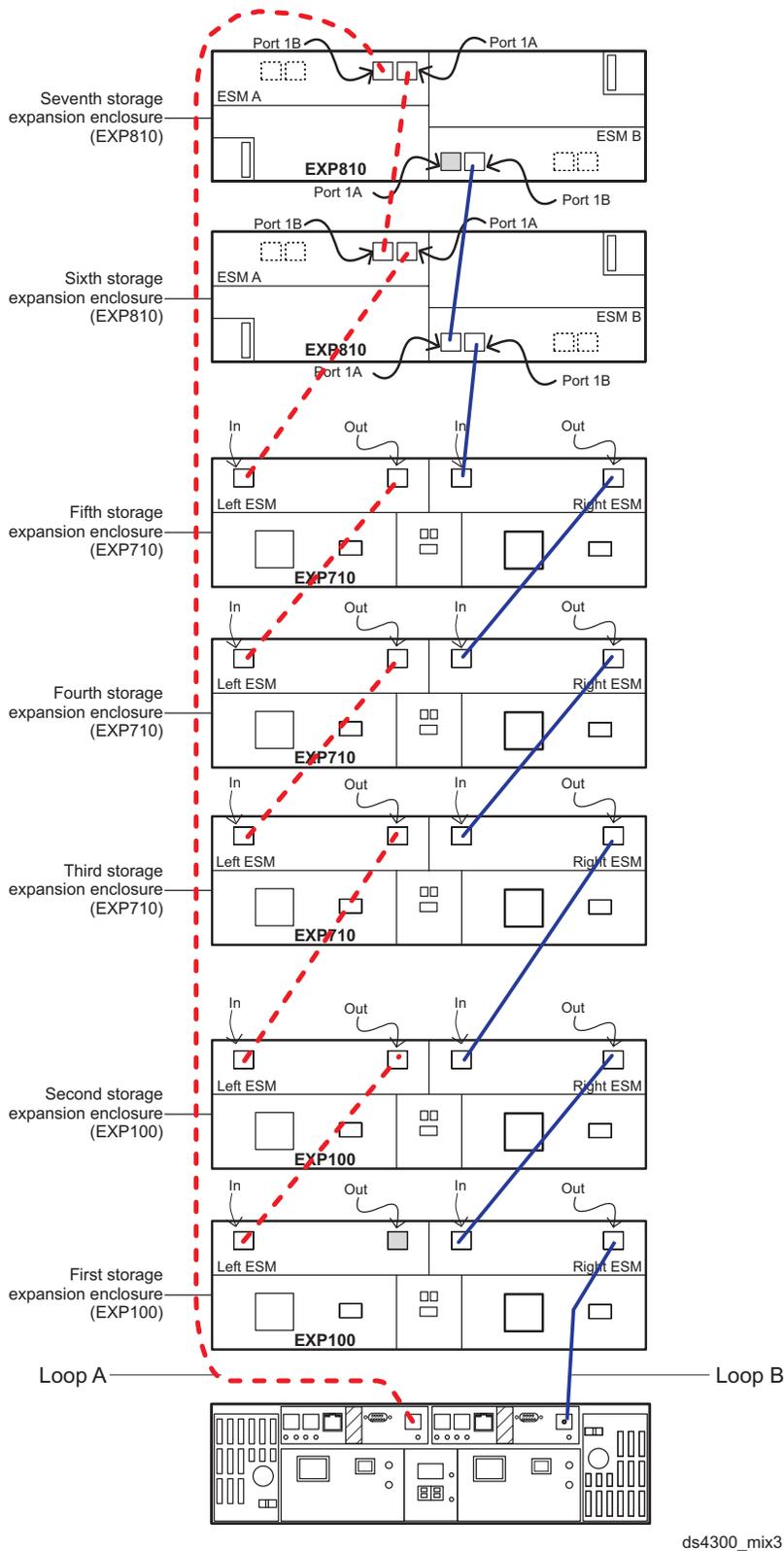
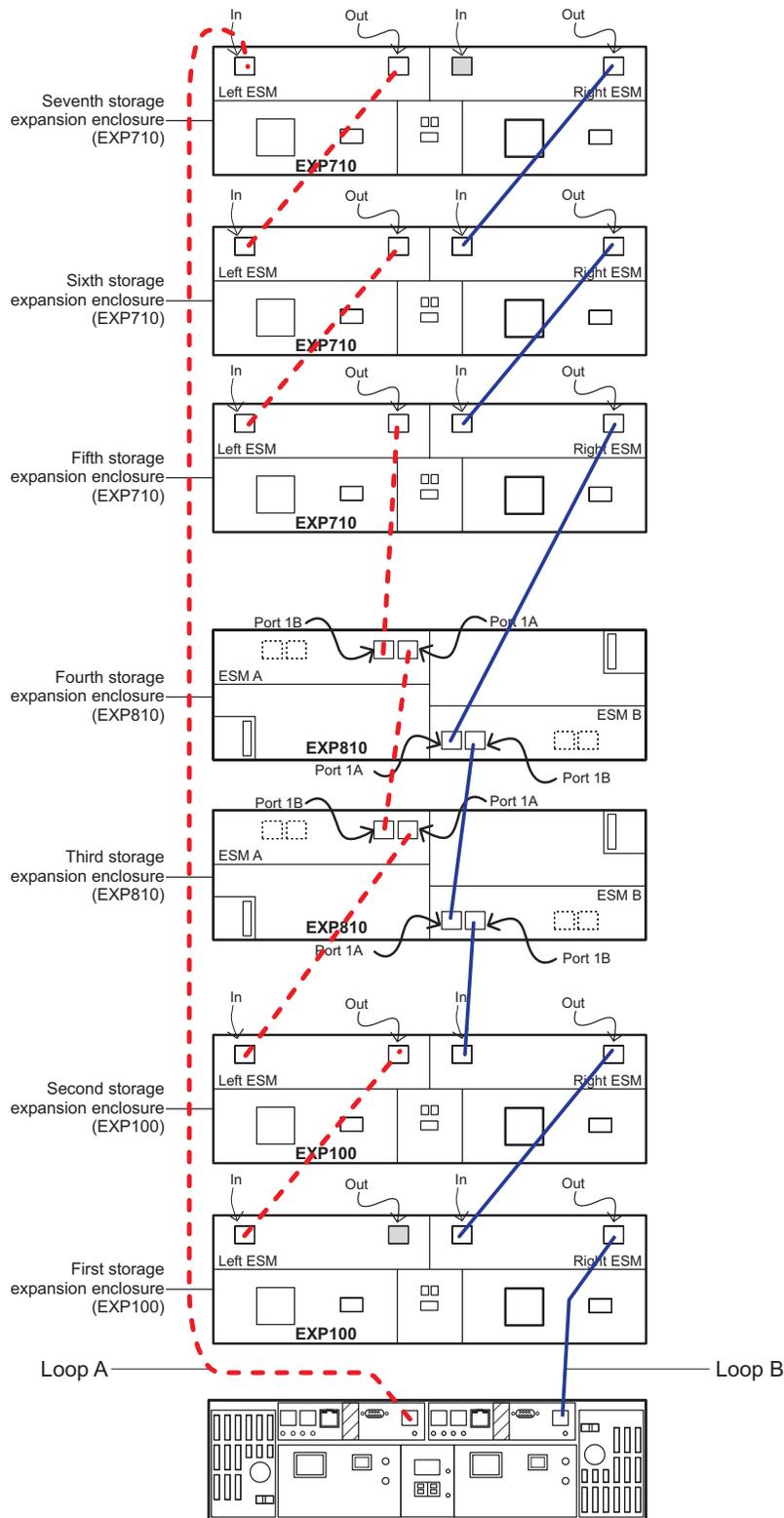
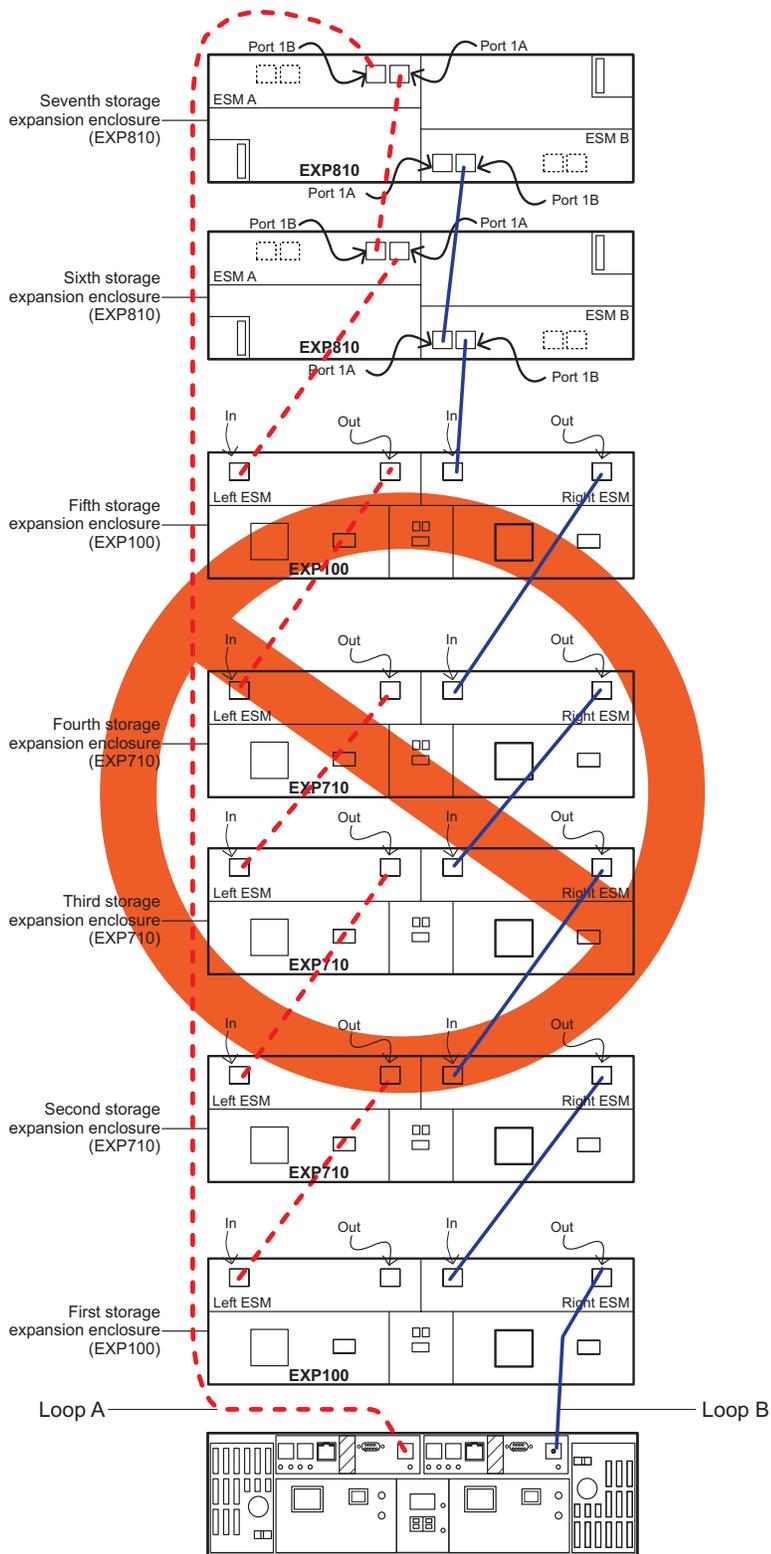


Figure 37. Correct cabling for an intermix of EXP100, EXP710, and EXP810 storage expansion enclosure (example 1)



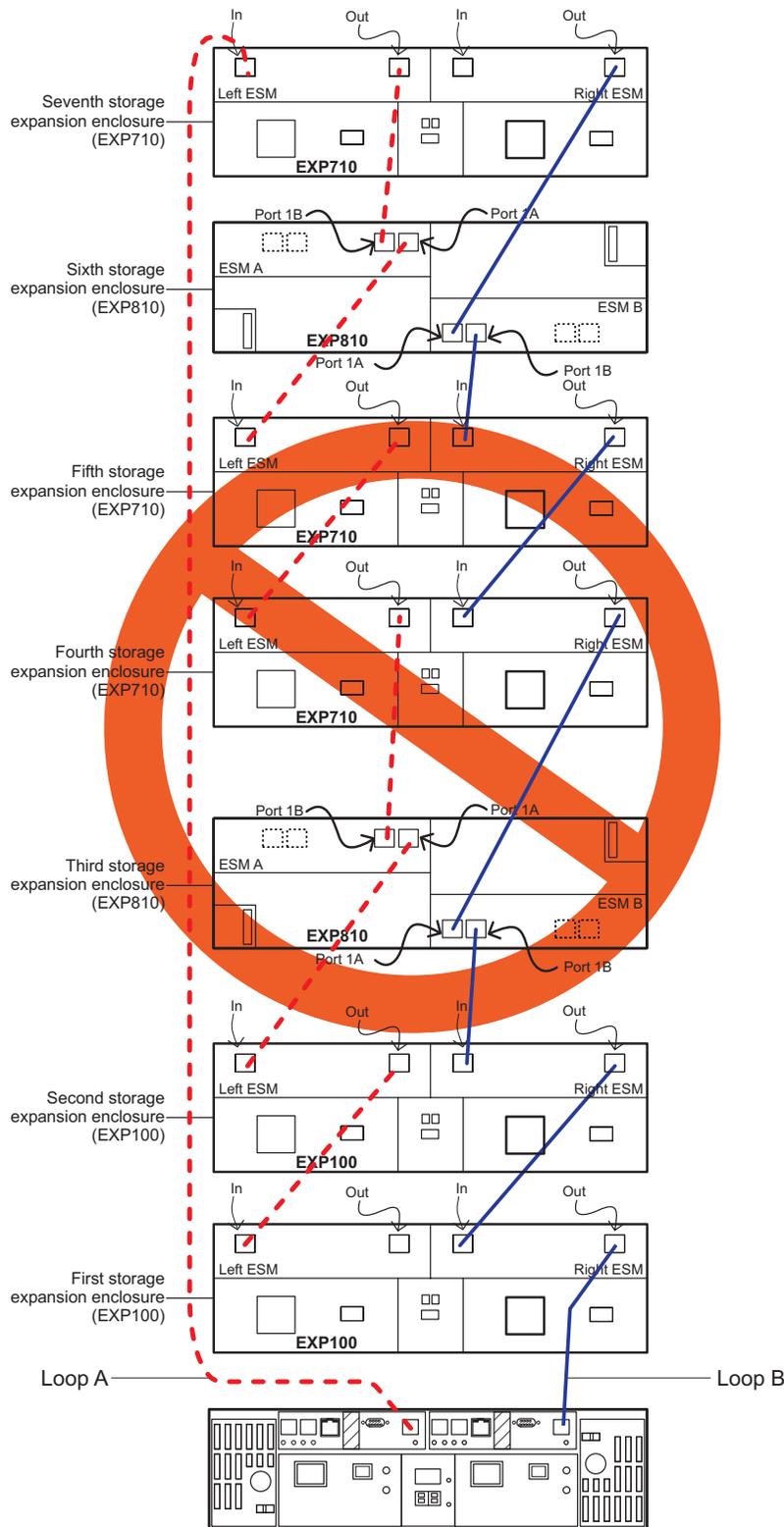
ds4300_mix4

Figure 38. Correct cabling for an intermix of EXP100, EXP710, and EXP810 storage expansion enclosure (example 2)



ds4300_mix5

Figure 39. Incorrect cabling for an intermix of EXP100, EXP710, and EXP810 storage expansion enclosure (example 1)



ds4300_mix6

Figure 40. Incorrect cabling for an intermix of EXP100, EXP710, and EXP810 storage expansion enclosure (example 2)

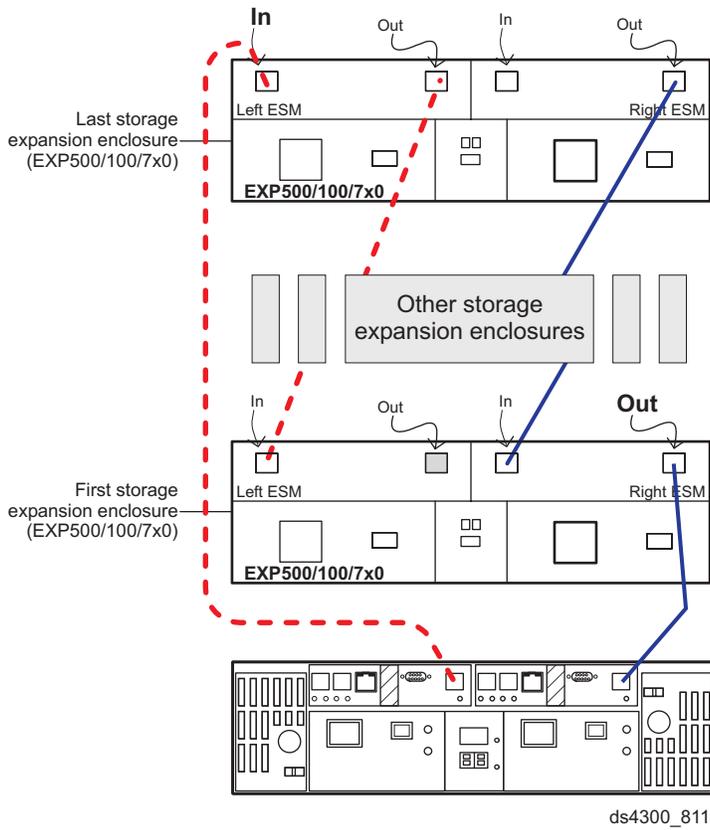


Figure 41. Cabling to 14-drive storage expansion enclosure ESM ports

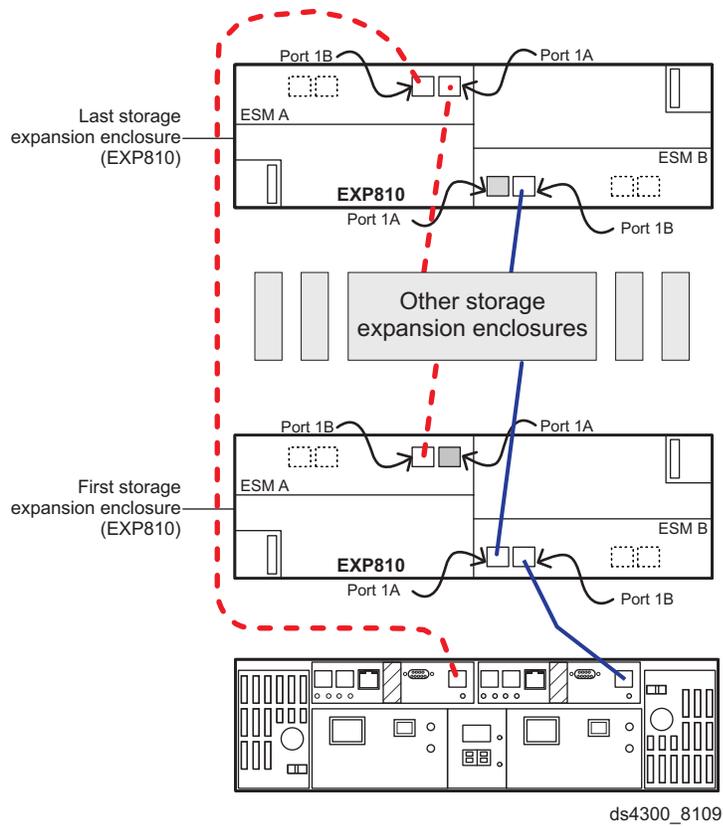
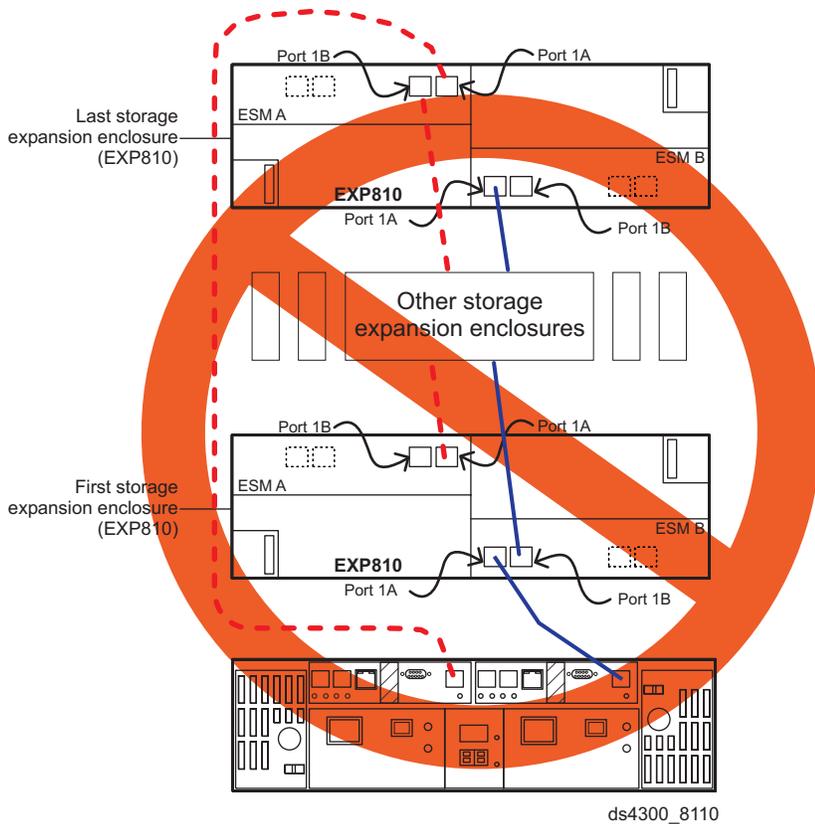


Figure 42. Correct cabling for EXP810 IB ports to the DS4300 expansion (or drive) port (example 1)



ds4300_8110

Figure 43. Incorrect cabling for EXP810 IA port to the DS4300 expansion (or drive) port (example 1)

Steps for connecting storage expansion enclosures to a storage subsystem

Before you begin, review the information listed in “General rules and recommendations for cabling storage expansion enclosures” on page 51 and “Storage expansion enclosure cabling diagrams” on page 53.

To connect storage expansion enclosures to the storage subsystem, perform the following steps:

Note: The following procedures are for *cold-case* procedures (in which the DS4300 is powered down when storage expansion enclosures are connected, as in the case of initial installation). For *hot-case* procedures (in which the DS4300 is powered on when storage expansion enclosures are connected), refer to the *IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*.

1. Follow the instructions in the Installation, User’s, and Maintenance Guide for your DS4000 storage expansion enclosure to set up and mount the storage expansion enclosures.
2. Determine a plan regarding the appropriate number of storage expansion enclosures you will connect to the DS4300. If you are connecting external storage expansion enclosures to the DS4300, ensure that the storage expansion enclosures are populated with at least two drives before you power

them on. Read the rules the storage expansion enclosure cabling limitations in “General rules and recommendations for cabling storage expansion enclosures” on page 51.

3. Depending on the type of storage expansion enclosure (14-drive or 16-drive) that you plan to connect to the DS4300 drive mini hub ports, see “Using EXP100, EXP700, or EXP710 storage expansion enclosures” or “Using EXP810 storage expansion enclosures” on page 66 for instructions on how to connect the DS4300 to the enclosures.

Note: Not all of the EXP100, EXP700, EXP710 or EXP810 enclosures can be cabled together. For information on supported combinations, see “Supported storage expansion enclosure configurations and intermix combinations” on page 47.

4. In non-EXP810 storage expansion enclosures, such as EXP710 or EXP100, set unique enclosure IDs (with the single digits unique among enclosures in a redundant drive loop pair) for all storage expansion enclosures that are cabled to the DS4300. See “Setting server/tray ID settings” on page 29, and then refer to your storage expansion enclosure installation manual for details on setting the enclosure ID.
5. For EXP810, ensure that the enclosure speed switch on the lower left corner on the front of the EXP810s set to 2 Gbps.

The DS4300 Storage Subsystem locates the drives in the storage expansion enclosures after you power on the configuration. Always connect power to the storage expansion enclosures first and then connect power to the DS4300. After you have powered on the configuration, use the DS4000 Storage Manager client to check the status of the new drives, correct any errors found, and configure the new drives.

Configuring the drive loops with storage expansion enclosures

This section provides information on how to connect supported storage expansion enclosures in a redundant drive loop.

Using EXP100, EXP700, or EXP710 storage expansion enclosures

This section provides instructions on how to connect one group of four EXP100, EXP700, or EXP710 storage expansion enclosures in a redundant drive loop pair. In addition, this procedure is also applicable when you have any number of enclosures, up to the maximum number that can be attached in the DS4300 redundant drive loop pair.

To complete this procedure, you will need two fiber-optic cables per storage expansion enclosure.

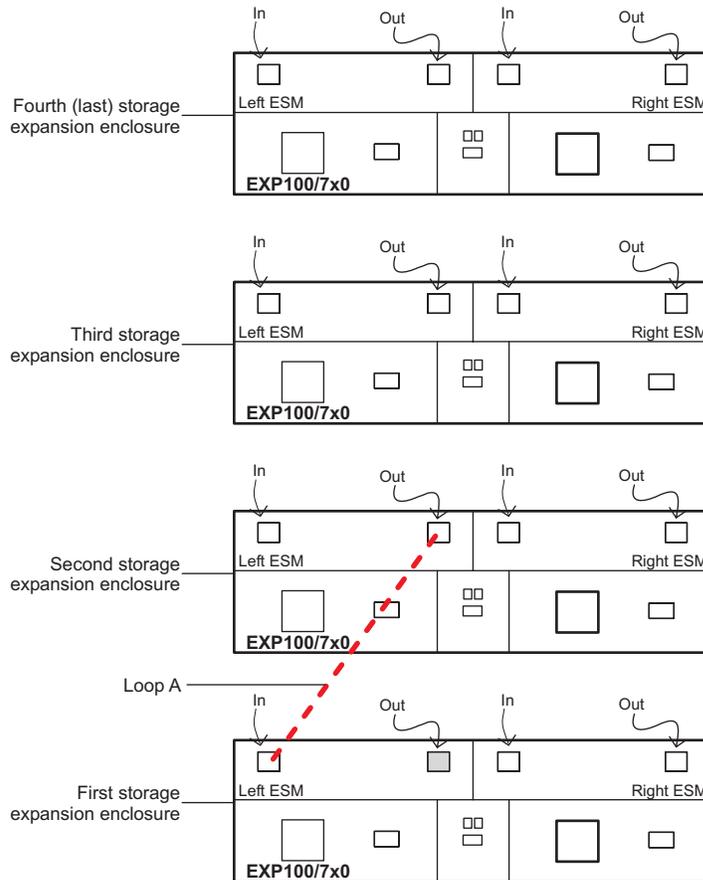
Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. Do not overtighten the cable straps or bend the cables to a diameter of less than 76 mm (3 in.) or a radius less than 38 mm (1.5 in.)

Connecting EXP100, EXP700, or EXP710 in a redundant pair of drive loop

This procedure describes the cabling for intermixing 14-drive storage expansion enclosures together in a redundant pair of drive loops.

1. Connect the first two storage expansion enclosures to drive loop A, as shown in Figure 44.

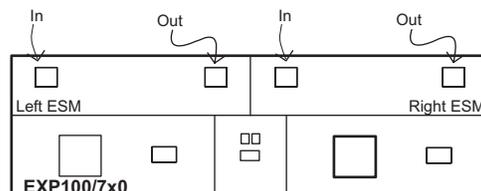
Starting with the first storage expansion enclosure, connect a fiber-optic cable from the In port on the left environmental services module (ESM) board to the Out port on the left ESM board in the second (next) storage expansion enclosure.



d4300_42c

Figure 44. Connecting two EXP100, EXP700, or EXP710 storage expansion enclosures into drive loop A

For the location of the ports on the storage expansion enclosure ESM board, see Figure 45.

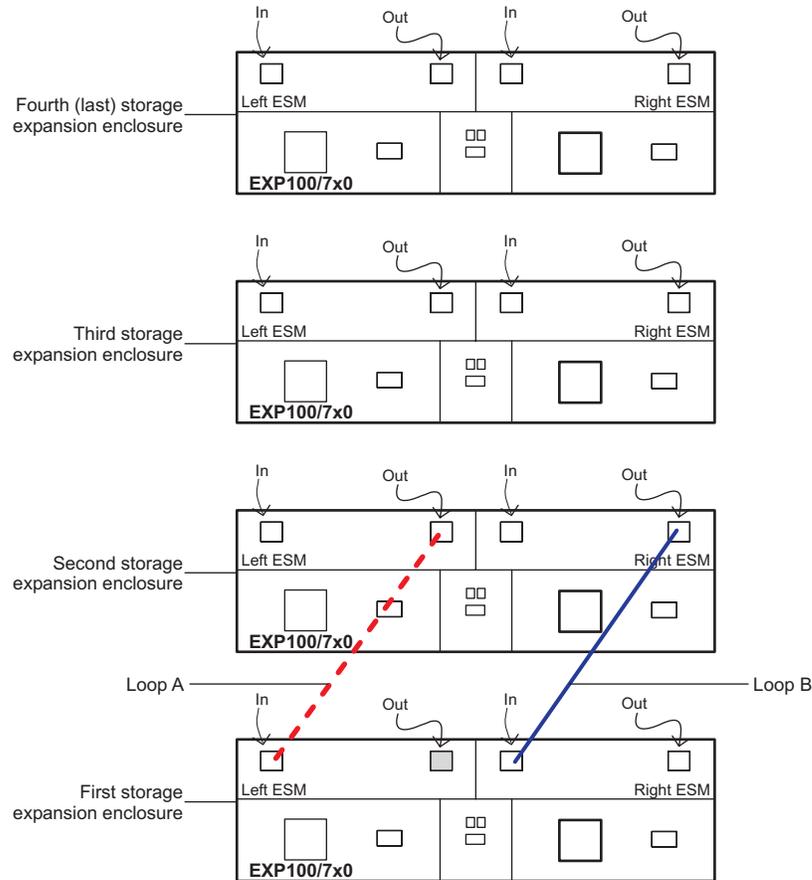


d4300_05a

Figure 45. EXP100, EXP700, or EXP710 storage expansion enclosure ESM board In and Out ports

2. Connect the same first two storage expansion enclosures to drive loop B, as shown in Figure 46.

Starting with the first storage expansion enclosure, connect a fiber-optic cable from the In port on the right ESM board to the Out port on the right ESM board in the second (next) storage expansion enclosure.



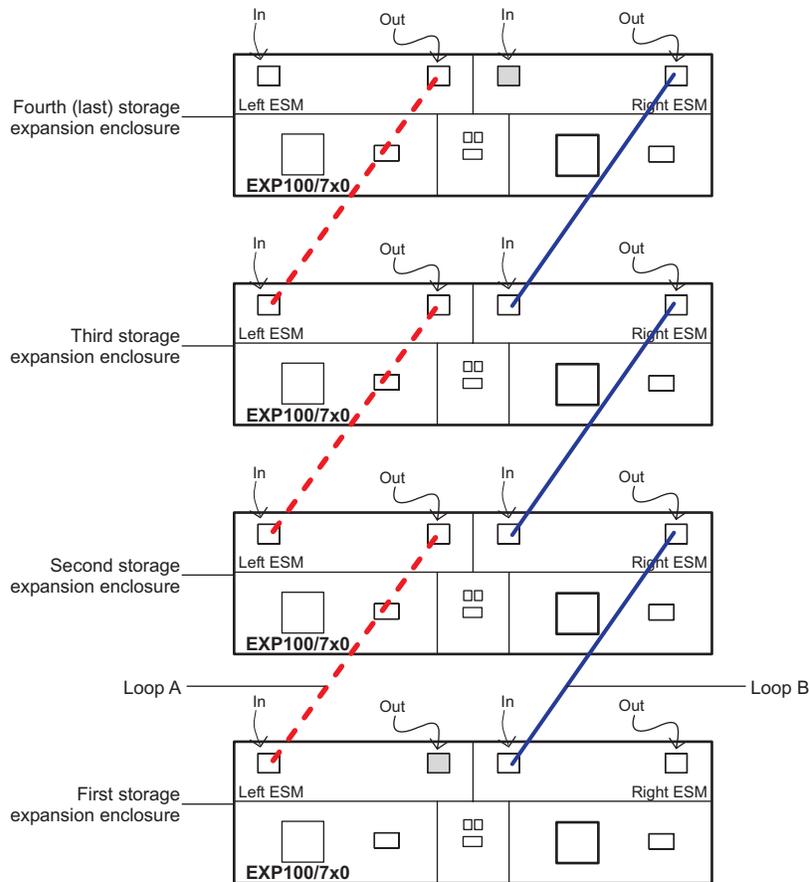
d4300_42d

Figure 46. Connecting two EXP100, EXP700, or EXP710 storage expansion enclosures into redundant drive loop B

If you want to connect more storage expansion enclosures into drive loops A and B, continue with Step 3; otherwise, go to “Connecting the redundant EXP100, EXP700, or EXP710 drive loop to the DS4300” on page 64.

3. Connect additional storage expansion enclosures to drive loops A and B, as shown in Figure 47 on page 64.

Starting with the second storage expansion enclosure, connect each additional storage expansion enclosure into drive loops A and B in the same manner. Leave the In port of the right ESM on the last storage expansion enclosure in the loop and the Out port of the left ESM on the first storage expansion enclosure unoccupied.



d4300_43c

Figure 47. Connecting additional EXP500, EXP100, EXP700, or EXP710 storage expansion enclosures to drive loops A and B

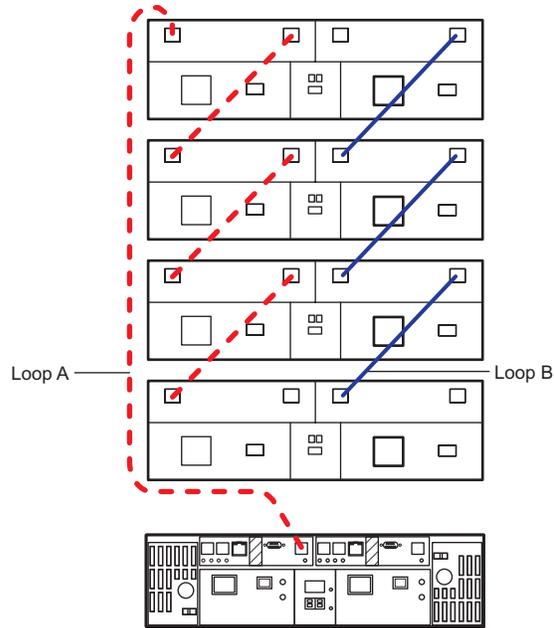
Connecting the redundant EXP100, EXP700, or EXP710 drive loop to the DS4300

After you configure the redundant drive loop using the EXP100, EXP700, or EXP710 storage expansion enclosures, use the following procedure to connect a redundant drive loop to the DS4300 Storage Subsystem. You will need two fiber-optic cables to connect the redundant drive loop pair to the DS4300 Storage Subsystem.

1. Connect drive loop A to the DS4300 Storage Subsystem, as shown in Figure 48 on page 65.

Starting with the last storage expansion enclosure in loop A, connect the In port on the left ESM board to the expansion port located in the DS4300 controller A module/CRU DS4300 Storage Subsystem.

Leave the Out port on the left ESM board on the first storage expansion enclosure and the In (lower) connector on drive mini hub 4 unoccupied.



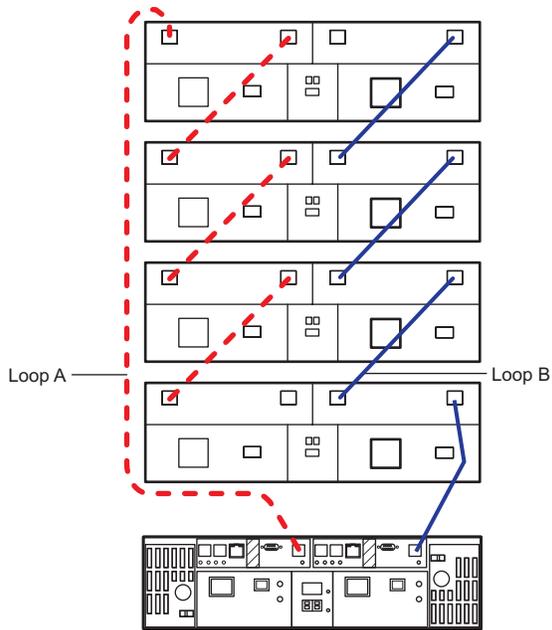
d4300_41a

Figure 48. Connecting EXP100, EXP700, or EXP710 drive loop A to the DS4300

2. Connect drive loop B to the DS4300 Storage Subsystem, as shown in Figure 49 on page 66.

Starting with the first storage expansion enclosure in the loop, connect the Out port on the right ESM board to the expansion port located in the DS4300 controller B module/CRU.

Leave the In port on the right ESM board on the last storage expansion enclosure unoccupied.



d4300_41b

Figure 49. Connecting redundant EXP100, EXP700, or EXP710 drive loops to the DS4300

Using EXP810 storage expansion enclosures

The section provides instructions on how to connect one group of four EXP810 storage expansion enclosures in a redundant drive loop. Instructions for how to connect a second group of four EXP810 storage expansion enclosures in a redundant drive loop are also included in this procedure. In addition, this procedure is also applicable when you have any number of enclosures, up to the maximum number that can be attached in the redundant drive loop pair.

To complete this procedure, you will need two fiber-optic cables per storage expansion enclosure.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. 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.)

Connecting EXP810 in a redundant pair of drive loop

This procedure describes how to cable 16-drive EXP810 storage expansion enclosure together in a redundant pair of drive loops.

1. Connect the first two storage expansion enclosures to drive loop A, as shown in Figure 50 on page 67.

Starting with the first storage expansion enclosure, connect a fiber-optic cable from port 1B on the ESM A board to port 1A on the ESM A board in the second (next) storage expansion enclosure.

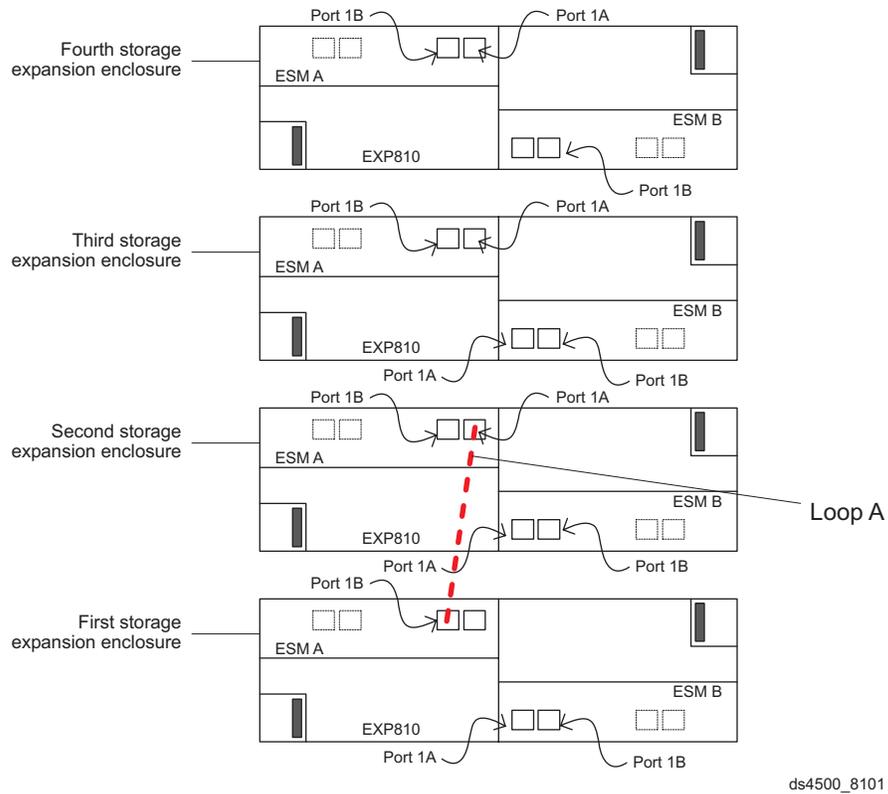


Figure 50. Connecting two EXP810 storage expansion enclosures into drive loop A

For the location of the ports on the storage expansion enclosure ESM board, see Figure 51.

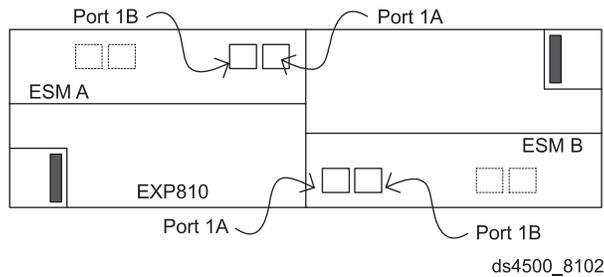
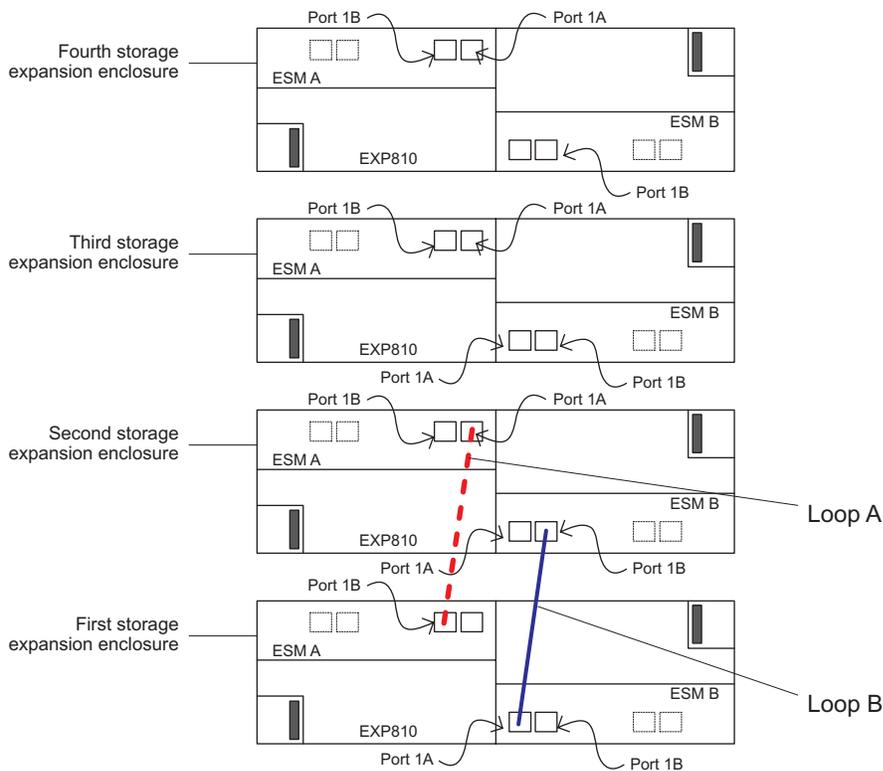


Figure 51. EXP810 storage expansion enclosure ESM board ports 1A and 1B

2. Connect the same first two storage expansion enclosures to drive loop B, as shown in Figure 52 on page 68.

Starting with the first storage expansion enclosure, connect a fiber-optic cable from port 1A on the ESM B board to port 1B on the ESM B board in the second (next) storage expansion enclosure.



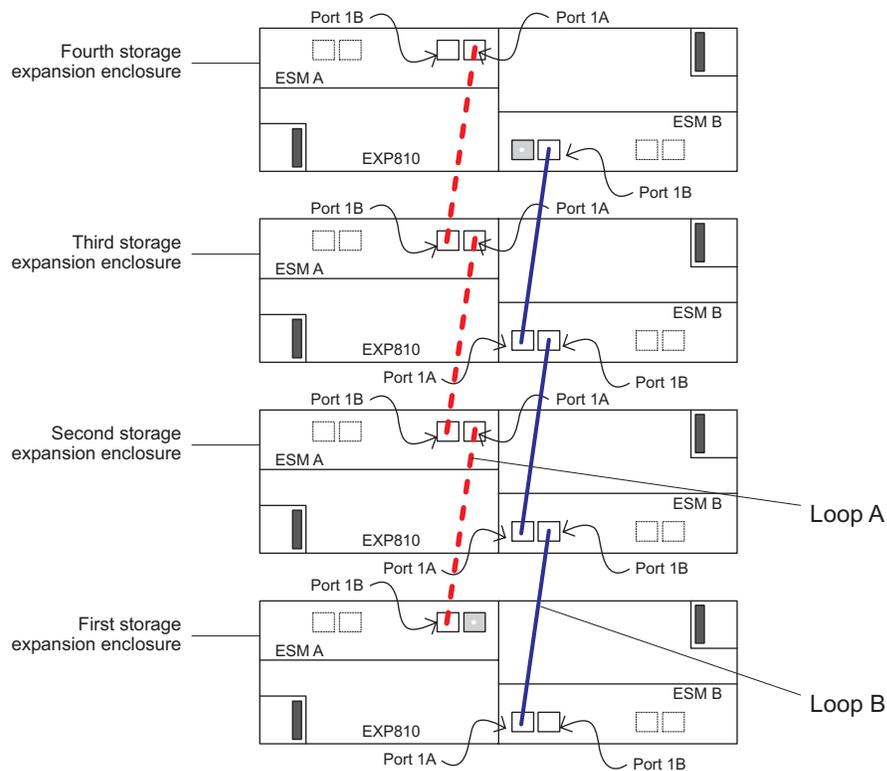
ds4500_8103

Figure 52. Connecting two EXP810 storage expansion enclosures into redundant drive loop B

If you want to connect more storage expansion enclosures into drive loops A and B, continue with Step 3; otherwise, go to “Connecting the redundant EXP810 drive loop to the DS4300” on page 69.

3. Connect additional storage expansion enclosures to drive loops A and B, as shown in Figure 53 on page 69.

Starting with the second storage expansion enclosure, connect each additional storage expansion enclosure into drive loops A and B in the same manner. Leave port 1A on the ESM B of the last (fourth) storage expansion enclosure in the loop and port 1A on the ESM A of the first storage expansion enclosure unoccupied.



ds4500_8104

Figure 53. Connecting additional EXP810 storage expansion enclosures to drive loops A and B

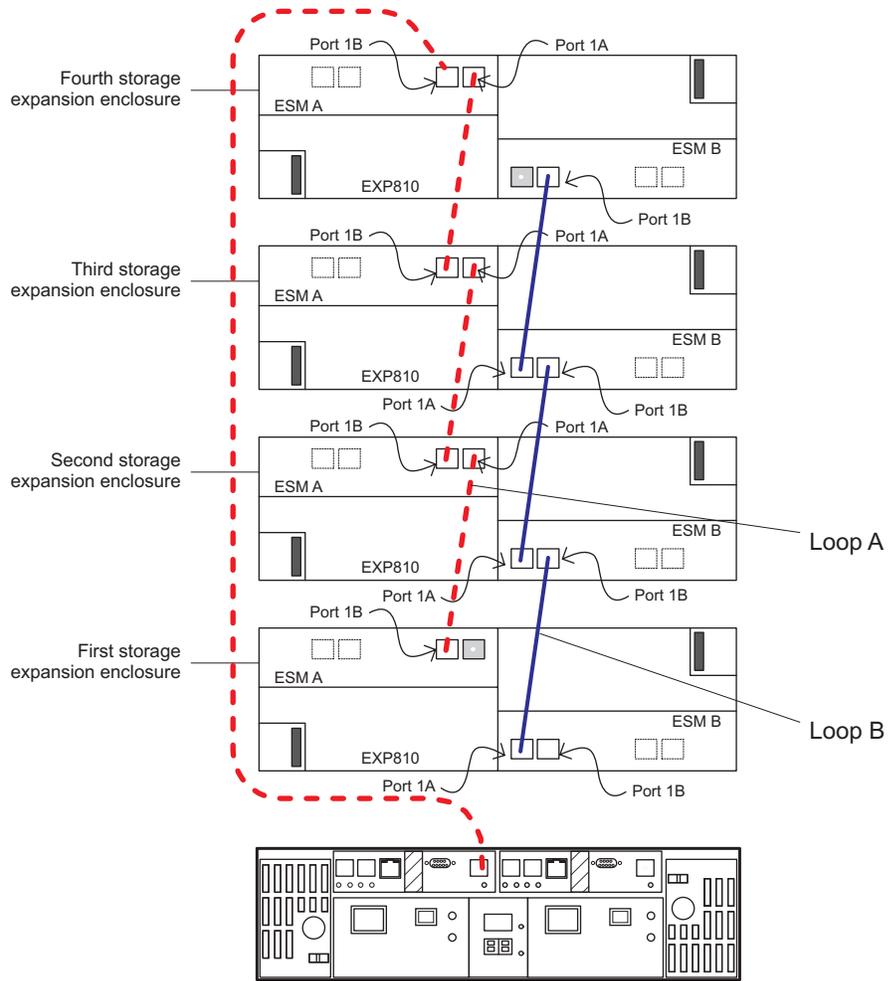
Connecting the redundant EXP810 drive loop to the DS4300

After you configure the redundant drive loop using the EXP810 storage expansion enclosures, use the following procedure to connect a redundant drive loop to the DS4300 Storage Subsystem. You will need two fiber-optic cables to connect the redundant drive loop pair (for example, loop A and loop B) to the DS4300 Storage Subsystem.

1. Connect drive loop A to the DS4300 Storage Subsystem, as shown in Figure 54 on page 70.

Starting with the last (fourth) storage expansion enclosure in loop A, connect port 1B on the ESM A board to the expansion port located in controller A module/CRU on the DS4300 Storage Subsystem.

Leave port 1A on the ESM A board on the first EXP810 storage expansion enclosure unoccupied.



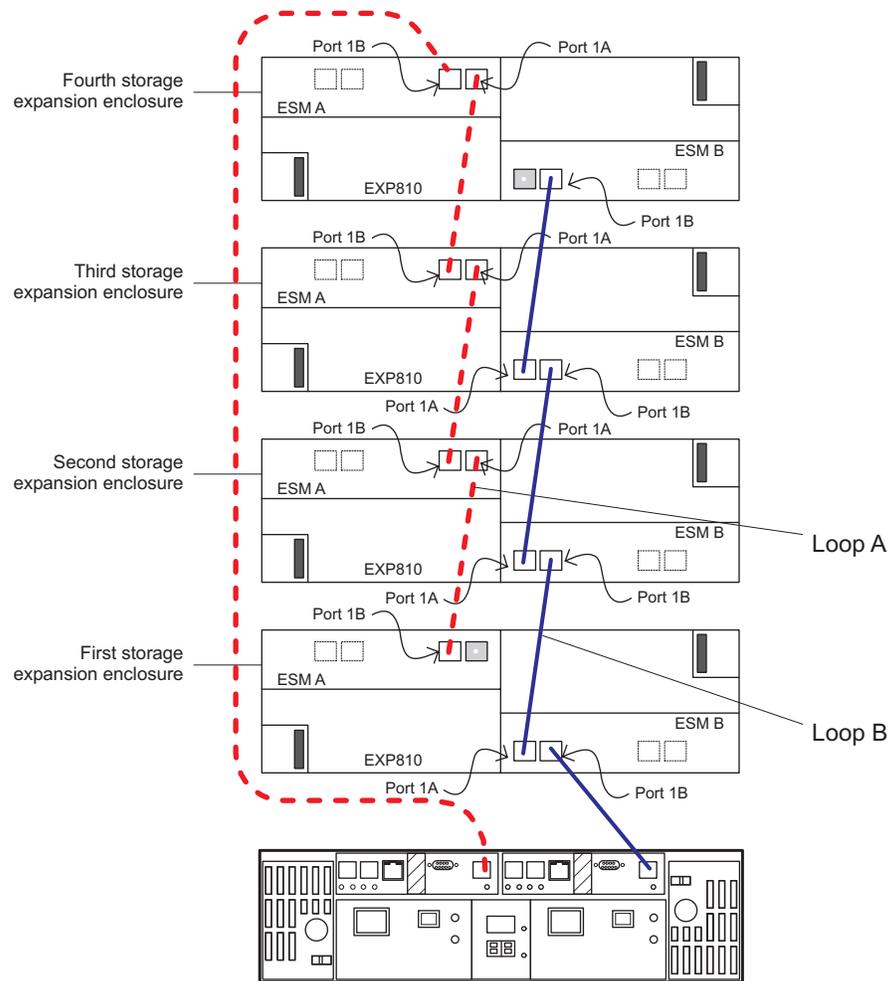
ds4300_8106

Figure 54. Connecting EXP810 drive loop A to the DS4300

2. Connect drive loop B to the DS4300 Storage Subsystem, as shown in Figure 55 on page 71.

Starting with the first storage expansion enclosure in the loop, connect port 1B on the ESM B board to the expansion port located in controller B module/CRU.

Leave port 1A on the ESM B board on the last (fourth) EXP810 storage expansion enclosure unoccupied.



ds4300_8107

Figure 55. Connecting redundant EXP810 drive loops to the DS4300

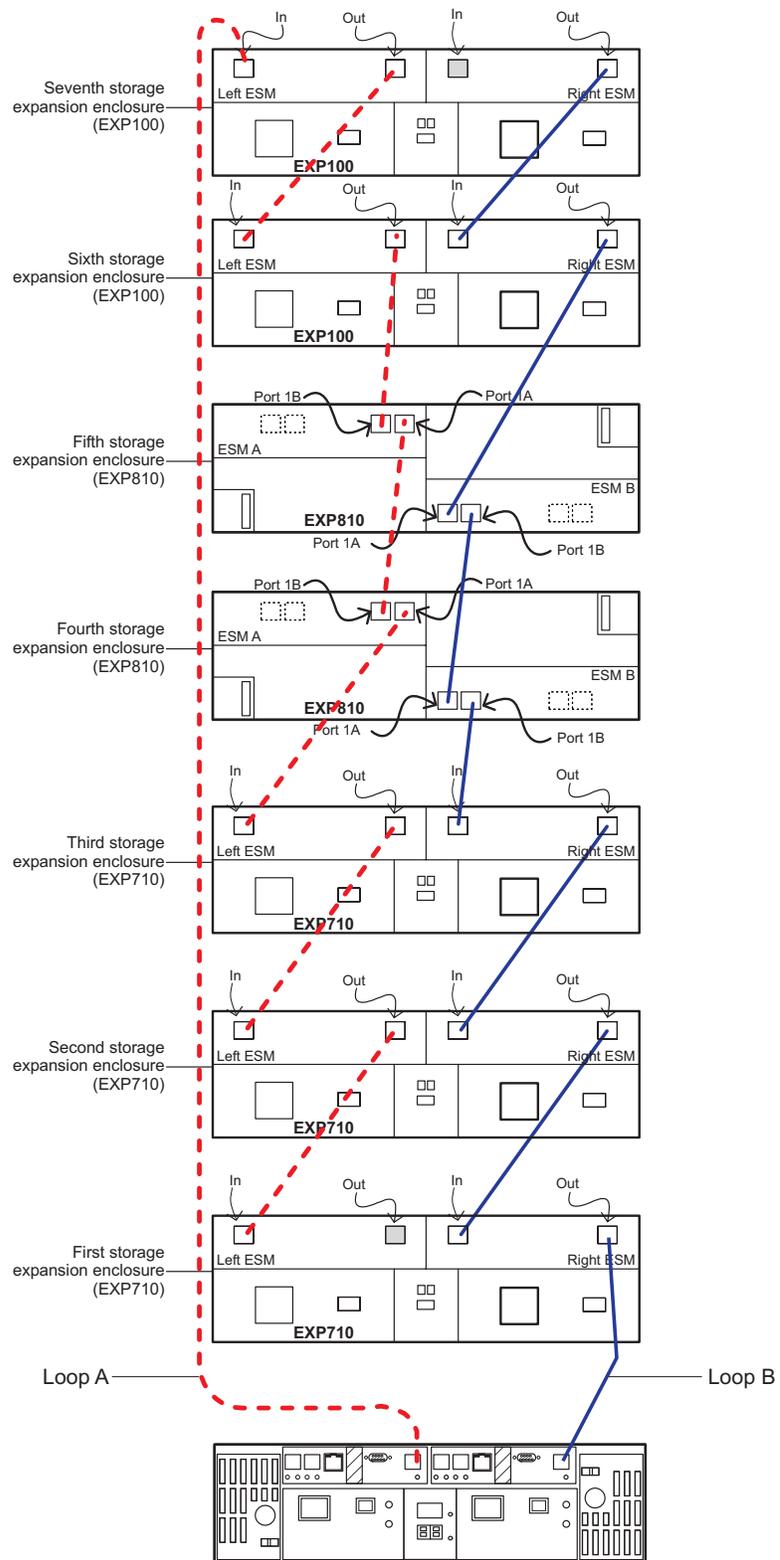
One DS4300 and two or more storage expansion enclosures in a mixed configuration

Note: Not all of the EXP100, EXP700, EXP710 or EXP810 enclosures can be cabled together. For information on supported combinations, see “Supported storage expansion enclosure configurations and intermix combinations” on page 47.

When you plan to cable the DS4300 Storage Subsystem to storage expansion enclosures that are in a mixed configuration, it is recommended that you cable the same type of enclosures together. Since the EXP810s and EXP710s are generally considered as the same type (enclosures with switched-ESMs type), these two enclosure models must be grouped together if they are contained within a drive loop. If a storage expansion type with non switched-ESMs, such as EXP100, is cabled between the EXP710s and EXP810s, a “drive enclosure not cabled correctly” error will be displayed in the DS4000 Storage Manager Recovery Guru.

| In addition, it is strongly recommended, for such reasons as easier maintenance
| and minimizing cabling errors, that you not only cable the same type of enclosures
| together, but that you also cable together the enclosures within groups of the same
| model. For example, cable the EXP710s together, followed by all of the EXP810s,
| then followed by all of the EXP100s, and so on.

| Figure 56 on page 73 shows an example of the recommended cabling scheme of
| mixed enclosure types behind a DS4300 Storage Subsystem using EXP100s,
| EXP710s, and EXP810s storage expansion enclosures. This figure also shows the
| IBM recommended cabling of enclosures when mixing EXP100s, EXP710s and
| EXP810s enclosures in the same redundant drive loop pair - a group of EXP100s,,
| followed by a group of EXP810s, followed by a group of EXP100s. The EXP810s is
| between the EXP100s and EXP710s.
|



ds4300_mix2

Figure 56. One DS4300 and two or more storage expansion enclosures in a mixed environment — Recommended cabling

Perform the following steps to create the recommended cabling scheme shown in Figure 56.

1. Connect the storage expansion enclosures to drive loop A as follows:
 - a. Starting with the first storage expansion enclosure, connect a fiber-optic cable from the In port on the left ESM to the Out port on the left ESM in the second enclosure.
Leave the Out port on the left ESM in the first enclosure unoccupied.
 - b. Connect the In port on the left ESM in the second enclosure to the Out port on the left ESM in the third enclosure.
 - c. Connect the In port on the left ESM in the third enclosure to port 1A on the ESM A in the fourth enclosure.
 - d. Connect port 1B on the ESM A in the fourth enclosure to port 1A on the ESM A in the fifth enclosure.
 - e. Connect port 1B on the ESM A in the fifth enclosure to the Out port on the left ESM in the sixth enclosure.
 - f. Connect the In port on the left ESM in the sixth enclosure to the Out port on the left ESM in the seventh enclosure.
2. Connect the storage expansion enclosures to drive loop B as follows:
 - a. Starting with the first storage expansion enclosure, connect a fiber-optic cable from the In port on the right ESM to the Out port on the right ESM in the second enclosure.
 - b. Connect the In port on the right ESM in the second enclosure to the Out port on the right ESM in the third enclosure.
 - c. Connect the In port on the right ESM in the third enclosure to port 1B on the ESM B in the fourth enclosure.
 - d. Connect port 1A on the ESM B in the fourth enclosure to port 1B on the ESM B in the fifth enclosure.
 - e. Connect port 1A on the ESM B in the fifth enclosure to the Out port on the right ESM in the sixth enclosure.
 - f. Connect the In port on the right ESM in the sixth enclosure to the Out port on the right ESM in the seventh enclosure.
Leave the In port on the right ESM in the last enclosure unoccupied.
3. Connect drive loop A to the DS4300 Storage Subsystem as follows:
 - Connect the In port on the left ESM in the seventh enclosure to the Out (upper) port on drive mini hub 4 on the DS4300.
Leave the In (lower) port on drive mini hub 4 unoccupied.
4. Connect drive loop B to the DS4300 Storage Subsystem as follows:
 - Connect the Out port on the right ESM in the first enclosure to the In (lower) port on drive mini hub 2 on the DS4300.
Leave the Out (upper) port on drive mini hub 2 unoccupied.

Host fibre channel connections

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, or you can connect more than two hosts to the fibre channel storage subsystem through switches. The illustrations in the following sections show common host system configurations.

Note: The default is one partition. Four-partition and eight-partition configurations are provided as option upgrades, as is the option of additional attachments to DS4000 EXP storage expansion enclosures. Contact your IBM resellers or marketing representatives for more information.

Installing the storage subsystem configuration

Using the information gathered in the previous sections, install the host systems and host adapters.

Notes:

1. See the documentation provided with your host adapters for installation requirements and procedures.
2. Use the correct host adapter driver. For the latest supported host adapters and drivers, go to the following Web site:
www.pc.ibm.com/support

Attach fiber-optic interface cables to each host adapter. You will connect the other end of the cables to the controller later in the installation process. For more information about handling fiber-optic cables, see “Handling fiber-optic cables” on page 33.

Note: Do not install the storage-management software at this time, if it is not already installed. Install the storage subsystem completely before you install the software because you cannot test the software installation until the hardware is connected.

DS4300 dual-controller storage subsystem (Model 60U/60X) configurations

This section includes the following examples of DS4300 dual-controller storage subsystem (Model 60U/60X) configurations:

- Redundant host and drive loop Fibre Channel configuration (Figure 57 on page 76)
- Single SAN fabric zone configuration (Figure 58 on page 77)
- Dual SAN fabric zone configuration, with an additional DS4300 storage subsystem and an EXP700 attached (Figure 59 on page 77)
- Two clusters (Figure 60 on page 78)

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

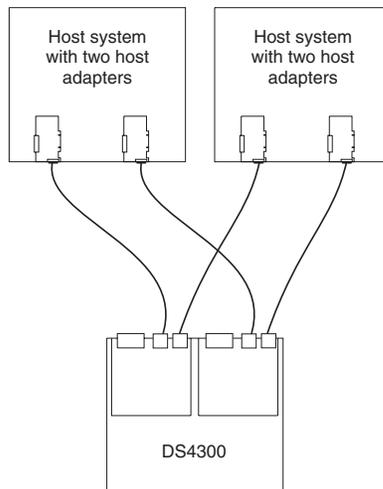
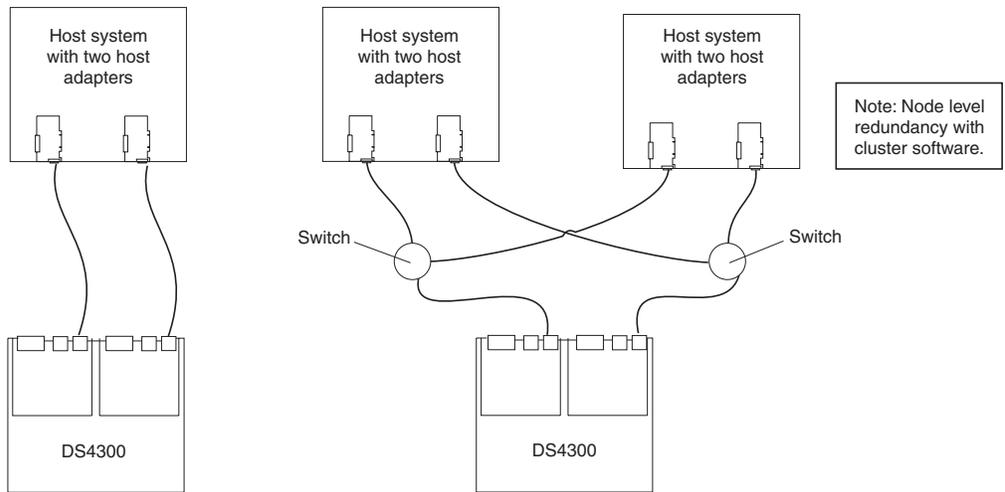


Figure 57. Redundant host and drive Fibre Channel loop configurations (Model 60U/60X)

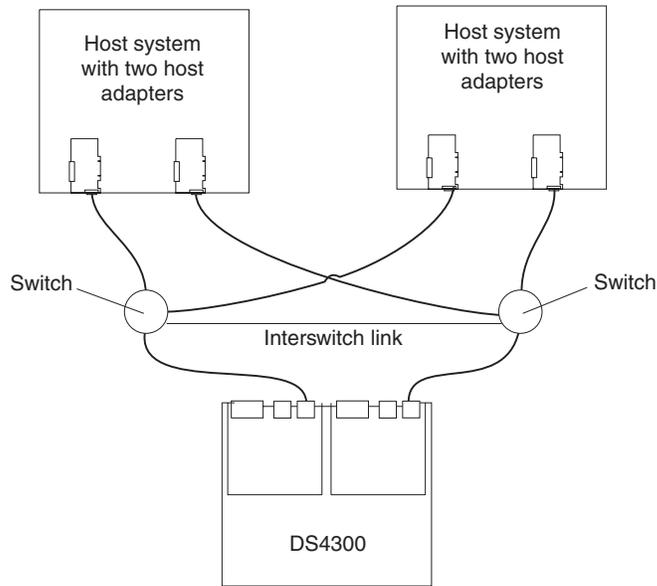


Figure 58. Example of a single-SAN fabric zone configuration (Model 60U/60X)

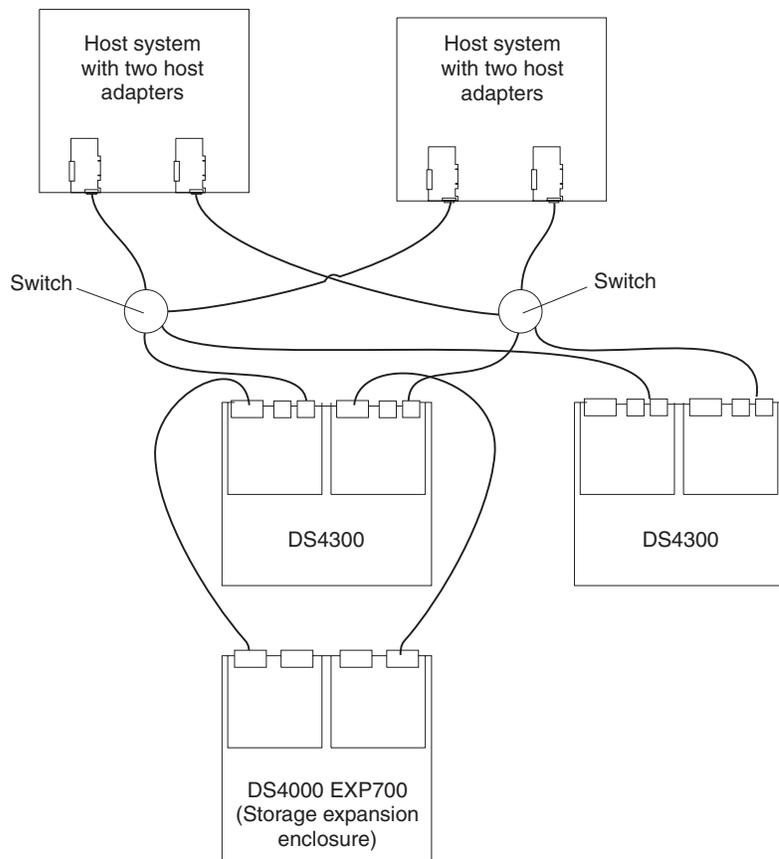


Figure 59. Example of a dual-SAN fabric zone configuration (Model 60U/60X)

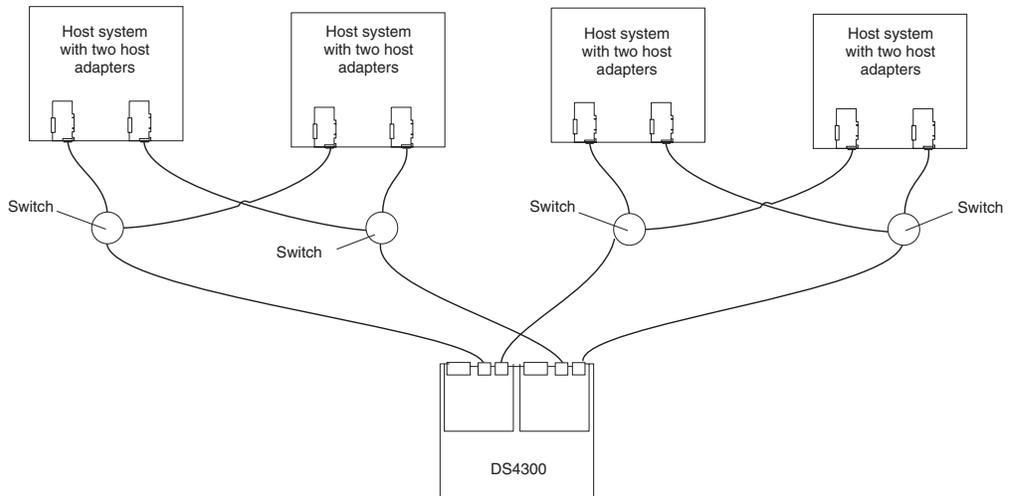


Figure 60. Example of a two-cluster configuration (Model 60U/60X)

DS4300 single-controller storage subsystem (Model 6LU/6LX) configurations

This section includes the following examples of DS4300 single-controller storage subsystem (Model 6LU/6LX) configurations:

- Single server configuration with one adapter (Figure 61)
- Single server configuration with two adapters (Figure 62 on page 79)
- Dual-server configuration with one adapter on each server (Figure 63 on page 79)
- Dual-server, single-SAN fabric zone configuration with one adapter on each server (Figure 64 on page 80)
- Dual-server, dual-SAN fabric zone configuration with two adapters per server (Figure 65 on page 80)

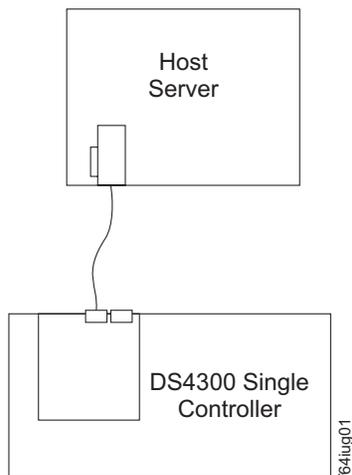


Figure 61. Example of a single server configuration with one adapter (Model 6LU/6LX)

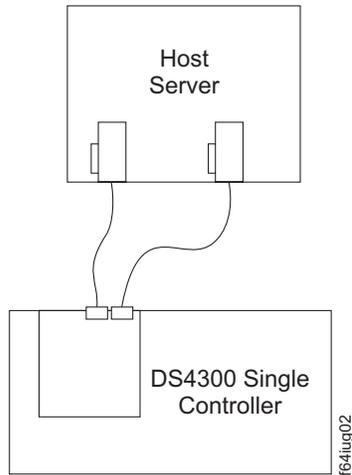


Figure 62. Example of a single server configuration with two adapters (Model 6LU/6LX)

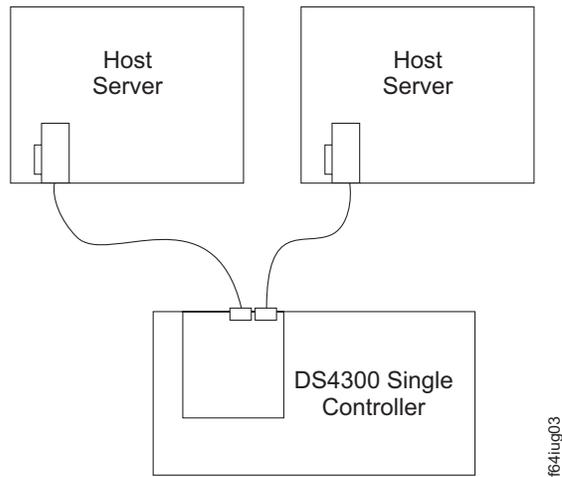


Figure 63. Example of a dual-server configuration with one adapter on each server (Model 6LU/6LX)

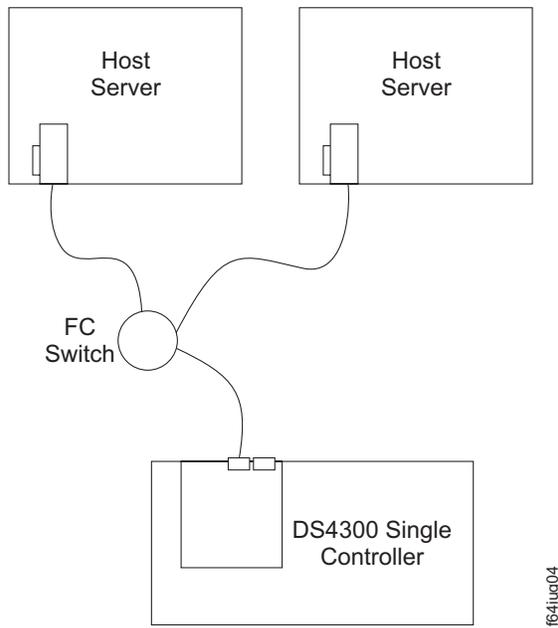


Figure 64. Example of a dual-server, single-SAN fabric zone configuration with one adapter on each server (Model 6LU/6LX)

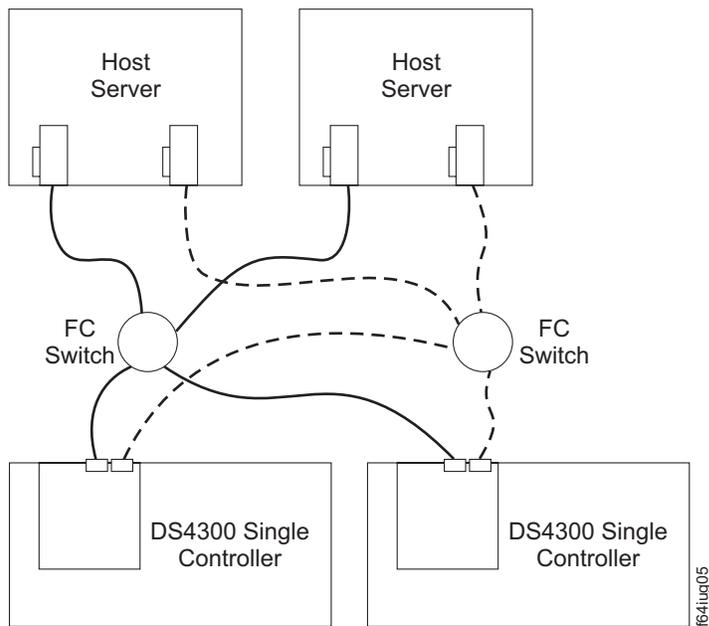


Figure 65. Example of a dual-server, dual-SAN fabric zone configuration with two adapters per server (Model 6LU/6LX)

Connecting hosts to the RAID controllers

Complete the procedure that is appropriate for your storage subsystem:

- “Steps for connecting hosts to a DS4300 dual-controller storage subsystem (Model 60U/60X)” on page 81
- “Steps for connecting hosts to a DS4300 single-controller storage subsystem (Model 6LU/6LX)” on page 81

Steps for connecting hosts to a DS4300 dual-controller storage subsystem (Model 60U/60X)

To connect a host adapter to a DS4300 dual-controller storage subsystem (Model 60U/60X), complete the following steps:

1. Install an SFP in a host port on the RAID controller.
2. Connect the host-system fibre channel cables between the RAID controller host ports and the HBA ports or fibre channel switch ports. Figure 66 shows the location on the RAID controllers where the host-system cables connect.

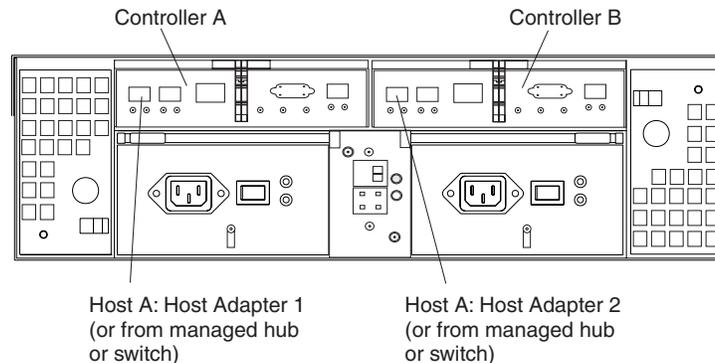


Figure 66. Location of host cables (Model 60U/60X)

For examples of redundant, partially redundant, and nonredundant host and drive loop configurations, see “Host fibre channel connections” on page 74.

Steps for connecting hosts to a DS4300 single-controller storage subsystem (Model 6LU/6LX)

To connect a host adapter to a DS4300 single-controller storage subsystem (Model 6LU/6LX), complete the following steps:

1. Install an SFP into a host port on the RAID controller.
2. Connect the host-system fibre channel cables between the RAID controller host ports and the HBA ports or fibre channel switch ports. Figure 67 on page 82 shows the location on the RAID controller where the host-system fibre channel cables connect.

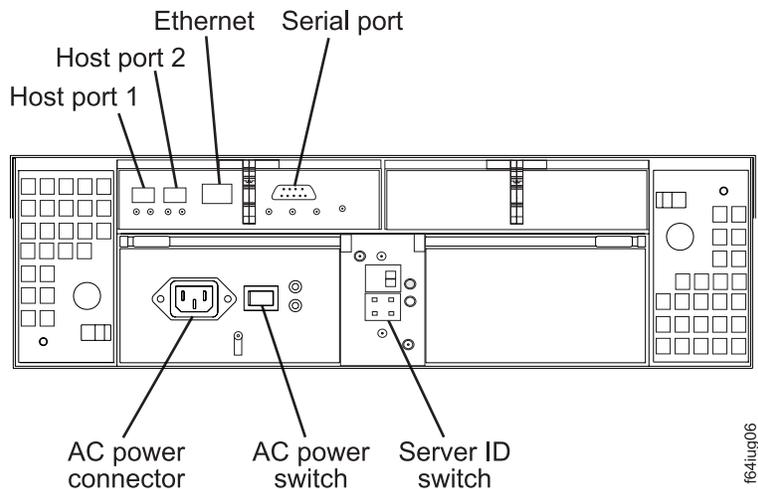


Figure 67. Location of host cables (Model 6LU/6LX)

Configuring the storage subsystem

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

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 subsystems in either of two ways: host-agent management or direct-management.

Note: If the operating system of the host server that the storage subsystem logical drive(s) is mapped to is not the Microsoft® Windows NT® platform, you have to make an out-of-band direct management connection to the storage subsystem to set the correct host type first. Then, the server will be able to recognize the storage subsystem correctly for in-band management.

Host-agent management method

This method requires host-agent software that is installed on the host server. The host-agent software allows the DS4000 storage manager client program to manage the DS4000 storage subsystem using the same fibre channel 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. A management station will have the client software installed. Figure 68 on page 83 shows the host-agent management method.

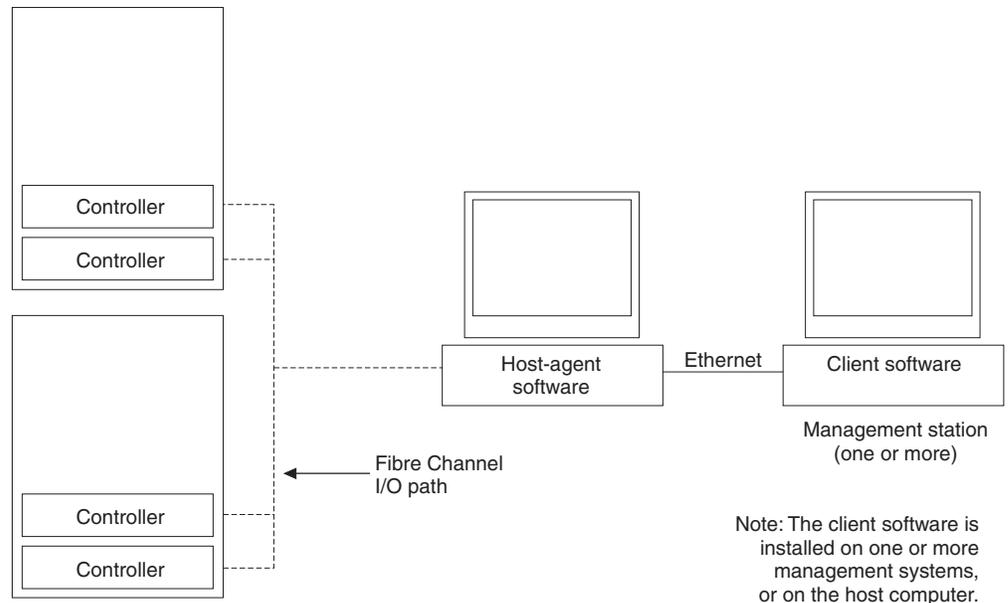


Figure 68. Host-agent managed storage subsystems

Direct-management method

This method uses Ethernet connections from a management station to each controller. You must install at least one management station. The management station can be the host or a workstation on the Ethernet network. The management station will have the client software installed. Attach Ethernet cables to each management station (one pair per storage subsystem). You will connect the cables to each controller later when you install the storage subsystem. Figure 69 shows the direct management method.

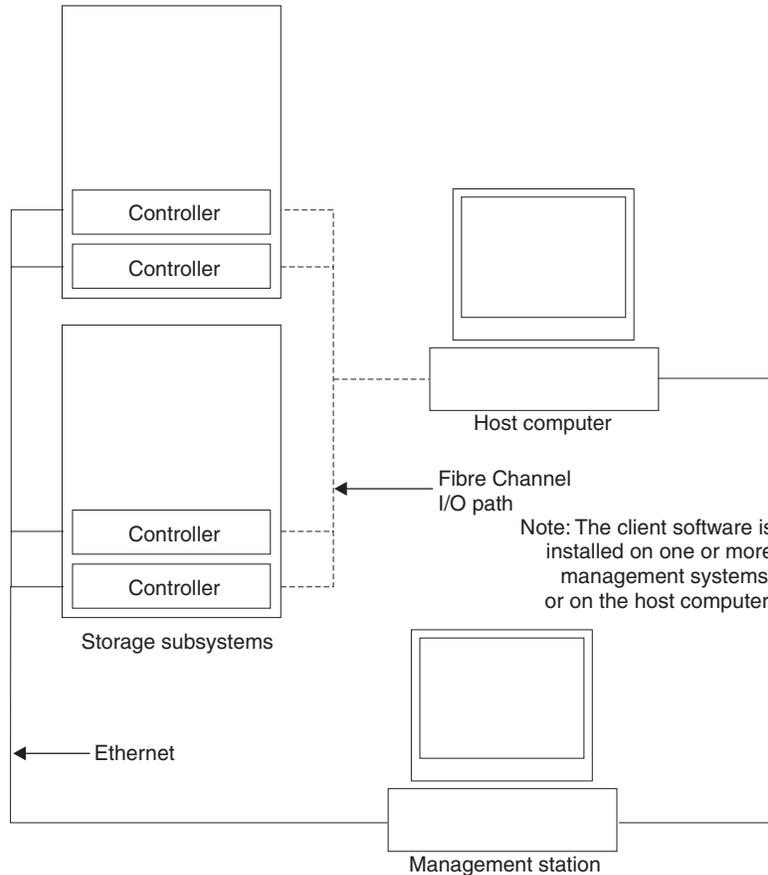


Figure 69. Direct-managed storage subsystems

Connecting secondary interface cables

Use the Ethernet interface ports on the back of the storage subsystem to connect the controllers for direct management of the storage subsystems.

DS4300 single-controller storage subsystem (Model 6LU/6LX)

Connect an Ethernet cable from the storage-management station to the Ethernet port of the controller.

DS4300 dual-controller storage subsystem (Model 60U/60X)

Connect a pair of Ethernet cables from the storage-management station to the Ethernet ports for Controller A (located on the left) and Controller B (located on the right) on the back of the storage subsystem. Figure 70 on page 85 shows the location of the ports.

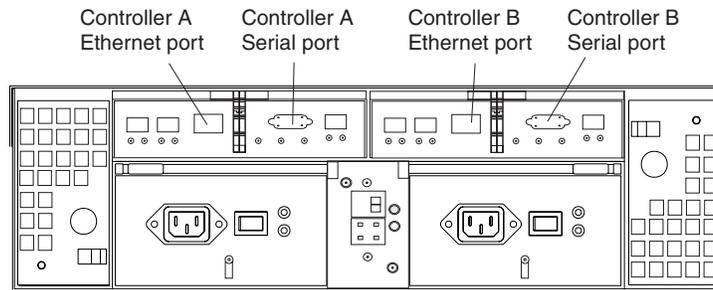


Figure 70. Ethernet and serial port locations

Important: The serial interface ports are intended to be used by service technicians to perform diagnostic operations on the storage subsystem. Inappropriate use will result in loss of system availability, loss of data, or both.

Power cabling

The DS4300 dual-controller storage subsystem (Model 60U/60X) uses two standard power cords, and the single-controller storage subsystem (Model 6LU/6LX) uses only one.

You can connect the power cords to a primary power unit inside the rack, such as a properly grounded ac distribution unit, or to an external source, such as a properly grounded electrical outlet.

If you have not already done so, attach the power cords, using the following illustration for the location of the component parts.

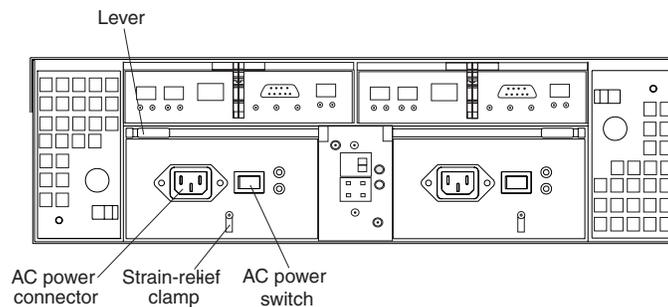


Figure 71. Power cord locations

Complete the following steps to attach the power cords:

1. Wrap the strain-relief clamp around the power cord approximately 20 cm (8 in.) from the power supply connection end.
2. Attach the power-supply nut, and tighten it securely.
3. Connect the power cord to the power supply.
4. Plug the power cord into a properly grounded electrical outlet.

Note: To maintain power redundancy on the DS4300 dual-controller storage subsystem (Model 60U/60X), plug the storage subsystem's right and the left power supplies into two independent external power circuits through

ac distribution units inside a rack cabinet or directly into external receptacles. Similarly, the right and left power supplies of the DS4000 storage expansion enclosures attached to the DS4300 storage subsystem should be plugged into the same two independent external power circuits as the DS4300 storage subsystem. See Figure 72 for an example of redundant power cabling.

Exception: The DS4300 single-controller storage subsystem (Model 6LU/6LX) has only one power supply, so it does not support power redundancy.

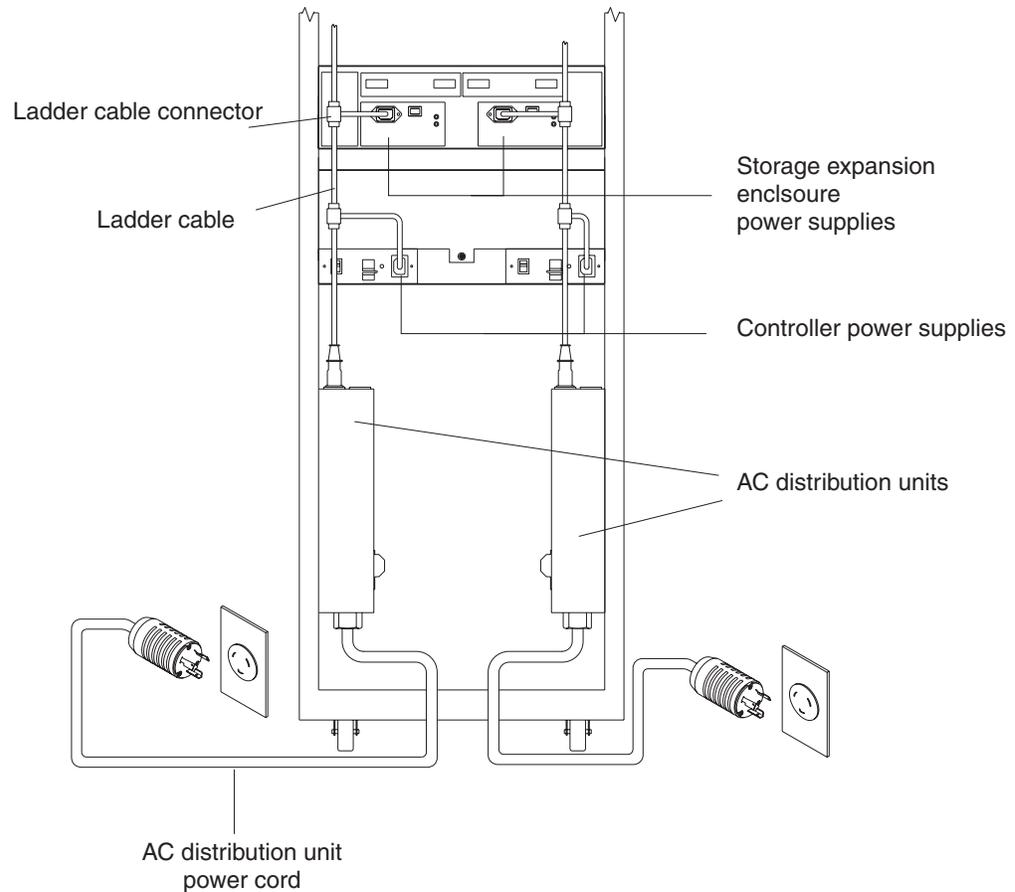


Figure 72. Redundant ac power connections to controllers and storage expansion enclosures

For details about power requirements, see “Specifications” on page 18.

- Go to “Turning the storage subsystem on and off” on page 92 for the initial startup of the storage subsystem.

Installing the storage-management software

Install the storage-management software by using the procedures in the *IBM DS4000 Storage Manager Installation and Support Guide* for your operating system. Use that document and the online help to configure the logical drives, partitions, and so on for the RAID controllers. Use your operating system documentation to make the new logical drives accessible to the operating system.

Note: Make sure that you start the storage-management software to continuously monitor the status of the storage subsystem. For information about the importance of this information, see “Monitoring status through software” on page 96.

Setting up IP addresses for DS4000 storage controllers

After you install DS4000 Storage Manager (as described in the DS4000 Storage Manager Installation and Support Guide for your host operating system), complete one of the following procedures to set up IP addresses:

- “Steps for setting up the DHCP/BOOTP server and network”
- “Steps for assigning static TCP/IP addresses to the DS4000 controllers”

Steps for setting up the DHCP/BOOTP server and network

To complete this procedure, you must have the following components:

- A DHCP or BOOTP server
- A network management station (NMS) for Simple Network Management Protocol (SNMP) traps
- A host that is connected to a storage subsystem through a fibre-channel I/O path
- A management station that is connected by an Ethernet cable to the storage subsystem controllers

Note: You can avoid DHCP/BOOTP server and network tasks either by using the default controller IP addresses, or by assigning static IP addresses to the controller, as described in the next section.

Complete the following steps to set up the DHCP/BOOTP server and network:

1. Get the MAC address from each controller blade.
2. Complete whichever of the following steps is appropriate for your server:
 - On a DHCP server, create a DHCP record for each of the MAC addresses. Set the lease duration to the longest time possible.
 - On a BOOTP server, edit the bootptab file to add in the entries that associate the MAC address tab with the TCP/IP address.
3. Connect the DS4000 storage subsystem Ethernet ports to the network.
4. Boot the DS4000 storage subsystem.

The DHCP server automatically assigns new IP addresses to the controller Ethernet port.

Steps for assigning static TCP/IP addresses to the DS4000 controllers

To complete this procedure, you must have the following components:

- A host that is connected to a storage subsystem through a fibre-channel I/O path
- A management station that is connected by an Ethernet cable to the storage subsystem controllers

Complete the following steps to assign static TCP/IP addresses to the DS4000 storage subsystem controllers, using default TCP/IP addresses that are assigned to the DS4000 storage subsystem controllers during manufacturing:

1. Make a direct management connection to the DS4000 storage subsystem, using the default TCP/IP addresses:
 - **Controller A:** 192.168.128.101

- **Controller B:** 192.168.128.102
- **Subnet Mask:** 255.255.255.0

Note: For a DS4000 subsystem that has two Ethernet ports per controller, such as the DS4200, DS4700 and DS4800, use the Ethernet port that is labeled #1.

2. Start the DS4000 Storage Manager client software. The Enterprise Management window opens.
3. Add the DS4000 subsystem to the DS4000 Enterprise Management domain using the default IP addresses.
4. In the Enterprise Management window, click on the name of the default storage subsystem. The Subsystem Management window opens.
5. In the Subsystem Management window, right-click the controller icon and select **Change** → **Network Configuration** in the pull-down menu. The Change Network Configuration window opens.
6. In the Change Network Configuration window, click on the Controller A and Controller B tabs and type the new TCP/IP addresses in their appropriate fields. Click **OK**.
7. Close the Subsystem Management window, wait at least five minutes, then delete the default DS4000 storage subsystem entry in the Enterprise Management window. The default DS4000 storage subsystem entry still displays, but shows an “unresponsive” icon.
8. If applicable, change the IP address of the Ethernet port in the management station to a value that is on the same TCP/IP subnet as the controller Ethernet port IP addresses that you just assigned. Exit DS4000 Storage Manager, then restart.
9. Add a new storage subsystem entry in the Enterprise Management window, using the new assigned IP addresses.

Note: To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data.

Chapter 4. Operating the storage subsystem

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

- Periodically, perform a full backup of the data on your storage drives.
- Before any planned system shutdown or after any system changes (additions, removals, or modifications), save controller subsystem profiles as explained in the Storage Manager guide for your operating system.
- Ensure that your system is in an optimal state before shutting down. Never turn the power off if any fault light is lit; be sure to resolve any error conditions before you shut down the system.
- During any maintenance or attended power-up procedure, carefully follow the power-up sequence listed in “Turning on the storage subsystem” on page 92. Each component of the subsystem should be checked that it is powered-on in the proper order during this entire power-up procedure to ensure the controller will be able to optimally access all of your storage subsystems.
- The storage subsystem supports simultaneous power-up to the system components; however, you should always follow the power-up sequence listed in “Turning on the storage subsystem” on page 92 during any attended power-up procedure.
- A storage system 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 IBM support if any of the following conditions occur:
 - The storage subsystem logical drives and arrays are not displayed in the Storage Manager client.
 - The storage subsystem logical drives and arrays do not come online.
 - The storage subsystem logical drives and arrays seem to be degraded.
- Using the DS4000 Storage Manager client, save the DS4000 subsystem configuration profile to a disk that is not affected every time you make changes to the DS4000 subsystem configuration (such as logical drive creation or modification, or storage partitioning changes).
- **DS4300 models 60U/60X only:** To maintain power redundancy, plug the DS4300 storage subsystem’s right and left power supplies into two independent external power circuits through ac distribution units inside a rack cabinet or directly into external receptacles. Similarly, the right and left power supplies of the DS4000 storage expansion enclosures attached to the DS4300 storage subsystem should be plugged into the same two independent external power circuits as the DS4300 storage subsystem. This ensures that the DS4300 storage subsystem and all its attached storage expansion enclosures will have power if only one power circuit is available. In addition, having all the right or all the left power supplies plug into the same power circuit will enable the components in the storage subsystem to power on simultaneously during an unattended restoration of power. See Figure 72 on page 86 for an example of redundant power connections.

Performing the DS4000 Health Check process

The DS4000 Health Check process is a sequence of suggested actions developed by IBM to help users verify and maintain the optimal performance of their DS4000 storage configurations. The information that you collect in these steps also helps provide IBM Service with important information needed for problem troubleshooting during IBM Service calls.

Perform the following Health Check tasks after the initial configuration of your DS4000 Storage Subsystem, and after all configuration sessions. It is also recommended that you set a regular schedule of periodic Health Check evaluations in order to keep your DS4000 code current and to preserve optimal data access and performance.

1. Monitor the Recovery Guru in the Storage Manager client for any obvious storage subsystem errors or problem conditions.
2. Gather and save the following DS4000 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 zip them into a single file by clicking **Advanced ► Troubleshooting ► Collect All Support Data** in the DS4000 Storage Manager Subsystem Management window.)
 - DS4000 storage subsystem management event log (MEL)
 - Storage Subsystem Profile or DS4000 Profile
 - Read-Link Status (RLS) data

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 DS4000 storage configuration failure. Do not save these event log files only to a LUN in the DS4000 Storage Subsystem.

3. Use the Storage Subsystem Profile or DS4000 Profile to verify that the following firmware levels are at the latest versions supported for your DS4000 storage subsystem:
 - Controller firmware
 - ESM firmware
 - Drive firmware

If you discover your firmware is not up-to-date, upgrade the firmware and software to the latest level appropriate to your DS4000 storage configuration. See “Web pages” on page 91 for information about where to find the latest firmware and software.

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

Save the storage subsystem profile before performing 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 DS4000 storage configuration failure.

Note: When you upgrade firmware, you must upgrade all client package components to the same release level. For example, if you are upgrading your controller firmware from version 5.x to version 6.x, you must also upgrade your Storage Manager client to version 9.x or higher. If your host system uses RDAC, upgrading controller firmware from version 5.x to version 6.x might also require host software updates, such as RDAC updates and HBA driver updates. Refer to the IBM DS4000 Web site for detailed instructions.

4. Use the Storage Subsystem Profile or DS4000 Profile to verify that the following functions are enabled:
 - For all DS4000 models, Media Scan should be enabled both at the controller level and at the LUN level.

- For all DS4000 models, the read/write cache should be enabled. In addition, use the Storage Subsystem Profile to verify that cache is matched between the controllers.

Web pages

IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates.

For DS4000 information, go to the following Web site:

www.ibm.com/servers/storage/support/disk/

For the latest information about operating system and HBA support, clustering support, SAN fabric support, and Storage Manager feature support, see the TotalStorage® DS4000 Interoperability Matrix at the following Web site:

www.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

Hardware responsibilities

In addition to the Health Check steps described above, regular hardware inspection and maintenance helps to support the optimal performance of your DS4000 storage configuration. You should periodically inspect the fibre channel components of your DS4000 storage configuration.

The following guidelines are suggested:

- Maintain an up-to-date storage subsystem profile for your DS4000 storage configuration. Save the profile to a server disk that will remain accessible in case of a DS4000 storage configuration failure. Do not save the profile only to a LUN in the DS4000 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 IBM-approved fibre channel cables for all situations. Note in your configuration documentation whether any cables are not IBM-approved.
- Create and maintain a cabling diagram of the current SAN 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, fibre channel switches, and other SAN attachments).
- Ensure that all ESMs are properly seated.
- Ensure that all drives are properly seated.
- Ensure that all SFP modules are properly seated.
- Confirm fibre channel cable loop size. (IBM specifications call for at least 3-inch cable loops, but it is recommended that you use 6-inch cable loops or longer.)
- Ensure proper fibre channel cable management.
- Ensure proper air flow and temperature for all components in your EXP810 storage configuration.

Note: You can find details on many of these inspection and maintenance responsibilities in the appropriate sections of this document.

In addition to these inspection and maintenance responsibilities, IBM also strongly recommends DS4000 training for staff that supports DS4000 storage configurations. Although training is not a part of the Health Check process, DS4000 training reduces the potential for configuration problems and contributes to the overall health of the system.

Turning the storage subsystem on and off

This section contains instructions for turning the storage subsystem on and off under normal and emergency situations.

If you are turning on the storage subsystem after an emergency shutdown or power outage, see “Restoring power after an emergency shutdown” on page 95.

Turning on the storage subsystem

Important: You must turn on the storage expansion enclosures and verify that the storage expansion enclosures’ FC connections are optimal by checking the indicator lights *before* you turn on the DS4300 storage subsystem. The controllers might not recognize the correct configuration if the hard disk drives are powered up after the DS4300 storage subsystem. For instructions on powering up the storage expansion enclosures, refer to the storage expansion enclosure documentation.

Note: Always wait at least 30 seconds between the time you turn off a power switch and the time you turn on the power again.

Use this procedure to turn on the power for the initial startup of the storage subsystem:

1. Verify the following:
 - a. All communication and power cables are plugged into the back of the storage subsystem and a properly grounded ac electrical outlet.
 - b. All hard disk drives are locked securely in place. For more information, see “Installing hot-swap drives” on page 121.

Note: At least two drives must be present before you start the DS4300 storage subsystem.

Attention: If you are restarting the system after a normal shutdown, wait at least 30 seconds before you turn on the power by using the power-on sequence in step 2.

2. Check the system documentation for the hardware devices that you intend to power up, and then determine the proper 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 the storage subsystem.

Attention: If you will be directly managing the storage array, you must set up the Dynamic Host Configuration Protocol (DHCP) or BOOT-P server before turning on the power. Setting up the server allows the controllers to obtain the corresponding IP address when you turn on the power to the array module. For more information, see the software installation guide for your operating system.

- b. You must turn on the storage expansion enclosures before the storage subsystem. The controllers might not recognize the correct configuration if

the drives are powered up after the storage subsystem. For instructions on powering up the storage expansion enclosures, see the storage expansion enclosure documentation.

- c. Turn on the power to the storage subsystem; then restart or turn on the power to the host.

Note: Depending on your operating system, you might not have to restart the host. For more information, see the software installation guide for your operating system.

3. Turn on the power to each device, based on the power-on sequence in step 2 on page 92. To turn on power to the storage subsystem, turn on the power-supply switches on the back of the storage subsystem. You must turn on both power-supply switches to take advantage of the redundant power supplies.
4. Use the storage-management software and the Fault LEDs to check the overall status of the storage subsystem and its components. All LEDs should be green on the front of the storage subsystem. If they are not, use the storage-management software to diagnose the problem (see “Monitoring status through software” on page 96).

Note: The green Drive active LED and amber Drive fault LED below the drive CRUs might flash intermittently as the drives spin-up. Wait until the storage subsystem is finished powering up before checking the LEDs on the front of the storage subsystem. For more information, see “Checking the LEDs” on page 97.

Turning off the storage subsystem

Attention: Except in an emergency, never turn off the power if any storage subsystem Fault LEDs are on. Correct the fault before you turn off the power. Use the storage-management software and the Fault LEDs to check the overall status of the storage subsystem and its components. All LEDs should be green on the front of the storage subsystem. If they are not, use the storage-management software to diagnose the problem (see “Monitoring status through software” on page 96). This ensures that the storage subsystem will power up correctly later. For more information, see “Troubleshooting” on page 145.

The storage subsystem is designed to run continuously, 24 hours a day. After you turn on the storage subsystem, do not turn it off. Turn off the power only when:

- Instructions in a hardware or software procedure require you to turn off the power.
- A service technician tells you to turn off the power.
- A power outage or emergency situation occurs (see “Performing an emergency shutdown” on page 95).

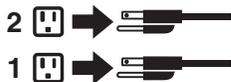
Statement 5



CAUTION:

The power control button on the device and 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 5



Use the following procedure to turn off the power:

1. Before proceeding, use the storage-management 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.
2. Use the storage-management software to check the status of the storage subsystem. Correct problems that are reported before you turn off the power.
3. Perform the following steps:
 - a. Stop all I/O activity to the storage subsystem and attached storage expansion enclosures. Make sure of the following:
 - All of the green Drive active LEDs on the front of the storage subsystem (and on all attached storage expansion enclosures) are not flashing.
 - The green Cache active LEDs located on the controller modules viewable from the back of the DS4300 storage subsystem are off.
 - b. Before the storage subsystem is powered off, use the operating system software to either disconnect the storage subsystem logical drives from the host or to flush the logical drive data cache in the host server memory.

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 4 for the proper shutdown sequence.

4. Turn off the power to each device based on the following shutdown sequence:
 - a. Turn off power to the host before the storage subsystem. If the host must stay powered on to support an existing 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 expansion enclosures. Turn off both power supply switches on the back of the storage subsystem.
 - c. Turn off power to other supporting devices (for example, management stations, fibre-channel switches, or Ethernet switches).

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

5. After you perform the necessary maintenance procedures, turn on the power using the procedure in “Turning on the storage subsystem” on page 92.

Restoring power after an unexpected shutdown

The storage subsystem might shut down unexpectedly under any of the following conditions:

Attention: There might be data loss in each of the following cases:

- The internal temperature of the storage subsystem exceeds the maximum operating temperature (an over-temperature condition).
If both fan CRUs fail or are unable to maintain an internal temperature below 70°C (158°F), one or both of the power supplies in the storage subsystem will shut down. If both power supplies shut down, the unit is inoperable.
The storage-management software warns you if the temperature of the unit is rising, before it has risen sufficiently to shut down the power supplies. The first warning comes when the storage subsystem internal temperature exceeds 45°C (113°F). The storage subsystem shuts down if the temperature rises to 70°C (158°F).
- There is a general power failure or a loss of power to the unit.
- You are forced to shut down the storage subsystem without performing the normal shutdown procedures (listed in “Turning off the storage subsystem” on page 93) because of an emergency situation.

Attention: To avoid damage to the hardware, take special care when restarting the system after an unexpected shutdown.

If the storage subsystem shuts down unexpectedly, go to “Restoring power after an over-temperature shutdown” on page 96. Otherwise, go to “Restoring power after an emergency shutdown.”

Note: Unattended restoration of power is supported; however, if power restoration is attended, you should follow the best practices guidelines and the power restoration sequence in “Turning on the storage subsystem” on page 92.

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 will help 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 midplane (see “Troubleshooting” on page 145).

Use the following procedure to shut down the storage subsystem during an emergency:

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 (front and back). Make note of any Fault LEDs that are on so you can correct the problem when you turn on the power again.
3. Turn off all power-supply switches starting with the DS4300 storage subsystem power supply switches first and then the power supply switches of the attached storage expansion enclosures; then unplug the power cords from the storage subsystem.

Restoring power after an emergency shutdown

Use the following procedure to restart the storage subsystem if you turned off the power-supply switches during an emergency shutdown, or if a power failure or a power outage occurred:

1. After the emergency situation is over or power is restored, check the storage subsystem for damage. If there is no visible damage, continue with step 2; otherwise, have your system serviced.
2. After you have checked for damage, ensure that the power-supply switches are off; then plug in the storage-server power cords.
3. Complete step 2 on page 92 to determine the proper power-on sequence for your system.
4. Complete steps 3 and 4 on page 93 to turn on power to the devices in your system and to check the status of the storage subsystem.

Restoring power after an over-temperature shutdown

Use the following procedure to restart the storage subsystem after an unexpected shutdown due to an over-temperature condition:

1. Make sure that the power-supply switches on the back of the storage subsystem are turned off.
2. Do whatever is necessary to cool the unit (replace the fans, use external fans to cool the room, and so on).
3. Check all components and cables for visible damage. *Do not start the storage subsystem if you find evidence of damage.*
4. Complete step 2 on page 92 to determine the proper power-on sequence for your system.
5. When the internal temperature of the storage subsystem is below 35°C (95°F), complete steps 3 and 4 on page 93 to turn on power to the devices in your system and to check the status of the storage subsystem.

Monitoring status through software

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

Notes:

1. You can only monitor storage subsystems that are within the management domain of the storage-management software.
2. If you do not install the Event Monitor service as part of the storage-management software installation, the Enterprise Management window of the storage-management software 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.

The storage-management software provides the best way to diagnose and repair storage-server failures. The software can help you do the following:

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

Although the storage subsystem has fault LEDs, these lights do not necessarily indicate which component has failed or needs to be replaced, or which type of recovery procedure you must perform. In some cases (such as loss of redundancy in various components), the fault LED does not turn on. Only the storage-management software can detect the failure.

For example, the recovery procedure for an IBM Predictive Failure Analysis® (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-management software can identify the risk level and provide the necessary recovery procedures.

Note: For PFA flags, the General-system-error LED and Drive fault LEDs do not turn on, so checking the LEDs will not notify you of the failure, even if the risk of data loss is high.

Recovering from a storage-server failure might require you to perform procedures other than replacing the component (such as backing up the logical drive or failing a drive before removing it). The storage-management software gives these procedures.

Attention: Not following the software-recovery procedures can result in data loss.

Firmware updates

In order to ensure the optimal operation of the DS4300 storage subsystem and its attached storage expansion enclosures, the storage expansion enclosure ESM firmware, the DS4300 storage subsystem controller firmware, the hard drive firmware, and the NVSRAM (for controllers only) must be up to date. Go to the following Web site to get the latest updates:

<http://www-1.ibm.com/servers/storage/support/disk/>

Apply the necessary updates before configuring the DS4300 arrays and logical drives. Subscribe to My Support for automatic notifications of firmware or storage manager software updates or any important information about your DS4000 subsystems (see “Product updates” on page 1).

Attention: Read the Readme file that is included in each firmware or DS4000 Storage Manager software package for any limitations, subsystem firmware prerequisites, or download-sequence information. For example, the controller firmware code might require the storage expansion enclosure ESM firmware to be upgraded first to a particular version, or the controller firmware download might require the halting of I/Os to the DS4300 storage subsystem’s logical drives. Failure to observe the limitations, prerequisites, and dependencies in the Readme file might result in a loss of data access.

Checking the LEDs

The LEDs display the status of the storage subsystem and components. Green LEDs indicate a normal operating status; amber LEDs indicate a possible failure.

It is important to check all the LEDs on the front and back of the storage subsystem when you turn on the power. In addition to checking for faults, you can use the LEDs on the front of the storage subsystem to determine if the drives are responding to I/O transmissions from the host.

For information about the LEDs on the front of the storage subsystem, see the following:

- Figure 73 on page 98

- Table 13

For information about the LEDs on the back of the storage subsystem, see the following:

- Figure 75 on page 101
- Table 14 on page 99
- Table 15 on page 101

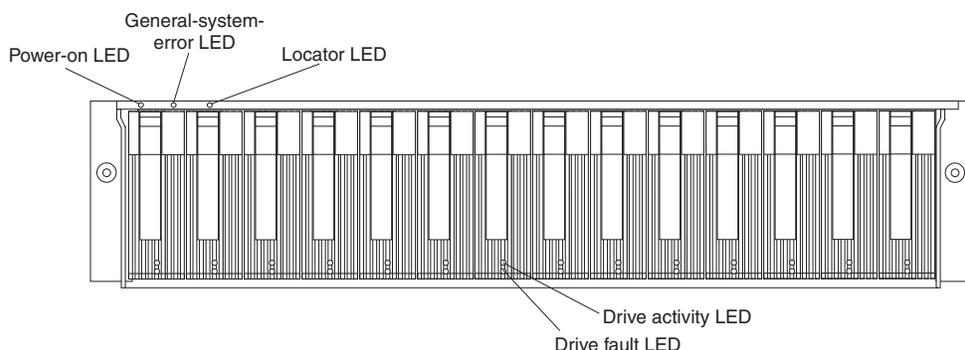


Figure 73. DS4300 storage subsystem LEDs (front)

Table 13. DS4300 storage subsystem LEDs (front)

LED	Color	Operating states ¹
Drive active	Green	<ul style="list-style-type: none"> • On - Normal operation • Flashing - The drive is reading or writing data. • Flashing every 5 seconds - The drive has not spun up. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – The storage subsystem has no power. – The drive is not properly seated in the storage subsystem.
Drive fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation • Flashing - The storage management software is locating a drive, logical drive, or storage subsystem. • On - The drive failed, or a user failed the drive.
Power	Green	<ul style="list-style-type: none"> • On - Normal operation • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – The storage subsystem has no power. – Both power supplies have failed. – There is an overtemperature condition.

Table 13. DS4300 storage subsystem LEDs (front) (continued)

LED	Color	Operating states ¹
General-system-error	Amber	<ul style="list-style-type: none"> • Off - Normal operation • On - A storage subsystem component failed.² <p>Note: When the power supply fails on the DS4300 model 6LU and 6LX storage subsystem, the general-system-error LED (and the Power-on LED) are not lit.</p>
Locator	Blue	<ul style="list-style-type: none"> • On - When on, this blue light indicates the storage management software is locating the server. • Off - When off, the storage management software is not actively searching for the server.

¹ Always use the storage management software to identify the failure.

² This LED could be turned on for fault conditions that are not caused by a subsystem components failure such as logical drive not on preferred path or drive has errors exceeded Predictive Failure limits. Always use the storage management software to identify the failure.

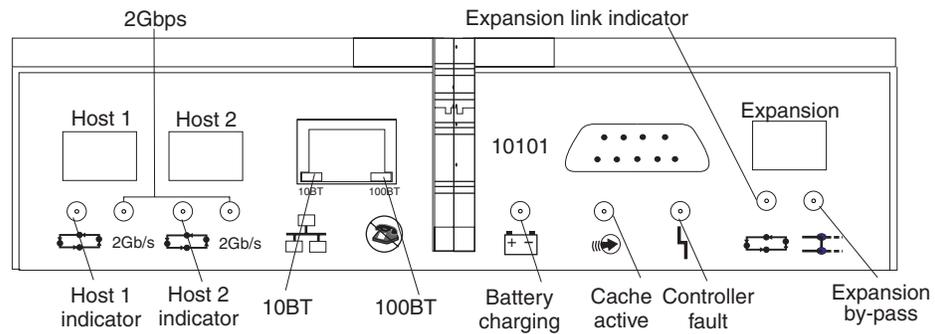


Figure 74. DS4300 RAID controller LEDs

Table 14. DS4300 RAID controller LEDs

Icon	LED	Color	Operating states ¹
	Fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation • On - The RAID controller failed.
	Host loop	Green	<ul style="list-style-type: none"> • On - Normal operation • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – The host loop is down, not turned on, or not connected. – An SFP failed, or the host port is not occupied. – The RAID controller circuitry failed, or the RAID controller has no power.

Table 14. DS4300 RAID controller LEDs (continued)

Icon	LED	Color	Operating states ¹
	Cache active	Green	<ul style="list-style-type: none"> • On - There is data in the RAID controller cache. • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – There is no data in the cache. – There are no cache options enabled for this DS4300 subsystem. – The cache memory failed, or the battery failed.
	Battery	Green	<ul style="list-style-type: none"> • On - Normal operation • Flashing - The battery is recharging or performing a self-test. • Off - The battery or battery charger failed.
	Expansion port bypass	Amber	<ul style="list-style-type: none"> • Off - Normal operation • On - One of the following situations has occurred: <ul style="list-style-type: none"> – An SFP module is inserted in the drive loop port and the fibre channel cable is not attached to it. – The fibre channel cable is not attached to an expansion unit. – The attached expansion unit is not turned on. – An SFP failed, a fibre channel cable failed, or an SFP failed on the attached expansion unit. <p>Note: There is no Expansion port bypass LED on the DS4300 model 6LU and 6LX storage subsystem.</p>
	Expansion Loop Link	Green	<ul style="list-style-type: none"> • On - Normal operation • Off - The RAID controller circuitry failed, or the RAID controller has no power.
No icon	2 Gbps	Green	<ul style="list-style-type: none"> • On - Normal operation (host connection is at 2 Gbps) • Off - Host connection is at 1 Gbps (which is not supported for controller firmware 05.33.xx.xx).
No icon	10BT	Green	<ul style="list-style-type: none"> • If the Ethernet connection is 10BASE-T: The 10BT LED is on; the 100BT LED flashes faintly. • If the Ethernet connection is 100BASE-T: The 10BT LED is off; the 100BT LED is on. • If there is no Ethernet connection: Both LEDs are off.
No icon	100BT		
¹ Always use the storage management software to identify the failure.			

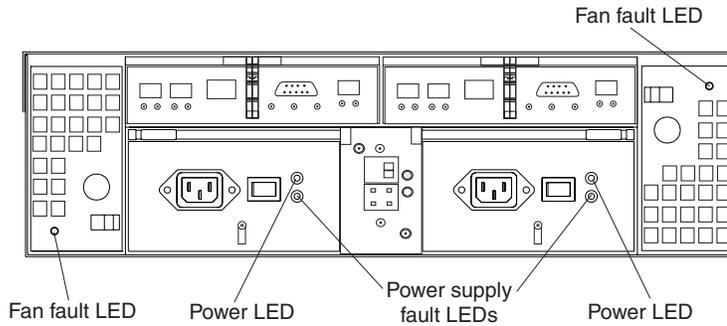


Figure 75. DS4300 storage subsystem fan and power supply LEDs

Table 15. DS4300 storage subsystem fan LED

LED	Color	Operating states ¹
Fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation • On - The fan FRU failed.
¹ Always use the storage management software to identify the failure.		

Table 16. DS4300 storage subsystem power supply LEDs

LED	Color	Operating states ¹
Fault	Amber	<ul style="list-style-type: none"> • Off - Normal operation • On - One of the following situations has occurred: <ul style="list-style-type: none"> – The power supply failed. – An overtemperature condition has occurred. – The power supply is turned off.
Power	Green	<ul style="list-style-type: none"> • On - Normal operation • Off - One of the following situations has occurred: <ul style="list-style-type: none"> – The power supply is disconnected. – The power supply is seated incorrectly. – The storage subsystem has no power.
¹ Always use the storage management software to identify the failure.		

Cache memory and RAID controller battery

Each RAID controller contains memory for caching read and write data. It also contains a rechargeable battery that maintains data in the cache in the event of a power failure. The following sections describe these features and their associated LEDs.

Cache memory

Cache memory is memory on the RAID controller that is used for intermediate storage of read and write data. 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.

See the storage management software documentation for information on how to set cache memory options.

The RAID controller has a Cache active LED that displays the current status of the cache. The LED is on if data is in the cache, and it is off if no data is in the cache.

If caching is enabled and the Cache active LED never comes on during I/O activity, it indicates that the cache memory failed or the battery failed. (The green Battery LED will be off.)

Note: Always use the storage management software to check your cache memory settings before you assume a hardware failure. On the DS4300 single-controller storage subsystem (model 6LU/6LX), the RAID controller cache memory is used for storing read data only. The controller firmware ignores a “write-cache enabled” setting. This protects data in the event of a controller failure, which would cause the cache to be inaccessible.

Figure 76 shows the location of the Cache active LED on the RAID controller modules which are located on the back of the DS4300 subsystem.

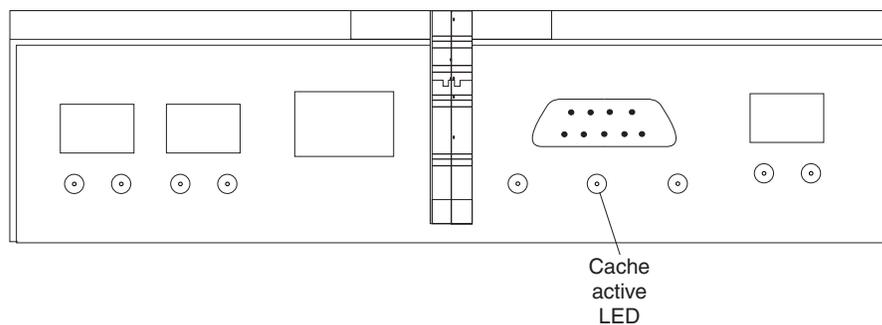


Figure 76. DS4300 storage subsystem cache active LED

RAID controller cache battery

Each RAID controller contains a sealed, rechargeable 4-volt lead-acid battery. This battery provides cache backup for up to three days in the event of a power loss.

The service life of the battery is three years, after which time the battery must be replaced. See the storage management software for information on how to view and set the battery expiration date.

Important: The replacement RAID controller CRU does not come with a RAID controller cache battery installed, nor the mounting hardware that holds the battery in place inside the RAID controller. You must remove the cache battery that is inside the existing RAID controller that you are replacing, and install that battery inside the replacement RAID controller CRU, using the battery unit mounting hardware taken from the existing controller. On the DS4300 model 6LU/6LX, you will have to stop all I/O to the storage subsystem before you replace the battery. The steps to remove and replace the battery are included in Chapter 5, “Installing and replacing components,” on page 105.

Each RAID controller has a green Battery LED on the back that indicates the following battery statuses:

- The LED is on and remains steady when the battery is fully charged.

- The LED flashes when the battery is charging or performing a self-test.
- The LED is off if the battery or the battery charger failed.

The battery performs a self-test at startup and every 25 hours thereafter (during which time the Battery LED flashes). If necessary, the battery begins recharging at that time. If the battery fails the self-test, the Battery LED turns off, indicating a battery fault.

Data caching starts after the battery completes the startup tests.

Figure 77 shows the location of the Battery LED on the RAID controller modules which are located on the back of the DS4300 subsystem.

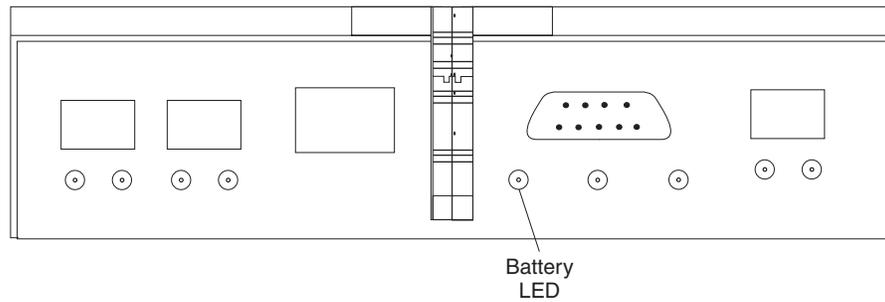


Figure 77. DS4300 storage subsystem battery LED

Chapter 5. Installing and replacing components

This chapter provides instructions to help you install or remove customer replaceable units (CRUs), such as hot-swap drives, fans, RAID controllers, and power supplies.

For more field-replaceable unit (FRU) and Option part number information, see the following Web site:

www.ibm.com/storage/techsup.htm

Handling static-sensitive devices

Attention: Static electricity can damage electronic devices and your system. 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 your movement. Movement can cause static electricity to 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 where others can handle and possibly damage the device.
- While the device is still in its static-protective package, touch it to an unpainted metal part of the storage subsystem for at least two seconds. This drains static electricity from the package and from your body.
- Remove the device from its package and install it directly into your storage subsystem without setting it down. If it is necessary to set the device down, place it in its static-protective package. Do not place the device on your storage subsystem cover or any metal surface.
- Take additional care when handling devices during cold weather because heating reduces indoor humidity and increases static electricity.

Upgrading your RAID controllers

This section describes the following upgrades:

- “Upgrading DS4300 Model 6LU/6LX to Model 60U/60X”
- “Upgrading the DS4300 Model 60U/60X from standard to Turbo option” on page 109

Upgrading DS4300 Model 6LU/6LX to Model 60U/60X

To upgrade from the DS4300 single-controller storage subsystem (Model 6LU/6LX) to the DS4300 dual-controller storage subsystem (Model 60U/60X), you must purchase one of the following upgrade kits:

- IBM DS4300 Model 6LU/6LX Upgrade, IBM part number 24P8963
- IBM DS4300 Model 6LU/6LX Turbo Upgrade, IBM part number 24P8964

See “IBM DS4300 Model 6LU/6LX” on page 2 for a description of the differences between the two upgrade kits.

The upgrade kits contain two DS4300 controller CRUs, with cache memory battery installed, and one power supply. You must purchase additional SFPs and fibre channel cables separately to make fibre channel connections to the host ports on the second DS4300 controller.

Use the following procedure for both upgrade kits.

Steps for upgrading from DS4300 Model 6LU/6LX to Model 60U/60X

Before you begin:

- Schedule downtime for the upgrade.
- If you purchase additional storage capacity at the same time as the controller upgrade kit, do not connect the new drives or storage expansion enclosures to the DS4300 controllers until you complete the following tasks:
 - Finish the upgrade process
 - Verify that the upgraded storage subsystem is in optimal state
- If you have premium features enabled in the existing DS4300 storage subsystem, ensure that you have access to the premium features key files before you begin the upgrade process. You will need to re-enable your premium features during the process.
- Ensure that you have installed the latest version of DS4000 Storage Manager. For more information, see the *IBM DS4000 Storage Manager Installation and Support Guide* for your operating system, or see the following Web site:

www-1.ibm.com/servers/storage/support/disk/

- Use the Storage Manager Client to determine whether the system is in an optimal state. If it is not, fix the problem to return the system to an optimal state before you attempt the upgrade.
- After the new controllers complete the boot process, the WWNN of the DS4300 controllers will change. If you have any applications that rely on the previous WWNNs, such as FC switch zoning definitions, you must update the applications with the new WWNNs.

Complete the following steps to upgrade from DS4300 Model 6LU/6LX to Model 60U/60X, using either the standard or the Turbo option upgrade kit:

1. In the Storage Manager Client, open a management connection to the DS4300 that you are upgrading.
2. Save the storage subsystem profile to a disk location that is *not* in the DS4300 that you are upgrading. In the Subsystem Management window, select **View** → **Storage Subsystem Profile**. When the Storage Subsystem Profile window opens, click **Save As**. The Save Profile window opens. Select an appropriate directory and choose a file name for the profile, then click **Save**. Click **Close** to close the Storage Subsystem Profile window.
3. Complete any necessary server preparation tasks, because the disks will not be available during the upgrade process. For example, stop all programs, services or processes in the host servers that access the logical drives.

Note: Make sure that you stop any background programs, services or processes that write data to the logical drives. For example, Microsoft MSCS periodically writes to the Quorum disk.

4. Stop I/O to the storage subsystem.
5. Unmount any mapped LUNs from the storage subsystem.

Note: In a Microsoft Windows® environment, remove the drive letter or the mount points of the mapped LUNs instead of unmounting the file systems.

6. If applicable, remove the controller WWNN from the fibre channel switch fabric zone definitions or any applications that use this WWNN info.
7. Wait one minute, then turn off the DS4300 storage subsystem that you are upgrading.
8. Label each cable that connects to the existing RAID controller CRU host ports to ensure that all cables will be properly reconnected to the new RAID controller CRU.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. When working with fiber-optic cables, do not pinch them, step on them, or locate them in aisles or walkways. Do not overtighten the cable straps or bend the cables to a radius smaller than 38 mm (1.5 in.).

9. Remove the fibre-channel cables from the SFPs on the RAID controller CRU. (After removing the fibre-channel cables, insert their protective caps.)
10. Remove the DS4300 single controller CRU, as follows:
 - a. Push down on the latch (centered above the RAID controller), then pull both levers at the same time out of the locked position.
 - b. Grasp the pull-rings, then pull on the levers and remove the RAID controller.
11. Unpack and insert the first upgrade DS4300 controller CRU into the left-hand controller slot, which is marked “Controller A”, as follows:
 - a. Slide the RAID controller all the way into the empty slot.
 - b. Close both levers until the latch locks into place.
12. Remove the SFPs from host ports of the DS4300 single-controller CRU and insert them into the host ports of the new DS4300 controller CRU, which you installed in step 11. (Use the instructions in “Removing SFP modules” on page 35 and “Installing SFP modules” on page 33.)
13. Remove the controller CRU blank from the right-hand controller slot, which is marked “Controller B.”
14. Insert the new RAID controller into the slot marked “Controller B.”.
15. Unpack the additional SFPs and insert them in the host ports of Controller B.
16. Remove the power supply blank from the right-hand power supply slot. Unpack and insert the upgrade power supply CRU into the slot. (See “Installing a hot-swap power supply” on page 133 for more information about installing power supplies.)
17. Reconnect the fibre-channel cables to their original host port locations in Controller A, using the instructions in Chapter 3, “Cabling the storage subsystem,” on page 29. Using the new fibre-channel cables, make the necessary fibre-channel connections to the host ports of controller B.
18. If DHCP/BootP was used to automatically set the IP address of the controller, complete the following steps:
 - a. Record the MAC address of the upgrade controller
 - b. Modify the existing DHCP/BootP record of the RAID controller to be upgraded with the new MAC address

Notes:

- a. Failure to modify the DHCP/BootP record will result in problems trying to manage the storage subsystem using the existing IP address.

- b. You must complete this step before you insert the upgrade controller into the DS4000 storage subsystem. For more information, see the instructions the appropriate *IBM DS4000 Storage Manager version 9.1x Installation and Support Guide*.
 - c. If you have created a DHCP/BootP record for controller A, you must add one for controller B. Otherwise, you might not be able to manage controller B using the Ethernet network.
19. Connect the power cord to the ac connector of the newly added power supply CRU.
 20. Plug the power cord into a properly grounded electrical outlet.
 21. Turn on the power supply switches. Make sure that the green Power LED on the new power supply CRU is on, and that the amber Fault LED is off.
 - If the Power LED is off, the power-supply CRU might not be installed correctly. Remove it, and then reinstall it.
 - Ensure that the electrical outlet is hot.
 - If the Fault LED is on, or if the Power LED stays off, contact your IBM support representative.

Note: To maintain power redundancy on the DS4300 dual-controller storage subsystem (Model 60U/60X), plug the right and the left power supplies into two independent external power circuits through ac distribution units (inside a rack cabinet or directly into external receptacles).

Similarly, plug the right and left power supplies of any attached DS4000 EXP storage expansion enclosures into the same two independent external power circuits as the DS4300 storage subsystem. See Figure 72 on page 86 for an example of redundant power cabling.

22. Wait a few minutes for the new controllers to complete the boot process.
23. If applicable, update the fibre channel switch fabric-zone definitions with the newly generated controller World Wide Node Name (WWNN).

Note: If you have any other applications that rely on the previous DS4300 controller WWNN, then you must also update the applications with the new WWNNs.
24. Using the Storage Manager client, open a management connection to the DS4300 storage subsystem.
25. Verify that the storage subsystem does not have any errors (beside the battery failed/charging error). If there are missing LUNs, configurations, failed fibre-channel hard drives or fibre-channel hard drives that display the “need attention” icon, contact your IBM support representative.
26. Set the enabled premium features back into an enabled and optimal state, using the existing premium features key files for the RAID controller that you removed from the original storage subsystem.

Note: Before you complete this step, the premium features might display as enabled, but they will be “out of compliance.”

27. If this is the Turbo upgrade option, use the Storage Manager Client to verify the firmware and NVSRAM. If the current versions are earlier than the versions that are included on the Turbo Option CD, reload the firmware and NVSRAM to the CD versions. Then, check the IBM Web site for any firmware or NVSRAM updates.

28. Enable full controller redundancy by making appropriate FC connections between controller B's host ports and the HBA ports in the servers that are connected to controller A. You must also install the LUN failover driver in the host server.

Note: If the failover driver is already installed, you might have to reconfigure the failover settings, reboot the server, or both—depending upon which failover driver you used. If you do not install or reconfigure the failover driver, you will not have controller redundancy protection.

29. In the host server, reestablish the I/O connections to the mapped LUNs by mounting the file systems or adding drive letter/mount points.

Note: You may have to reboot servers that use Microsoft Windows operating systems to enable them to recognize the drives.

30. If this is the Turbo upgrade option, follow the Web activation instructions provided in the upgrade kit to activate the Storage Partitioning Premium Feature and register the ability to attach seven additional DS4000 EXP storage expansion enclosures.

Upgrading the DS4300 Model 60U/60X from standard to Turbo option

If you have purchased the DS4300 Turbo option, you must replace your existing 256-MB memory controllers to 1-GB memory controllers shipped as part of the option. You should perform this upgrade with the power on as a hot-swap. It is also possible to perform this procedure as a cold-swap.

Note: A controller hot-swap replacement is when the controllers are replaced one at a time while the storage subsystem is powered on. Care must be exercised to ensure a successful upgrade. Hot-swap is the preferred method for upgrading your controllers. A controller cold-swap replacement is when both controllers are replaced at the same time after the storage subsystem is powered off. Power is turned back on to the storage subsystem after the controllers are replaced.

This section contains the following procedures:

- “Steps for hot-swap RAID controller upgrade”
- “Steps for cold-swap RAID controller upgrade” on page 115

Steps for hot-swap RAID controller upgrade

Important:

- You cannot hot-swap the RAID controller of a DS4300 single-controller storage subsystem (Model 6LU/6LX).
- You must install the latest version of Storage Manager client software in the management workstation or in the host server connected to the DS4300 that will be upgraded before you replace the old controller with the new controller. For more information, see the *IBM DS4000 Storage Manager Installation and Support Guide* for your operating system, or the following Web site:

www-1.ibm.com/servers/storage/support/disk/

- This procedure must be done when the DS4300 system is at a low I/O state. It is preferred that no I/Os are made to the DS4300 server while the storage subsystem is being upgraded.

- The upgrade should be performed when the system is in an optimal state. If it is not, fix the problem before attempting the upgrade. Use the Storage Manager client to determine if the system is in an optimal state.
- You must have a management connection to the controller before attempting the upgrade because you need to use the Storage Manager client to set the controller to certain states before replacing it, and to verify its operating condition status.

You need to use the Storage Manager client to properly set the controller state by completing the following steps:

1. Disable controller caching.
 2. Set the controller to offline state before replacing it.
 3. Set the controller to online state after inserting the new controller.
 4. Verify controller operating condition status after the new controller is brought online.
- Save the configuration/profile before upgrading.

Each RAID controller fits into the back of the storage subsystem and has the following components:

- Battery
- Cache memory
- Two host ports and one expansion port
- One Ethernet port
- One serial port

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front. There is also a label giving the cache battery manufacturing and installation dates on the top of the controller unit. Figure 78 shows the location of these items.

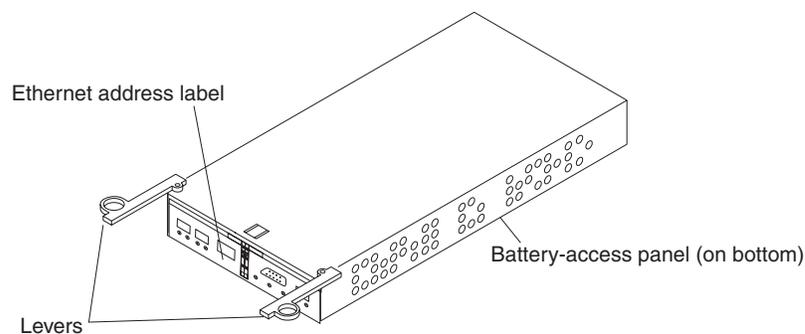


Figure 78. RAID controller levers and labels

For information about the RAID controller cache memory and rechargeable battery, see “Cache memory and RAID controller battery” on page 101.

You must replace both controllers. Replace one controller at a time. To upgrade your RAID controller, complete the following steps:

1. Open a management connection to the DS4300 using the Storage Manager client.

2. Save the storage subsystem profile to a disk location that is *not* in the DS4000 storage subsystem that you are upgrading. In the Subsystem Management window, select **View-->Storage Subsystem Profile**. When the Storage Subsystem Profile window opens, click **Save As**. The Save Profile window opens. Select an appropriate directory and choose a file name for the profile, then click **Save**.

Click **Close** to close the Storage Subsystem Profile window.

3. Use the Storage Manager client to flush and disable the read/write cache on both controllers, using the following steps. Either check that the cache LED on the back of the controller is off or wait two to three minutes.
 - a. In the Logical/Physical View of the Subsystem Management window, right-click any of the logical drive tree nodes and select **Change-->Cache Settings**. A Change Cache Settings window opens.
 - b. Click **Select All** to select all logical drives, and clear all of the Cache Setting Enable check boxes, then click **OK**. Click **OK** when the Confirmation window opens.

Note: A progress window shows the modification progress. After the cache setting modification complete, click **OK** to close the progress window and return to the Subsystem Management window.

Refer to the Storage Manager client online Help panels for more details on disabling cache.

4. Place the controller in an offline state. In the Logical/Physical View of the Subsystem Management window, right-click the controller icon and select **Place-->Offline**. Click **Yes** when the Controller Offline Confirmation window opens. Verify that the controller amber fault LED is lit. In the Storage Manager client, the controller will be displayed with a red "X" icon.
5. Label each cable that connects to the RAID controllers. This ensures that all cables will be properly reconnected to the new RAID controllers.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. When working with fiber-optic cables, do not pinch them, step on them, or locate them in aisles or walkways. Do not overtighten the cable straps or bend the cables to a radius smaller than 38 mm (1.5 in.).
6. From the first RAID controller to be upgraded, remove the fibre-channel cables from the SFPs. The location of these components is shown in Figure 79 on page 112.

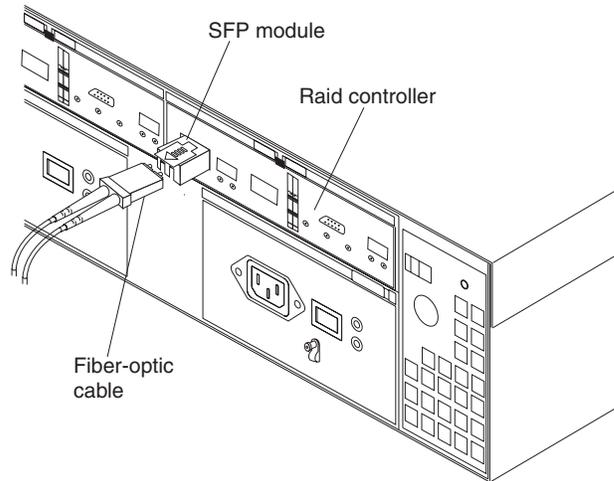


Figure 79. Location of SFPs and fiber-optic cables

After removing the fibre-channel cables, insert the protective caps.

7. Use the following procedure to remove the SFPs from the RAID controller to be upgraded.
 - a. Remove the LC-LC fibre-channel cable from the SFP module. For more information, see "Handling fiber-optic cables" on page 33.
 - b. Unlock the SFP module latch:
 - For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 80.

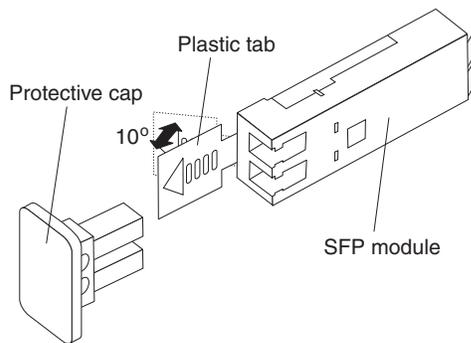


Figure 80. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 81 on page 113.

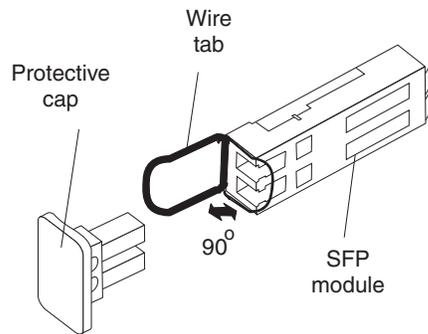


Figure 81. Unlocking the SFP module latch - wire variety

- c. With the SFP latch in the unlocked position, extract 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 minihub port.
- d. Replace the protective cap on the SFP module.
- e. Place the SFP module into a static-protective package.
- f. Replace the protective cap on the port.
8. Remove the RAID controller to be upgraded, as follows:
 - a. Push down on the latch (centered above the RAID controller). Pull both levers at the same time out of the locked position.
 - b. Grasp the pull-rings (see Figure 82), then pull on the levers and remove the RAID controller.

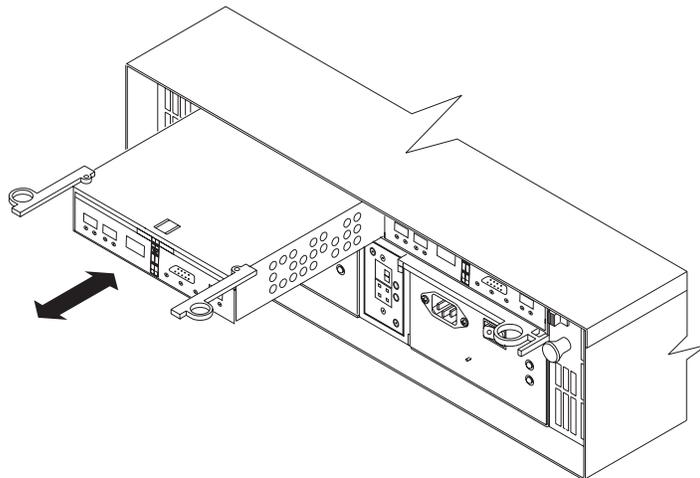


Figure 82. Pull-rings for removing a controller

9. Unpack the new RAID controller with the 1-GB memory. Verify that the battery is in the controller by opening the DS4300 controller CRU, using step 6 through step 9 of “Replacing the battery in the RAID controller” on page 140. If there is no battery in the new DS4300 controller, remove the battery from the old controller and install it in the new controller.

Set the RAID controller on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return the RAID controller.

10. If DHCP/BootP was used to automatically set the IP address of the controller, record the MAC address of the upgrade controller and modify the existing DHCP/BootP record of the RAID controller to be upgraded with the new MAC address. Failure to modify the DHCP/BootP record will result in problems trying to manage the storage subsystem using the existing IP address. This step must be performed before you insert the upgrade controller into the DS4000 storage subsystem.
11. Install the new RAID controller, as follows:
 - a. Slide the RAID controller all the way into the empty slot.
 - b. Close both levers until the latch locks into place.

Attention: When you replace the old RAID controller, the storage-management software automatically synchronizes the firmware between the existing controller and the new controller. After you replace a controller, always use the storage-management software to verify the firmware levels and nonvolatile storage random access memory (NVS RAM) files.

12. Insert the SFPs according to the instructions in “Installing SFP modules” on page 33.
13. Connect the fibre-channel cables to their original locations, according to the instructions in Chapter 3, “Cabling the storage subsystem,” on page 29.
14. Wait approximately one minute, and then check the green Host Loop LED, green Expansion Loop LED, and amber Fault LED on the new RAID controller.

Note: If the Expansion Loop LED is off, the RAID controller might not be inserted correctly. Remove the RAID controller and reinsert it.

15. Bring the controller online by completing the following steps:
 - a. In the Physical View of the Subsystem Management window, right-click the controller icon and select **Place-->Online**.
 - b. Click **Yes** when the Controller Online Confirmation window opens.
16. Check that the controller is online. Use either of the two following methods:
 - Use the Storage Manager client to verify that the controller is online (up) and running by selecting the menu option to display the properties of the controller that has just been replaced. If the controller is not up, you will get a controller-connection error window instead of the Controller Properties window. Wait a minute and retry until you get the properties window.
 - Check the LEDs at the back of the controller. All Fault LEDs should be off and the Host Loop and Expansion Loop LEDs should be on.
17. If the Fault LED is on, the Host Loop LED and the Expansion Loop LED stay off, or any other Fault LED is on, see the Storage Manager client for problem determination.

Note: The battery LED may be flashing indicated battery charging is in progress.

18. Repeat step 4 through step 17 for the second controller. However, do not continue with this step if the new controller is not in online and optimal state due to reasons other than battery charging and controller cache memory not matching.
19. Enable controller caching by completing the following steps:

- a. In the Logical/Physical View of the Subsystem Management window, right-click any of the logical drive tree node and select **Change-->Cache Settings**. A Change Cache Settings window opens.
- b. Click **Select All** to select all of the logical drives. Select the appropriate check boxes to enable the read/write caching options that you want, then click **OK**.
- c. Click **OK** when the confirmation window opens.

Note: A progress window shows the modification progress. After the cache setting modification completes, click **OK** to close the window and return to the Subsystem Management window.

20. Verify firmware and NVSRAM. Reload the firmware and NVSRAM to the version shipped on the Turbo option CD. Then, check the IBM Web site for any firmware updates.

Steps for cold-swap RAID controller upgrade

Important:

- You must install the latest version of Storage Manager client software in the management workstation or in the host server connected to the DS4300 that will be upgraded before you replace the old controller with the new controller. For more information, see *IBM DS4000 Storage Manager Installation and Support Guide* for your operating system, or the following Web site:

www-1.ibm.com/servers/storage/support/disk/

- Schedule downtime for the upgrade.
- The upgrade should be performed when the system is in an optimal state. If it is not, fix the problem before attempting the upgrade. Use the Storage Manager client to determine if the system is in an optimal state.
- Save the configuration/profile before upgrading.
- If you have premium features enabled in the existing DS4300 storage subsystem, ensure that you have access to the premium features key files before you begin this procedure. You will need to re-enable your premium features during the procedure.
- After the new controllers complete the boot process, the WWNN of the DS4300 controllers will change. If you have any applications that rely on the previous WWNNs, such as FC switch zoning definitions, you must update the applications with the new WWNNs.

Each RAID controller fits into the back of the storage subsystem and has the following components:

- Battery
- Cache memory
- Two host ports and one expansion port
- One Ethernet port
- One serial port

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front. There is also a label giving the cache battery manufacturing

and installation dates on the top of the controller unit. Figure 83 shows the location of these items.

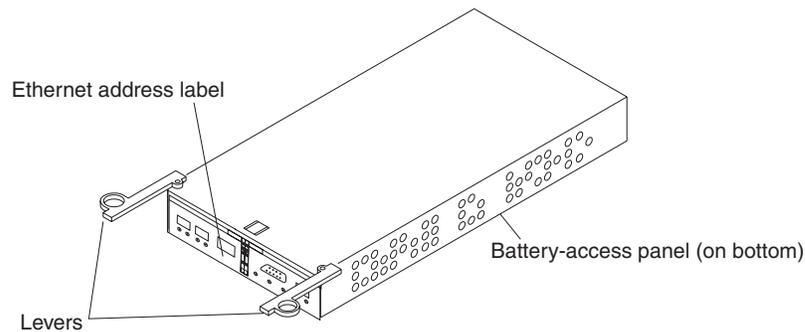


Figure 83. RAID controller levers and labels

For information about the RAID controller cache memory and rechargeable battery, see “Cache memory and RAID controller battery” on page 101.

Replace both controllers at the same time. To upgrade your RAID controllers, complete the following steps.

Before you begin: Schedule the upgrade to take place at a convenient time, because the storage subsystem will be powered down during the upgrade process.

1. Open a management connection to the DS4300 using the Storage Manager client.
2. Save the storage subsystem profile to a disk location that is *not* in the DS4000 storage subsystem that you are upgrading. In the Subsystem Management window, select **View-->Storage Subsystem Profile**. When the Storage Subsystem Profile window opens, click **Save As**. The Save Profile window opens. Select an appropriate directory and choose a file name for the profile, then click **Save**.

Click **Close** to close the Storage Subsystem Profile window.

3. Complete any necessary server preparation tasks, because the disks will not be available during the upgrade process. For example, stop all programs, services or processes in the host servers that access the logical drives.

Note: Make sure that you stop any background programs, services or processes that write data to the logical drives. For example, Microsoft MSCS periodically writes to the Quorum disk.

4. Use the Storage Manager client to flush and disable the read/write cache on both controllers, using the following steps. Either check that the cache LED on the back of the controller is off or wait two to three minutes.
 - a. In the Logical/Physical View of the Subsystem Management window, right-click any of the logical drive tree nodes and select **Change-->Cache Settings**. A Change Cache Settings window opens.
 - b. Click **Select All** to select all logical drives, and deselect all of the Cache Setting Enable check boxes, then click **OK**. Click **OK** when the Confirmation window opens.

Note: A progress window shows the modification progress. After the cache setting modification complete, click **OK** to close the progress window and return to the Subsystem Management window.

Refer to the Storage Manager client online Help panels for more details on disabling cache.

5. Stop I/O to the storage subsystem.
6. Unmount any mapped LUNs from the storage subsystem.
7. Turn off the DS4300 storage subsystem.
8. Label each cable that connects to the RAID controllers. This ensures that all cables will be properly reconnected to the new RAID controllers.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. When working with fiber-optic cables, do not pinch them, step on them, or locate them in aisles or walkways. Do not overtighten the cable straps or bend the cables to a radius smaller than 38 mm (1.5 in.).

9. From both RAID controllers to be upgraded, remove the fibre-channel cables from the SFPs. The location of these components is shown in Figure 84.

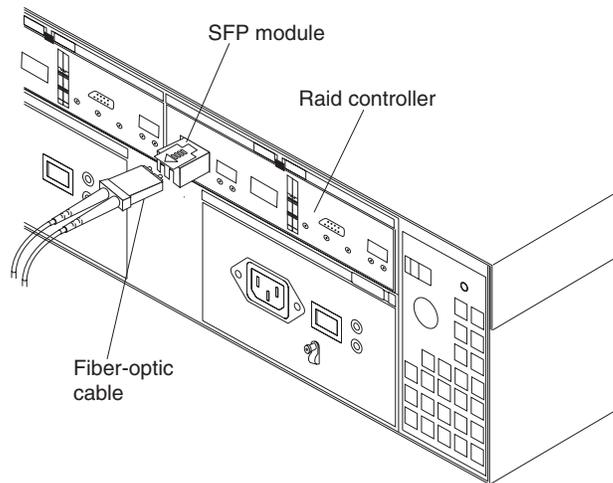


Figure 84. Location of SFPs and fiber-optic cables

After removing the fibre-channel cables, insert the protective caps.

10. Use the following procedure to remove the SFPs from the RAID controllers to be upgraded:
 - a. Remove the LC-LC fibre-channel cable from the SFP module. For more information, see "Handling fiber-optic cables" on page 33.
 - b. Unlock the SFP module latch:
 - For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 85 on page 118.

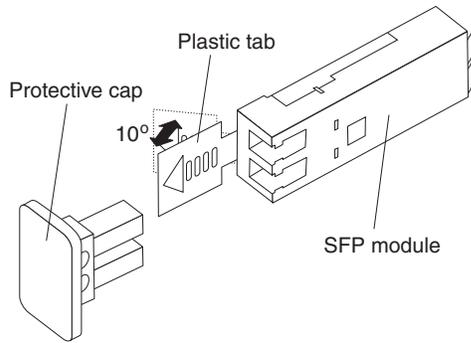


Figure 85. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 86.

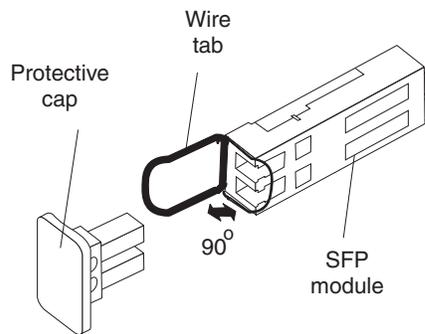


Figure 86. Unlocking the SFP module latch - wire variety

- c. With the SFP latch in the unlocked position, extract 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 minihub port.
 - d. Replace the protective cap on the SFP module.
 - e. Place the SFP module into a static-protective package.
 - f. Replace the protective cap on the port.
11. Remove each RAID controller to be upgraded, as follows:
- a. Push down on the latch (centered above the RAID controller). Pull both levers at the same time out of the locked position.
 - b. Grasp the pull-rings (see Figure 87 on page 119), then pull on the levers and remove the RAID controller.

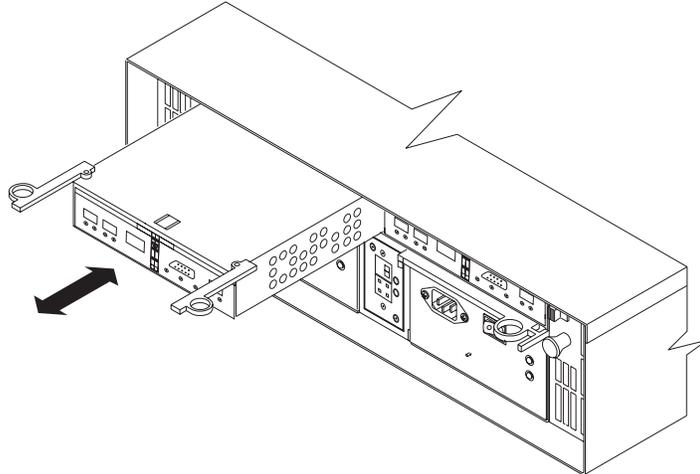


Figure 87. Pull-rings for removing a controller

12. Unpack the new RAID controller with the 1-GB cache. Verify that the battery is in the controller by opening the DS4300 controller CRU, using step 6 through step 9 of “Replacing the battery in the RAID controller” on page 140. If there is no battery in the new DS4300 controller, remove the battery from the old controller and install it in the new controller.

Set the RAID controllers on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return the RAID controllers.

13. If DHCP/BootP was used to automatically set the IP address of the controller, record the MAC address of the upgrade controller and modify the existing DHCP/BootP record of the RAID controller to be upgraded with the new MAC address. Failure to modify the DHCP/BootP record will result in problems trying to manage the storage subsystem using the existing IP address. This step must be performed before you insert the upgrade controller into the DS4000 storage subsystem.
14. Install each of the new RAID controllers, as follows:
 - a. Slide the RAID controller all the way into the empty slot.
 - b. Close both levers until the latch locks into place.
15. Insert the SFPs according to the instructions in “Installing SFP modules” on page 33.
16. Connect the fibre-channel cables to their original locations on both of the upgraded controllers, according to the instructions in Chapter 3, “Cabling the storage subsystem,” on page 29.
17. Turn on the DS4300 storage subsystem.
18. Wait approximately one minute, and then check the green Host Loop LED, green Expansion Loop LED, and amber Fault LED on the new RAID controllers.

Note: If the Host Loop LED or the Expansion Loop LED is off, the RAID controller might not be inserted correctly. Remove the RAID controller and reinsert it.

19. Check that the controller is online. Use either of the two following methods:
 - Use the Storage Manager client to verify that the controllers are online (up) and running by selecting the menu option to display the properties of the

controllers that have just been replaced. If the controllers are not up, you will get a controller-connection error window instead of the controller properties window. Wait a minute and retry until you get the properties window.

- Check the LEDs at the back of each controller. All Fault LEDs should be off and the Host Loop and Expansion Loop LEDs should be on.
20. If the Fault LED is on, the Host Loop LED and the Expansion Loop LED stay off, or any other Fault LED is on, see the Storage Manager client for problem determination.

Note: The battery LED may be flashing indicated battery charging is in progress.

21. After the controllers finish rebooting, their WWNNs will change. If you have applications that rely on the previous DS4300 controller WWNNs (such as fibre channel switch zoning definitions) you must update the applications with the new WWNNs.
22. Enable caching on both controllers.
23. Verify firmware and NVSRAM. Reload the firmware and NVSRAM to the version shipped on the Turbo option CD. Then, check the IBM Web site for any firmware updates.
24. If applicable, re-enable your premium features using the premium features key files of the controllers that you replaced.

Working with hot-swap drives

This section explains how you can increase the storage-server capacity by adding more drives or replacing existing drives with ones containing a larger capacity.

Figure 88 shows the location of the hot-swap drive bays that are accessible from the front of the storage subsystem. To maintain proper cooling within the storage subsystem, always keep a filler panel in each drive bay that does not contain a drive CRU.

Attention: The disk drive modules for the DS4300 storage subsystem and/or EXP700 and EXP710 storage expansion enclosures are not the same as the SATA disk drive modules for the EXP100 nor the FC or SATA enhanced disk drives modules for the EXP810. The DS4300/EXP700/EXP710, EXP100 and EXP810 use different non-interchangeable drive options and CRUs. Please order the correct options/CRUs for the enclosures in your configuration. Force-fitting insertion of the incorrect disk drive modules may cause damage to the drive CRUs or the enclosure chassis slots /backplane. IBM does not sell or provide replacement parts to change the drive CRU form factors.

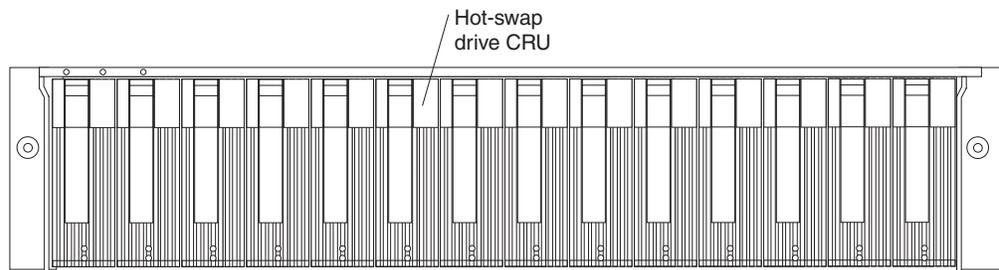


Figure 88. Location of hot-swap drives

Attention:

1. Never hot-swap a drive CRU when its green Activity LED is flashing. Hot-swap a drive CRU only when its amber Fault LED is completely on and not flashing or when the drive is inactive with the green Activity LED on and not flashing.
2. After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

Before you install or remove drive CRUs, review the following information:

Filler panels

Storage subsystems without a full set of drives (14) contain filler panels in the unused drive bays. Before installing new drives, you must remove the filler panels. Save the filler panels for future use. Each of the 14 bays must always contain either a filler panel or a drive CRU.

Drive CRUs

The RAID controller supports up to 14 (half-high or slim) 40-pin fibre-channel hard disk drives. These drives come preinstalled in drive trays. This drive-and-tray assembly is called a *drive CRU*. You can install the drive CRUs in the 14 drive bays on the front of the storage subsystem.

Drive LEDs

Each drive CRU has two LEDs, which indicate the status for that particular drive. For information about the drive LED operating states and descriptions, see Figure 73 on page 98 and Table 13 on page 98.

Fibre-channel loop IDs

When you install a drive CRU in the storage subsystem, the drive CRU connects into a printed circuit board called the *midplane*. The midplane automatically sets the fibre-channel loop ID to the default value 00.

Hot-swap hardware

The storage subsystem contains hardware that you can use to replace a failed hard disk drive without turning off the storage subsystem. Therefore, you can continue operating the system while a hard disk drive is removed or installed. These drives are known as *hot-swap* drives.

Slim drives

You can install slim, hot-swap drive CRUs.

Installing hot-swap drives

Before you begin: Take the following precautions.

- Read the safety and handling guidelines that are provided in “Safety” on page iii and “Handling static-sensitive devices” on page 105.
- Ensure that the current system configuration is working properly.
- Back up all important data before you make changes to storage devices, such as hard disk drives.

Use the following procedure to install hot-swap drives in the storage subsystem. You can install additional drives while the storage subsystem is powered up and running.

Note: If you are replacing a drive, see “Replacing hot-swap drives” on page 123.

1. Read the instructions that come with the drive CRU.
2. Check for Fault LEDs. If any amber LEDs are lit, see “Checking the LEDs” on page 97 and “Troubleshooting” on page 145.

3. Determine the bay into which you want to install the drive.
4. Install the drive CRU:

Note: The hard disk drive comes with a tray already attached. Do not attempt to detach the drive **4** from the tray **3**. See Figure 89.

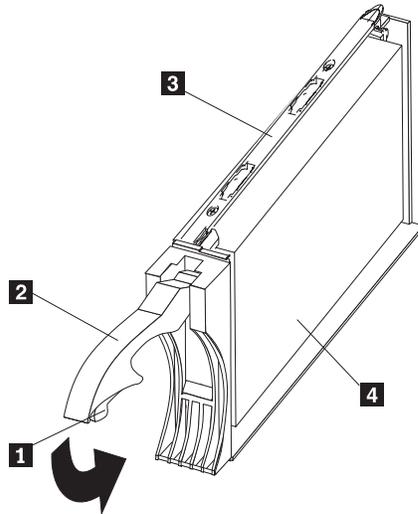


Figure 89. Releasing the drive latch

- a. Release the blue latch **1** on the drive CRU by pressing on the inside of the bottom of the tray handle. See Figure 89.
- b. Pull the handle **2** on the tray out into the open position.
- c. Slide the drive CRU into the empty bay until the tray handle **2** touches the storage-server bezel.
- d. Push the tray handle **2** down into the closed (latched) position.
5. Check the drive LEDs.
 - a. When a drive is ready for use, the green Activity LED is either continuously on or rapidly flashing, and the amber Drive fault LED is off.
 - b. If the amber Drive fault LED is completely on and not flashing, remove the drive from the unit and wait 10 seconds; then reinstall the drive.
6. Use the Storage Manager client to configure the drive.
7. Update the information in Appendix A, "Records," on page 155.

Replacing hot-swap drives

Drive problems include any malfunctions that delay, interrupt, or prevent successful I/O activity between the hosts and the hard disk drives. This includes transmission problems between the host controllers, the RAID controllers, and the drives. This section explains how to replace a failed drive.

Notes:

1. Failure to replace the drives in their correct bays might result in loss of data. If you are replacing a drive that is part of a RAID level 1 or RAID level 5 logical drive, ensure that you install the replacement drive in the correct bay.
2. After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

Use the following procedure to replace hot-swap drives:

1. Check the hardware and software documentation that is provided with the system to see if there are restrictions regarding hard disk drive configurations. Some system fibre-channel configurations might not allow mixing different drive capacities or types within an array.
2. Check the Storage Manager client online help for recovery procedures for a drive that has failed. Follow the steps in the software procedure before you continue with this procedure.
3. Determine the location of the drive that you want to remove.

Attention: Never hot-swap a drive CRU when its green Activity LED is flashing. Hot-swap a drive CRU only when its amber Drive fault LED is on and not flashing or when the drive is inactive with the green Activity LED on and not flashing.

If the drive is not in a failed state (as indicated by a lit amber LED), manually fail the drive using the Storage Management client before attempting to remove it from the drive slot.

4. Remove the drive CRU.
 - a. Press on the inside of the bottom of the tray handle to release the blue latch **1**. See Figure 90 on page 124.
 - b. Pull the handle **2** on the tray **3** out into the open position.
 - c. Lift the drive CRU partially out of the bay.
 - d. To avoid possible damage to the drive **4**, wait at least 20 seconds before you fully remove the drive CRU from the storage subsystem to allow for the drive to spin down.

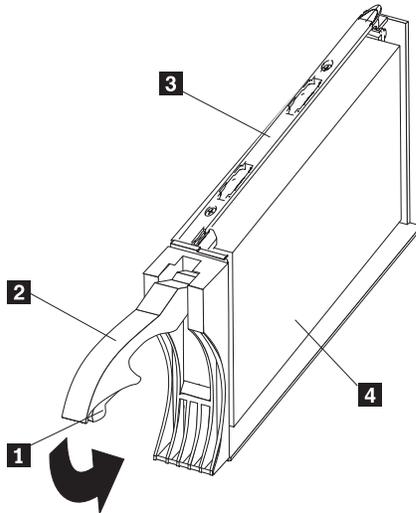


Figure 90. Drive latch on a hot-swap drive

- e. Verify that there is proper identification (such as a label) on the drive CRU, and then slide it completely out of the storage subsystem.
5. Install the new drive CRU.

Attention: After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

 - a. Gently push the drive CRU into the empty bay until the tray handle **2** touches the storage-server bezel.
 - b. Push the tray handle **2** down into the closed (latched) position.
6. Check the drive LEDs.
 - a. When a drive is ready for use, the green Activity LED is either on continuously or rapidly flashing, and the amber Drive fault LED is off.
 - b. If the amber Drive fault LED is on and not flashing, remove the drive from the unit and wait 10 seconds; then reinstall the drive.
7. If the drive is part of a defined RAID array, the array reconstruction (without hot-spare) or copy-back (with hot-spare) operation automatically starts.

Upgrading drives

You can upgrade drives in the following two ways:

- By adding drives to empty slots in the storage subsystem (see “Installing hot-swap drives” on page 121)
- By replacing existing drives with larger capacity drives

Adding larger-capacity drives

This section provides guidelines for upgrading the drives in the storage subsystem. Read the software documentation and this entire section to determine if you should use this procedure, use a modified version of this procedure, or use a different procedure that is provided by your operating system. *Instructions that are provided with your software should supersede anything stated in this document.*

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 storage subsystem. After replacing 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 expansion 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 installing 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 127.

Using this method, you can replace the drives while the storage subsystem is running, eliminating the down time 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, or 5). You cannot use this method with any drives containing 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 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 the 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 for arrays consisting of 3 to 5 fibre channel drives. If you have more than 10 drives or SATA drives with a large capacity of 400G or 500G, consider replacing all drives at the same time, as described in the next section.

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 containing RAID 0 logical drives. All the data 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 subsystem, which makes the storage subsystem (and any attached storage expansion enclosures) inaccessible to other users.

To replace all the drives at the same time, perform the following steps:

1. Read the following information:
 - The information in “Adding larger-capacity drives” on page 124, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
 - The information in your software documentation regarding 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 regarding the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.
2. Use the Storage Manager client to check the status of the storage subsystem. 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 105.
 4. Unpack the new drives.
 - Set the drives on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return the drives.
 5. Perform the following steps:
 - a. Stop all I/O activity to the storage subsystem and attached storage expansion enclosures. Make sure of the following:
 - 1) All of the green Drive activity LEDs on the front of the storage subsystem (and on all attached storage expansion enclosures) are not flashing.
 - 2) The green Cache active LEDs are off on the front of the RAID controllers.
 - b. 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 proper shutdown sequence.
 6. Turn off the power to each device based on 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 an existing 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 expansion enclosures. Turn off both power supply switches on the back of the storage subsystem.
 - c. Turn off power to other supporting devices (for example, management stations, fibre-channel switches, or Ethernet switches).
 - Notes:**
 - 1) You do not need to perform this step if you are servicing only the storage subsystem.
 - 2) Depending on your operating system, you might not have to restart the host. For more information, see the software installation guide for your operating system.
 7. Use the procedures in “Replacing hot-swap drives” on page 123 to remove the drives that you want to replace. Use the procedures in “Installing hot-swap drives” on page 121 to install the new drives into the storage subsystem.

8. After you install all the new drives, check the system documentation for the hardware devices that you intend to power up, and then determine the proper 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. You must turn on the storage expansion enclosures before the storage subsystem. The controllers might not recognize the correct configuration if the drives are powered up after the storage subsystem. For instructions on powering up the storage expansion enclosures, see the storage expansion enclosure 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, based on the power-on sequence in step 8. To turn on power to the storage subsystem, turn on the power-supply switches on the back 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 LED and the amber Drive fault LED below the new drive CRUs.

Make sure that the Drive activity LEDs are on 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 CRU might not be installed correctly. Remove the drive CRU, wait 70 seconds, and then reinstall it.
 - If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. See the Storage Manager client for problem determination.
11. Use the Storage Manager client to configure the new drives. See the Storage Manager client 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 125.)

Note: If your storage subsystem has hot spares assigned, 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.

To replace the drives one at a time, perform the following steps:

1. Read the following information:
 - “Adding larger-capacity drives” on page 124, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
 - Your software documentation regarding drive upgrades and installation
 - The documentation that comes with the new drivesRead all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information regarding the drives

and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.

2. Use the Storage Manager client to check the status of the unit. Correct any problems that are reported.
3. Back up the data on 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 105.

4. Unpack the new drives.
Set the drives on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return the drives.
5. Use the Storage Manager client to ensure that the array that was defined using these drives is in optimal (not degraded) state before manually failing the first drive you want to replace. If the array is in degraded state, use the recovery procedures to bring the array into the optimal state.

Make sure of the following:

- You fail only one drive.
- The software status display shows a failed status for the appropriate drive.
- The amber Drive fault LED (on the front bezel below the drive) is on.

Attention: Removing the wrong drive can cause data loss. Make sure that you remove only the failed drive CRU. The Drive fault LED below the failed drive CRU should be on.

If you remove an active drive accidentally, wait at least 70 seconds and then reinstall it. Because you failed two drives in a RAID array, the array might be marked failed by the controller. This array will not be available to the host for I/O. See the Storage Manager client online Help for further recovery instructions. Do not attempt to replace any drives until the array is brought back to optimal state.

After you remove a drive CRU, wait 70 seconds before replacing or reseating the drive CRU to allow the drive to properly spin down. Failure to do so may cause undesired events.

6. Use the procedures in “Replacing hot-swap drives” on page 123 to remove the failed drive. Use the procedures in “Installing hot-swap drives” on page 121 to install the new drives into the storage subsystem.

The new drive automatically reconstructs the data after you install it in the drive slot.

During data reconstruction, the amber Drive fault LED might come on for a few minutes, 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 your 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 below the new drive CRUs.

Make sure that the Drive activity LEDs are on 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 CRU might not be installed correctly. Remove the drive CRU, wait 30 seconds, and then reinstall it.
 - If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. See the Storage Manager client for problem determination.
8. Use the Storage Manager client 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 will continue to flash after reconstruction is finished if there is I/O activity to that drive. In that case, use the host software to determine if the data reconstruction is finished.

9. When reconstruction is finished on the new drive, repeat step 5 on page 128 through step 8 for each additional drive that you want to install.
10. Use the Storage Manager client to configure the additional space on the new drives.

Working with hot-swap cooling fans

The storage subsystem cooling system consists of two fan CRUs, each containing two fans. The fan CRUs circulate air inside the unit by pulling in air through the vents on the front of the drive CRUs and pushing out air through the vents in the back of each fan CRU. See Figure 91.

If two fans fail, or the fans cannot maintain an internal temperature below 70°C (158°F), the power supplies in the unit will automatically shut down (an over-temperature condition). If this occurs, you must cool the unit and restart it. See “Restoring power after an over-temperature shutdown” on page 96.

Attention: The fans in the storage subsystem draw in fresh air and force out hot air. These fans are hot-swappable and redundant; however, when one fan fails, you must replace the fan CRU within 48 hours to maintain redundancy and optimum cooling. When you replace the failed fan CRU, be sure to install the second fan CRU within 10 minutes to prevent any overheating due to the lack of the additional fan CRU.

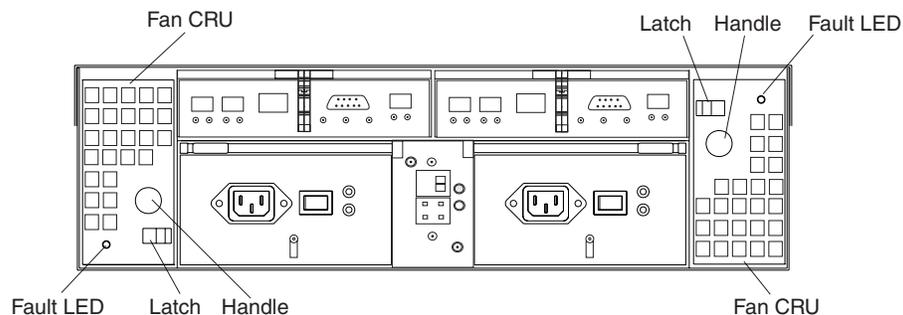


Figure 91. Fan locations

Fan CRUs

The two fan CRUs are hot-swappable and redundant.

Fault LEDs

These amber LEDs light when a fan failure occurs.

Latches and handles

Use the latches and handles to remove or install the fan CRUs.

Attention: Do not run the storage subsystem without adequate ventilation and cooling, because it might cause damage to the internal components and circuitry.

Both fan units must always be in place, even if one is not functioning properly, to maintain proper cooling.

Use the following procedure to replace a hot-swap fan:

1. Check the LEDs on the back of the storage subsystem.
2. If the amber Fault LED is on, remove the fan CRU that has failed by completing the following steps:
 - a. Slide the latch to unlock the fan CRU.
 - b. Use the handle (black knob) to pull the fan from the storage subsystem. See Figure 92.

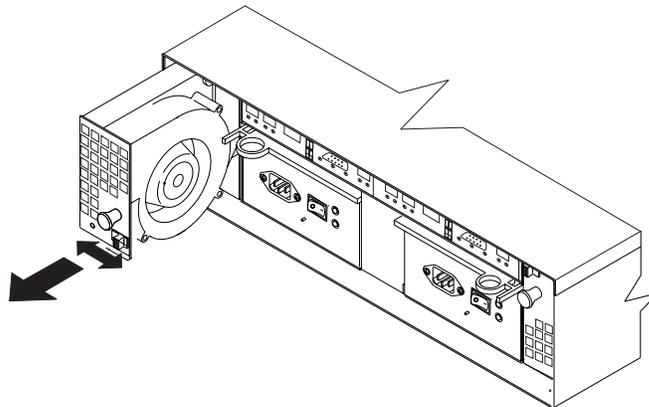


Figure 92. Removing a fan

3. Install the new fan unit by completing the following steps:
 - a. Place the fan CRU in front of the fan slot.
 - b. Hold the latch open, and slide the fan all the way into the slot. If the fan does not go into the bay, rotate it 180°. Ensure that the latch is on the side closest to the center of the storage subsystem.
 - c. Release the latch. If the lever remains open, pull back on the fan slightly, and then push it in again until the latch snaps into place.
4. Check the LEDs.

The Fault LEDs turn off after a few seconds. If they remain on, see “Troubleshooting” on page 145.

Working with hot-swap power supplies (dual-controller models only)

The storage subsystem power system consists of two power supply CRUs.

Exception: The DS4300 single-controller storage subsystem (Model 6LU/6LX) has only one power supply CRU. Therefore, you cannot hot swap the power supply.

The power supply CRUs provide power to the internal components by converting incoming ac voltage to dc voltage. One power supply CRU can maintain electrical power to the unit if the other power supply is turned off or malfunctions. The power supply CRUs are interchangeable (by reversing the locking levers).

Each power supply CRU 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. All power remains off until you cycle the power switches (turn the power switches off, wait at least 30 seconds, then turn the power switches on). For more information, see “Restoring power after an unexpected shutdown” on page 94 and “Restoring power after an over-temperature shutdown” on page 96.

The power supplies are customer replaceable units (CRUs) and do not require preventive maintenance.

- Always keep the power supplies in their proper places to maintain proper controller-unit cooling.
- Use only the supported power supplies for your specific storage subsystem.

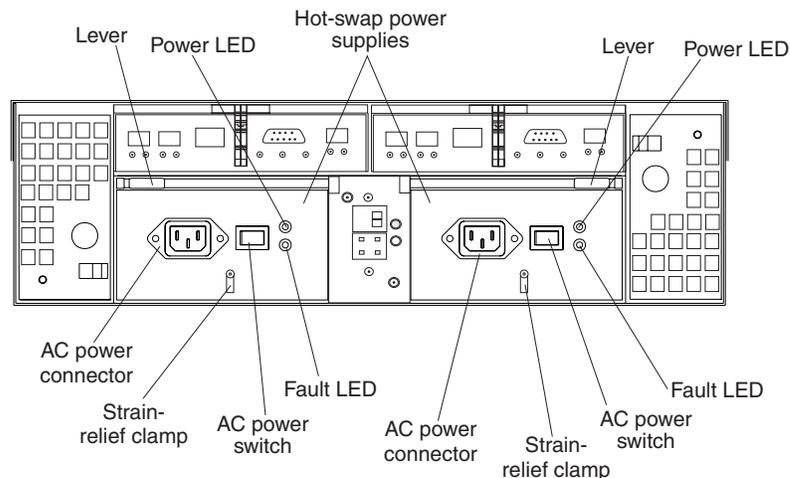


Figure 93. Power supply controls

The following power-supply controls on the rear of the storage subsystem are shown in Figure 93:

Levers

Use these locking handles to remove or install a power supply.

Power LED

These green LEDs light when the storage subsystem is turned on and receiving ac power.

Fault LEDs

These amber LEDs light if a power supply failure occurs or if the power supply is turned off.

AC power switches

Use these switches to turn the power supplies on and off. You must turn on both switches to take advantage of the redundant power supplies.

AC power connectors

This connection is for the ac power cord.

Strain-relief clamp

Use this clamp to provide strain relief on the power cord.

Removing a hot-swap power supply

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.

To remove a hot-swap power supply, perform the following steps:

1. Turn off the ac power switch. See Figure 94.

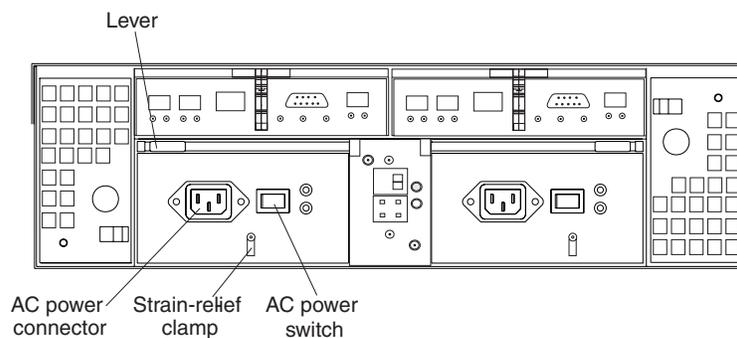


Figure 94. Lever for power supply removal

2. Unplug the power cord from the electrical outlet.
3. Disconnect the power cord from the ac power connector on the power supply.
4. Remove the nut and strain-relief clamp from the rear of the power supply.
5. Remove the power supply from the storage subsystem, as follows:
 - a. Grasp the pull-ring on the power-supply lever and squeeze the latch to release it.

- b. Pull the lever open and remove the power supply.

Installing a hot-swap power supply

Note: When you replace a power supply that has failed, ensure that the power supply latch is mounted on the side of the power supply that faces the middle of the storage subsystem. If it is not, remove the lever screw, flip the lever over, and tighten the screw on the opposite side.

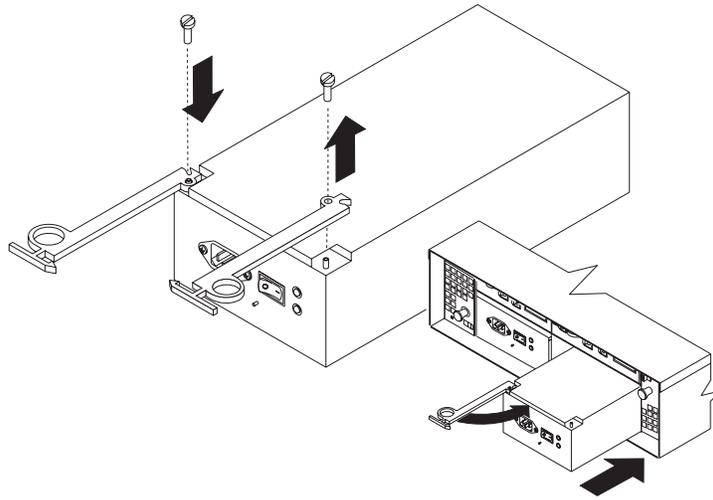


Figure 95. Installing a hot-swap power supply

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.

To install a hot-swap power supply, perform the following steps:

1. Ensure that the ac power switch is off on the power supply that you are installing.
2. Install the power supply in the storage subsystem, as follows:
 - a. Slide the power supply into the storage subsystem. Make sure that the lever is pulled straight out as you slide the power supply into the storage subsystem.

- b. Close the lever until the pull-ring latch locks in place. Make sure that the lever locks into place in the storage-server chassis.
3. Wrap the strain-relief clamp around the power cord approximately 20 cm (8 in.) from the power-supply connection end.
4. Attach the power-supply nut and tighten it securely.
5. Connect the power cord to the AC power connector. See Figure 96.

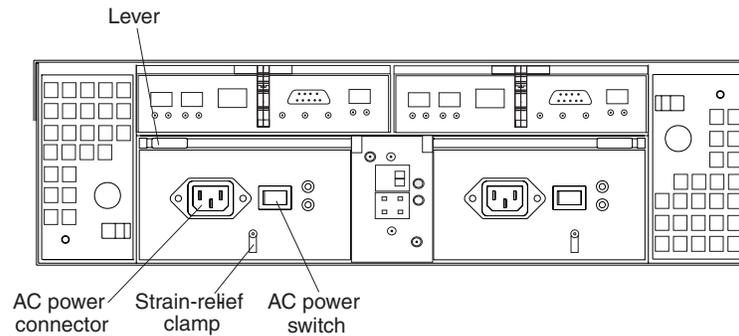


Figure 96. Connecting the power cord to the AC power connector

6. Plug the power cord into a properly grounded electrical outlet.
7. Turn on the power-supply switch.
8. Make sure that the green Power LED on the new power-supply CRU is on and the amber Fault LED is off.
 - If the Power LED is off, the power-supply CRU might not be installed correctly. Remove it and then reinstall it.
 - If the Fault LED is on or the Power LED stays off, see the Storage Manager client for problem determination.

For more information about the LEDs, see “Checking the LEDs” on page 97.

Working with hot-swap RAID controllers (dual-controller models only)

Each RAID controller fits into the back of the storage subsystem and has the following components:

- Battery
- Cache memory
- Two host ports and one expansion port
- One Ethernet port
- One serial port

Exception: The DS4300 single-controller storage subsystem (Model 6LU/6LX) has only one RAID controller. Therefore, you cannot hot swap the RAID controller.

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front. There is also a label giving the cache battery manufacturing and installation dates on the top of the controller unit. Figure 97 on page 135 shows the location of these items.

Note: Each DS4300 controller type has a different FRU number, as follows:

DS4300 storage subsystem type	Controller FRU part number (P/N)
Single-controller (Model 6LU/6LX)	24P8961
Dual-controller, standard (Model 60U/60X)	24P8059
Dual-controller, Turbo option with 1-GB memory (Model 60U/60X)	24P8225

Important: Please note the following information.

- The cache battery is not included with the controller FRU.
- Ensure that you replace the failed controller with the appropriate FRU. There are no protection mechanisms to block out an incorrect FRU from being inserted into DS4300 controller slots. Unpredictable results can occur when nonmatching controller FRUs are present in a single DS4300 chassis.
- After the new controller in a DS4300 single-controller storage subsystem (Model 6LU/6LX) completes the boot process, its WWNN will change. If you have any applications that rely on the previous WWNNs, such as FC switch zoning definitions, you must update the applications with the new WWNNs.

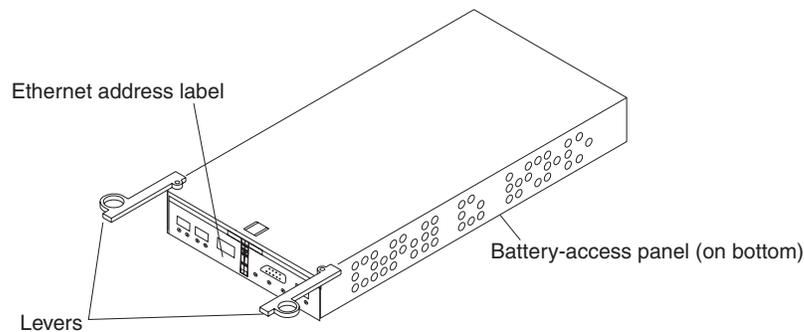


Figure 97. RAID controller levers and labels

For information about the RAID controller cache memory and rechargeable battery, see “Cache memory and RAID controller battery” on page 101.

Replacing a RAID controller

When instructed to do so by the storage-management software, replace a RAID controller that has failed.

Important: The replacement RAID controller CRU does not come with a RAID controller cache battery installed, nor the mounting hardware that holds the battery in place inside the RAID controller. You must remove the cache battery that is inside the existing RAID controller that you are replacing, and install that battery inside the replacement RAID controller CRU, using the battery unit mounting hardware taken from the existing controller. The steps to remove and replace the battery are included in the following procedure.

Note: Avoid operating the DS4300 storage subsystem with controllers of different cache sizes. Operating the storage subsystem with controllers of different cache size will disable caching and might adversely affect performance.

To replace a RAID controller, perform the following steps:

1. Check the Storage Manager client online Help for instructions on RAID controller failure-recovery procedures. Follow the steps provided in the software documentation before continuing with step 2.
2. Label each cable that connects to the RAID controller that has failed. This ensures that all cables will be properly reconnected to the new RAID controller.

Attention: Handle and install fiber-optic cables properly to avoid degraded performance or loss of communications with devices. When working with fiber-optic cables, do not pinch them, step on them, or locate them in aisles or walkways. Do not overtighten the cable straps or bend the cables to a radius smaller than 38 mm (1.5 in.).

3. From the RAID controller that has failed, remove the fibre-channel cables from the SFPs. The location of these components is shown in Figure 98.

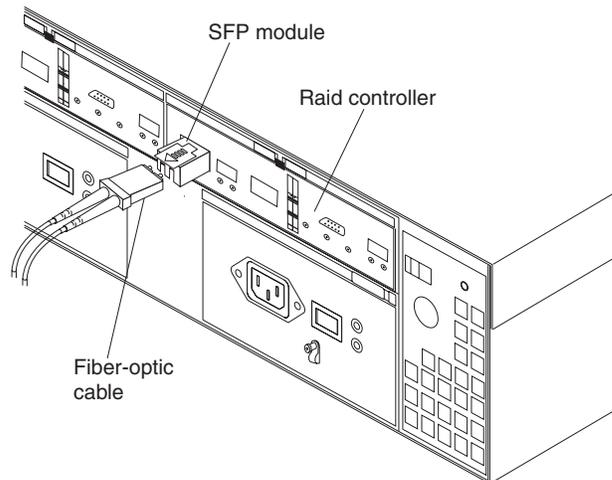


Figure 98. Location of SFPs and fiber-optic cables

After removing the fibre-channel cables, insert the protective caps.

4. Use the following procedure to remove the SFPs from the RAID controller that has failed.
 - a. Remove the LC-LC fibre-channel cable from the SFP module. For more information, see “Handling fiber-optic cables” on page 33.
 - b. Unlock the SFP module latch:
 - For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 99 on page 137.

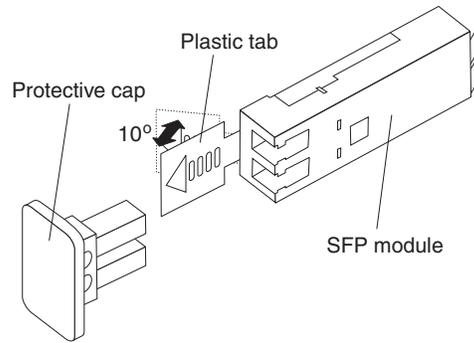


Figure 99. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 23 on page 36.

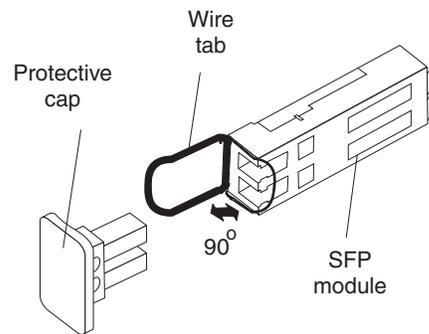


Figure 100. Unlocking the SFP module latch - wire variety

- c. With the SFP latch in the unlocked position, extract 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 minihub port.
 - d. Replace the protective cap on the SFP module.
 - e. Place the SFP module into a static-protective package.
 - f. Replace the protective cap on the port.
5. Remove the failed RAID controller (the Fault LED is on), as follows:
 - a. Push down on the latch (centered above the RAID controller). Pull both levers at the same time out of the locked position.

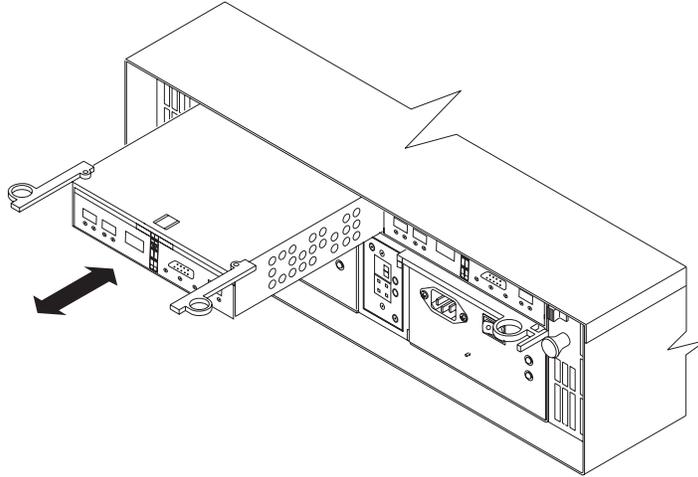


Figure 101. Pull-rings for removing a controller

- b. Grasp the pull-rings; then pull on the levers and remove the RAID controller.
6. To access the cache battery, place the RAID controller CRU bottom up on a flat surface. Using a #2 Phillips head screwdriver, remove the six screws (three on each side of the RAID controller) that hold the RAID controller bottom panel to the sides of the RAID controller, as shown in Figure 102.

Note: Before you move the cache battery from your old controller to your replacement controller, read the detailed instructions in this procedure.

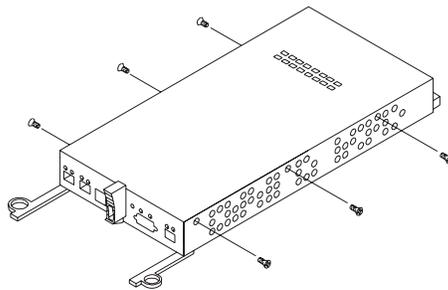


Figure 102. Controller battery-access panel screws

7. Slide the RAID controller bottom panel away from the front side of the RAID controller (away from the SFP slots and black center latch) to unlatch it from the side panels.
8. Carefully flip over the RAID controller bottom panel. Disconnect the battery harness on the battery from the two-pin connector on the controller board, as shown in Figure 103 on page 139.

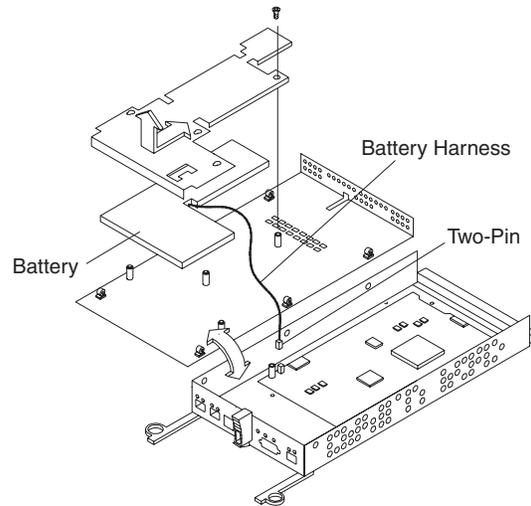


Figure 103. Removing the controller battery

9. Remove the screw that holds the battery access panel. Carefully slide the access panel toward the front to unlatch it from the three pins mounted on the RAID controller bottom panel.
10. Remove the battery unit and place it on a dry, level surface. If this is a battery replacement, then replace the old battery with the new one and go to step 17 on page 139.
11. Unpack the new RAID controller.
Set the RAID controller on a dry, level surface away from magnetic fields. Save the packing material and documentation in case you need to return the RAID controller.
12. Place the replacement RAID controller CRU bottom up on a flat surface. Using a #2 Phillips head screwdriver, remove the six screws (three on each side of the RAID controller) that hold the RAID controller bottom panel to the sides of the RAID controller, as shown in Figure 102 on page 138.
13. Slide the RAID controller bottom panel away from the front side of the RAID controller (away from the SFP slots and black center latch) to unlatch it from the side panels.
14. Carefully flip over the RAID controller bottom panel.
15. Remove the screw that holds the battery access panel. Carefully slide the access panel toward the front to unlatch it from the three pins mounted on the RAID controller bottom panel.
16. If DHCP/BootP was used to automatically set the IP address of the controller, record the MAC address of the upgrade controller and modify the existing DHCP/BootP record of the RAID controller to be upgraded with the new MAC address. Failure to modify the DHCP/BootP record will result in problems trying to manage the storage subsystem using the existing IP address. This step must be performed before you insert the upgrade controller into the DS4000 storage subsystem.
17. Position the battery inside the replacement RAID controller.
18. Reassemble the battery access panel to the RAID controller bottom panel by aligning it with the three pins on the RAID controller bottom panel. Slide the

battery access panel toward the back until you can reinsert the screw that holds the battery access panel to the RAID controller bottom panel. Do not overtighten.

19. You must reconnect the battery harness to the two-pin connector on the controller board.

Note: The connector is keyed so that there is only one way to attach the harness to the connector. Do not force fit.

20. Flip the RAID controller bottom panel over and carefully place it on the controller sides. Push the RAID controller bottom panel toward the front to latch it to the side panels. If the controller bottom panel is placed correctly, you should be able to access the mounting holes for the six screws that you removed from step 6 on page 138. Reinsert the six screws. Do not overtighten.
21. Install the new RAID controller, as follows:
 - a. Slide the RAID controller all the way into the empty slot.
 - b. Close both levers until the latch locks into place.

Attention: When you replace the failed RAID controller, the storage-management software automatically synchronizes the firmware between the existing controller and the new controller. After you replace a controller, always use the storage-management software to verify the firmware levels and NVSRAM files.

22. Insert the SFPs according to the instructions in “Installing SFP modules” on page 33.
23. Connect the fibre-channel cables to their original locations, according to the instructions in Chapter 3, “Cabling the storage subsystem,” on page 29.
24. Wait approximately one minute, and then check the green Host Loop LED, green Expansion Loop LED, and amber Fault LED on the new RAID controller.
 - If the Host Loop LED or the Expansion Loop LED is off, the RAID controller might not be inserted correctly. Remove the CRU and reinsert it.
 - If the Fault LED is on, the Host Loop LED and the Expansion Loop LED stay off, or any other Fault LED is on, see the Storage Manager client for problem determination, or contact IBM support.
25. See the Storage Manager client online Help for instructions on bringing the controller online.

Replacing the battery in the RAID controller

Each RAID controller contains a rechargeable battery that maintains the data in the cache memory for three days without power to the unit.

Important: If you are replacing the battery in a DS4300 single-controller storage subsystem (Model 6IU/6LX), complete the following steps before beginning the replacement procedure:

- Schedule down time for the battery replacement, because the disk will not be available during the procedure.
- Complete any necessary server preparation tasks.
- Save the configuration/profile.
- Use the Storage Manager client to flush and disable the cache on the controller, using the following steps. Either check that the cache LED on the back of the controller is off, or wait two to three minutes.

1. In the Logical/Physical View of the Subsystem Management window, right-click any of the logical drive tree nodes and select **Change-->Cache Settings**. A Change Cache Settings window opens.
2. Click **Select All** to select all logical drives, and deselect all of the Cache Setting Enable check boxes, then click **OK**. Click **OK** when the Confirmation window opens.

Note: A progress window shows the modification progress. After the cache setting modification complete, click **OK** to close the progress window and return to the Subsystem Management window.

See the Storage Manager client online Help panels for more details on disabling cache.

- Stop I/O to the storage subsystem.
- Unmount any mapped LUNs from the storage subsystem.
- Power down the DS4300 single-controller storage subsystem (Model 6LU/6LX).

Use the following procedure if the Storage Manager client instructs you to replace the battery because the current battery has failed or is nearing its expiration date. You can also use the Storage Manager client to check the status of the battery.

1. Check the Storage Manager client online Help for instructions on battery replacement procedures. If you are using write-cache mirroring, this might involve clearing cache memory on the RAID controller that contains the battery that has failed. This is done by either placing the controller offline before removing it from the DS4300 server or turning off caching in the DS4300 server, using the Storage Manager client. Follow the steps given in the software procedure before you continue with 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 105.

2. Unpack the new battery.
Set the new battery on a dry, level surface. Save all packing materials in case you need to return the battery.

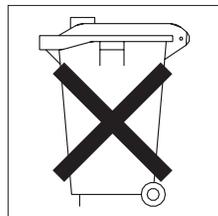
Note: The battery comes with a new battery label. You will need this label later in the procedure.

3. Review all documentation that comes with the new battery for updated replacement procedures and other information.
4. Use the Storage Manager client to locate the RAID controller that contains the failed battery. (The RAID controller Fault LED might be on.)
5. Label each cable that connects to the RAID controller that contains the battery that has failed. This ensures that all cables will be properly reconnected to the RAID controller after you replace the battery.
6. Use the Storage Manager client to take offline the RAID controller that contains the battery that has failed.

Attention: On DS4300 single-controller storage subsystem Model 6LU/6LX, you can not place the controller offline. Instead, you must power down the DS4300 storage subsystem. For more information on preparation tasks, see the Important note in the beginning of this section.

7. Remove the fibre-channel cables and the SFPs from the RAID controller that contains the battery that has failed or is nearing its expiration date. For more information, see “Handling fiber-optic cables” on page 33.
8. Remove the RAID controller, as follows:
 - a. Push down on the latch, which is centered above the RAID controller. Pull both levers at the same time out of the locked position.
 - b. Grasp the pull-rings; then pull on the levers and remove the RAID controller.
9. Place the RAID controller CRU bottom up on a flat surface. Using a #2 Phillips head screwdriver, remove the six screws (three on each side of the RAID controller) that hold the RAID controller bottom panel to the sides of the RAID controller, as shown in Figure 102 on page 138.
10. Slide the RAID controller bottom panel away from the front side of the RAID controller (away from the SFP slots and black center latch) to unlatch it from the side panels.
11. Carefully flip over the RAID controller bottom panel. Disconnect the battery harness on the battery from the two-pin connector on the controller board as shown in Figure 103 on page 139.
12. Remove the screw that holds the battery access panel. Carefully slide the access panel toward the front to unlatch it from the three pins mounted on the RAID controller bottom panel.
13. Remove the battery unit and place it on a dry, level surface. If this battery is a replacement battery, then replace the old battery with the new one.
14. Write the battery replacement information on the label on the battery pack.
 - Installed date – Write today’s date
 - Replacement Date – Write the date three years from today’s date

Note: The preferred method of checking for the battery operating age is through the Storage Manager client.



CONTAINS
SEALED LEAD
BATTERY.
BATTERY
MUST BE
RECYCLED.

Pb

CAUTION:

This product contains a sealed lead acid battery. The battery must be recycled or disposed of properly. In the United States, IBM has established a collection process for reuse, recycling, or proper disposal of used IBM sealed lead acid batteries. For information on proper disposal of these batteries, please contact IBM at 1-800-426-4333 your IBM representative. For information on disposal of sealed lead acid batteries outside the United States, go to www.ibm.com/ibm/environment/products/batteryrecycle.shtml or contact your local waste disposal facility. If the battery CRU is physically damaged or leaking electrolyte gel, *do not* ship it to a recycling center. The battery contains sealed lead-acid batteries that might be considered hazardous material. You must handle this unit in accordance with all applicable local and federal regulations.

15. Position the replacement battery inside the RAID controller.
16. Reassemble the battery access panel to the RAID controller bottom panel by aligning it with the three pins on the RAID controller bottom panel. Slide the battery access panel toward the back until you can reinsert the screw that holds the battery access panel to the RAID controller bottom panel. Do not overtighten
17. You must reconnect the battery harness to the two-pin connector on the controller board.

Note: The connector is keyed so that there is only one way to attach the harness to the connector. Do not force fit.

18. Flip the RAID controller bottom panel over and carefully place it on the controller sides. Push the RAID controller bottom panel toward the front to latch it to the side panels. If the controller bottom panel is placed correctly, you should be able to access the mounting holes for the six screws that you removed in step 6 on page 138. Reinsert the six screws. Do not overtighten.
19. **[NTD]: This information is stated in the Caution above. Does it need to be said again? Seems redundant.** Dispose of the used battery CRU according to local and federal regulations, which might include hazardous material handling procedures.

This product contains a sealed lead acid battery. The battery must be recycled or disposed of properly. In the United States, IBM has established a collection process for reuse, recycling, or proper disposal of used IBM sealed lead acid batteries. For information on proper disposal of these batteries, please contact IBM at 1-800-426-4333 your IBM representative. For information on disposal of sealed lead acid batteries outside the United States, go to www.ibm.com/ibm/environment/products/batteryrecycle.shtml or contact your local waste disposal facility.

20. Install the RAID controller, as shown in Figure 104 on page 144.

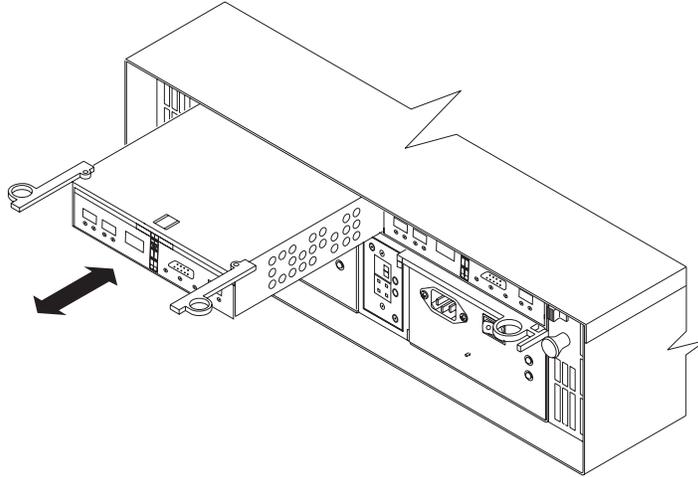


Figure 104. Installing a new RAID controller

- a. Slide the RAID controller all the way into the empty slot.
 - b. Close both levers until the latch locks into place.
21. Install the SFPs and then connect the fibre-channel cables to their original locations.
 22. On the DS4300 single-controller storage subsystem (Model 6LU/6LX), turn on power to the storage subsystem and attached devices. For the proper power-on sequence, see “Turning on the storage subsystem” on page 92.
 23. On the DS4300 dual-controller storage subsystem (Model 60U/60X, standard and Turbo option), wait approximately one minute. Then, use the Storage Manager client to place the controller in online state. (It was placed offline in step 6 on page 141.)

Note: If the operation fails, repeat the command. If the operation fails again, reseal the controller and repeat this step.

24. Note that on all DS4300 models, it might take 15 minutes to a few hours for a new battery to become fully charged. The Storage Manager client will show the battery as failed until it is fully charged. Controller caching is automatically disabled until the new battery becomes fully charged.
25. On the DS4300 single-server storage controller (Model 6LU/6LX), use the Storage Manager client to re-enable the read I/O caching setting.
26. Use the Storage Manager client to monitor the status of the storage subsystem and to reset the battery age.

Note: In the DS4300 dual-controller storage subsystem (Model 60U/60X), there are two cache batteries (one for each controller). Make sure that you reset the age for the correct battery.

Installing SFPs and fiber-optic cables

Each RAID controller unit has two host ports and one expansion port. SFPs are inserted into the ports, and then fibre-channel cables are connected to the SFPs. For information on installing SFPs and fiber-optic cables, see “Handling fiber-optic cables” on page 33.

Chapter 6. Solving problems

This chapter contains information to help you solve some of the simpler problems that you might have with your storage subsystem. It contains the problem indicators and error messages along with suggested actions to take to resolve the problem.

For instructions on how to obtain service and technical assistance for your storage subsystem and other IBM products, see “Getting information, help, and service” on page xxii

Note: See the *IBM TotalStorage DS4000 Hardware Maintenance Manual and Problem Determination Guide* for additional troubleshooting and debugging procedures.

General checkout

Use the LEDs, the diagnostics and test information, and the Symptom-to-FRU index to diagnose problems. The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

Using the diagnostic hardware

The DS4300 Storage Subsystem comes with a wrap-plug adapter and LC coupler. The wrap-plug adapter and LC coupler are used to identify fibre path problems. The loopback and sendEcho tests are described in the *IBM TotalStorage DS4000 Problem Determination Guide*.

Troubleshooting

This section contains information to help you solve some of the problems you might have with your storage subsystem. Table 17 contains the problem symptoms and error messages, along with suggested actions to take to resolve problems.

Always use the DS4000 Storage Manager client to diagnose storage subsystem problems and component failures and find solutions to problems that have definite symptoms. You can use Table 6 which contains the problem symptoms, along with suggested actions as a guide for troubleshooting problems in addition to the DS4000 Storage Manager Recovery Guru in the Subsystem Management window. Do not rely solely on Table 17 for a FRU replacement decision. In addition, do not contact IBM Support unless the problem persists or the problem can not be troubleshoot using the information in Table 17 or the Recovery Guru procedures as displayed in the DS4000 storage manager subsystem management window.

Table 17. Storage subsystem troubleshooting

Problem indicator	Component	Possible cause	Possible solutions
Amber LED on	Drive CRU	Drive failure	Replace the drive that has failed.
	Fan CRU	Fan failure	Replace the fan that has failed.

Table 17. Storage subsystem troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
	RAID controller Fault LED	RAID controller failure	<p>If the DS4300 RAID controller has been placed offline by the user, use storage management software to place it online. If the controller did not come on-line after several attempts (>4), replace the RAID controller.</p> <p>Otherwise, use the DS4000 storage manage software to determine whether the fault is caused by any of the following:</p> <ul style="list-style-type: none"> • A failed cache battery. (Controller cache battery will also not be lit.) Replace the battery if this is the case. • A non-functional RAID controller. Replace the controller if this is the case.
	Expansion or host port bypass LED	SFP port empty	<p>No corrective action is needed if this is a stand-alone storage subsystem with no storage expansion enclosures attached, and if the system is properly configured.</p> <p>Otherwise, check to make sure that the storage expansion enclosure is powered on, SFPs are inserted in the controller expansion port and the storage expansion enclosure ESM ports and the FC cables are attached properly.</p>
		Fibre-channel cable is not attached to the storage expansion enclosure.	Connect the fibre-channel cable to the expansion enclosure ESM port; check other FC connections.
		Storage expansion enclosures are set at 1 Gbps.	The DS4300 supports 2 Gbps fibre-channel connections only in the drive loops. Make appropriate hardware changes to ensure the DS4300 ports are connecting to ports that operate at 2 Gbps.

Table 17. Storage subsystem troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
Amber LED on (continued)	Expansion or host port bypass LED (continued)	FC HBA or switch can operate at 1 Gbps speed only.	The DS4300 with controller firmware version 05.33.xx.xx supports 2 Gbps fibre-channel host connections. Upgrade to controller firmware version 5.34.xx.xx or later (6.19.xx.xx is recommended) to enable the support of 1 Gbps host port connections.
		No incoming signal detected.	<ul style="list-style-type: none"> • Reattach the SFPs and fibre-channel cables. • Perform fibre-channel (FC) path diagnostic using the FC loopback adapter and the path diagnostic procedure in the <i>IBM TotalStorage DS4000 Problem Determination Guide</i>. Replace input and output SFPs or FC cables as necessary. Ensure that the SFPs and FC cables are of IBM supported options. • Make sure that the storage expansion enclosures are power on and are in optimal state. • - Make sure that the storage enclosure speed switch is set to 2 Gbps. Note: The storage expansion enclosure must be powered cycle before the new speed setting becomes effective. • A RAID controller malfunctioned. Replace the RAID controller if previous steps did not solve the problem.
	Front panel	General system error	Indicates that a Fault LED somewhere on the storage subsystem has turned on. (Check for amber LEDs on CRUs.) Use Storage Manager software to diagnose server problems.
Amber LED is off and green LED off	Power-supply CRU	Power switch is turned off or ac power failure	Check that all of the power cords are firmly plugged in. If applicable, check that the main circuit breakers for the rack power distribution units or the AC electrical outlets are turned on. Turn on all power-supply switches.

Table 17. Storage subsystem troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
Amber and green LEDs on	Power-supply CRU	Power supply failure	Replace the failed power-supply CRU.
All green LEDs off	All CRUs	Subsystem power is off	Check that all storage-server power cords are plugged in and the power switches are on. If applicable, check that the main circuit breakers for the rack or the AC electrical outlets are turned on.
		AC power failure	Check the main circuit breaker and ac outlet.
		Power supply failure	Replace the power supply.
		Midplane failure	Have the midplane replaced (service technician only).
Amber LED flashing	Drive CRUs	Drive identify is in process	No corrective action is needed.

Table 17. Storage subsystem troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
One or more green LEDs off	Power supply CRUs	Power cord unplugged or switches turned off	Make sure that the power cord is plugged in and the power-supply switches are turned on.
	All drive CRUs	Midplane failure	Have the midplane replaced (service technician only).
	Front panel	Power supply problem	Make sure that the cords are plugged in and power supplies are turned on.
		Hardware failure	If any other LEDs are on, replace the midplane (service technician only).
	Battery	Battery failure	Replace the battery.
	Cache active	The cache is disabled	Use the storage-management software to enable the logical drive read and write cache settings.
		The cache memory has failed	Replace the RAID controller after using the DS4000 storage manager software to verify the controller failure.
		The cache battery has failed	Use the storage-management software to check and replace the battery.
		There is no I/O	Generate I/O.
	Host loop	Host or switch is off or has failed	Check if host or switch is on. Replace attached devices that have failed.
		Fibre-channel cable has failed	Ensure that the fibre-channel cables are undamaged and properly connected.
		SFP has failed	Ensure SFP is seated properly; replace SFP.
		RAID controller has no power or has failed	Ensure that the unit is powered on. Replace RAID controller.

Table 17. Storage subsystem troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
One or more green LEDs off (continued)	Expansion loop	Drives are improperly installed or not installed	Ensure that the drives are properly installed.
		RAID controller has no power or has failed	Ensure that the unit is powered on. Replace the RAID controller.
		Impending drive failure	A bad drive or drives can issue LIPs that cause the drive expansion loop to go down momentarily. Use the RLS function in the storage-management software to determine which drives are bad. Replace the bad drives.
		Externally attached expansion port Device (SFP, FC cables or ESM) has failed.	Replace the storage expansion enclosure SFP, fibre-channel cable or the storage expansion enclosure ESM as appropriate. Use the DS4000 storage manager software and the fiber-channel path diagnostic procedure as documented in the <i>IBM TotalStorage DS4000 Problem Determination Guide</i> to troubleshoot the failing component.
Intermittent or sporadic power loss to the storage subsystem	Some or all CRUs	Defective ac power source or partially plugged-in power cord	Check the ac power source; verify that the ac circuit that the storage subsystem connects to is not being overloaded. Reseat all installed power cables and power supplies. If applicable, check the power components. Replace defective power cords.
		Power supply has failed	Check for a Fault LED on the power supply, and replace the failed CRU.
		Operating environment temperature is > 40C	Ensure that the adequate cooling is available for the configuration. Refer to the Heat, airflow and cooling for rack guidelines to ensure proper cooling.
		Midplane has failed	Have the midplane replaced (service technician only).

Table 17. Storage subsystem troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
Unable to access drives	Drives and expansion loop	Fibre-channel cabling has failed.	Ensure that the fibre-channel cables are undamaged and properly connected.
		Incorrect DS4300 controller firmware installed to support a particular DS4000 storage expansion enclosure model. For example, EXP810s require controller firmware version 6.19.xx.xx and later.	Check the IBM DS4000 System Storage product support Web site for the latest version of controller firmware and storage expansion enclosure ESM firmware. Update the firmware to the latest version if required.
		Storage expansion enclosures are not powered on, not supported or failed.	Ensure that the storage expansion enclosures are powered on and are in optimal state. Use the DS4000 storage manager to determine whether the storage expansion enclosure is supported by the DS4300 subsystem or not and whether the storage expansion enclosure ESMs are in failed state or not.
		SFP has failed.	Ensure SFP is seated properly; replace SFP.
		Drive failed or bypassed.	Replace drive.
		RAID controller has failed.	Replace the RAID controller.
Random errors	Subsystem	Midplane has failed	Have the midplane replaced (service technician only).

Table 17. Storage subsystem troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
<p>The Storage Manager client Enterprise Management window sees each storage subsystem controller as an independent storage subsystem.</p>			<p>No drives are present in the storage subsystem. Ensure that at least one drive is present in the storage subsystem so that it can be configured properly.</p> <p>One controller was replaced incorrectly. The controller firmware versions probably failed to synchronize correctly. To recover, perform the following steps:</p> <ol style="list-style-type: none"> 1. Remove and reinsert the controller blade. 2. Wait 5 minutes. 3. Delete the controller entry with the incorrect firmware version from the DS4000 Storage Manager Enterprise Management window. 4. Add the controller back to the DS4000 Storage Manager Enterprise Management window using the Add Device menu option in the Enterprise Management window. 5. If the Storage Manager client Enterprise Management window still shows each storage subsystem controller as an independent storage subsystem or a partially managed device, repeat this procedure. If the problem still persists, contact IBM support.

Parts listing

Figure 105 on page 153 and the following table provide a parts listing for the DS4300 storage subsystem.

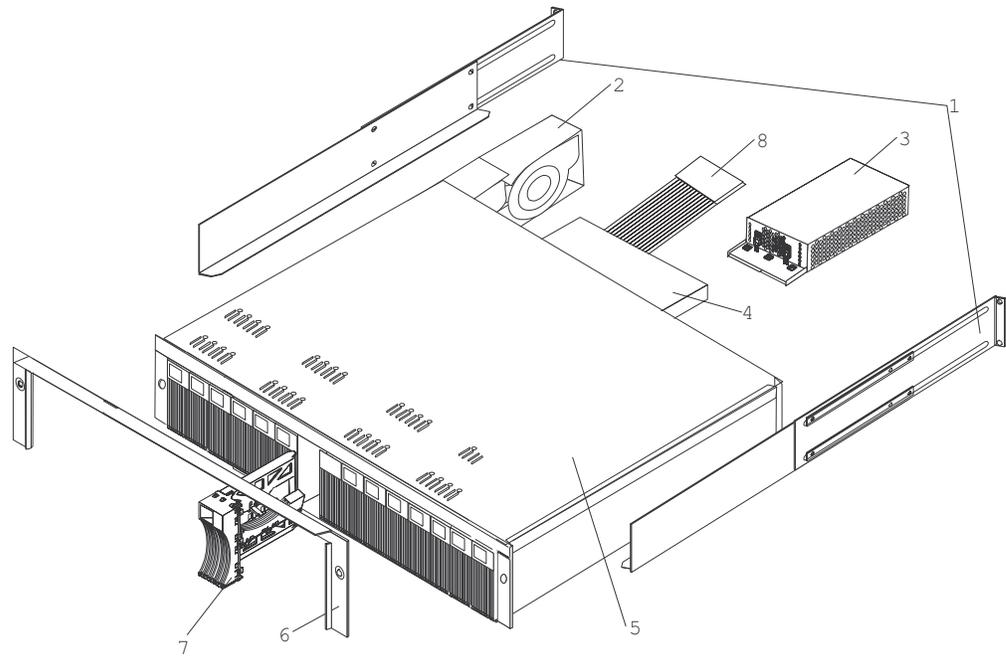


Figure 105. DS4300 storage subsystem parts list

Index	Fibre channel Type 1722 DS4300 storage subsystem	FRU No.
1	Rail Kit Left/Right	37L0067
2	Fan assembly	19K1293
3	Power Supply assembly (400 W)	19K1289
4	FC RAID Controller (base model, 256 MB cache, no battery)	24P8059 (24P8206)
4	FC RAID Controller (Turbo, 1 GB cache, no battery)	24P8225
4	FC RAID Controller (model 6LU/6LX single-controller, 256 MB cache, no battery)	24P8961
5	Midplane/frame (base model)	24P8129
5	Midplane/frame (model 6LU/6LX single-controller)	25R0107
6	Bezel assembly (DS4300)	25R0199
6	Bezel assembly (FASt600)	24P8058
7	DASD Bezel Filler assembly	19K1291
8	Switch Harness	19K1297
	Miscellaneous Hardware Kit	09N7288
	Battery bracket	25R0089
	Short Wave SFP	19K1280
	Long Wave SFP	19K1281
	Cable, 5M Optical	19K1266
	Cable, 25M Optical	19K1267
	Cable, 1M Optical	19K1265
	9' Line Cord	6952300
	Battery, Cache	24P8062
	Line Cord Jumper, High Voltage	36L8886

Index	Fibre channel Type 1722 DS4300 storage subsystem	FRU No.
	Cable, FRU SC-LC Adapter	19K1268
	1.2-m FC copper cable (IBM TotalStorage SAN Integration Server only)	17P7508
	Wrap plug (loopback adapter)	17P6918

Figure 72 on page 86 lists required power cords for the DS4000 storage components discussed in this document by country and region.

Appendix A. Records

Whenever you add options to your controller unit, be sure to update the information in this appendix. Accurate, up-to-date records make it easier to add other options and provide needed data whenever you contact technical support.

Identification numbers

Record and retain the following information.

Product name:	IBM DS4300 Storage Subsystem
Machine:	
Model number:	_____
Serial number:	_____

The serial number is located on the front bottom-right corner of the chassis and on the rear of the storage subsystem.

Installed-device records

Use the following table to keep a record of the options that are installed in or attached to your controller unit. This information can be helpful when you install additional options or if you ever need to report a hardware problem. Copy these tables before recording information in them, in case you need extra space to write new values later, when you update your system configuration.

Drive location	Drive part and model numbers	Drive serial number
Bay 1		
Bay 2		
Bay 3		
Bay 4		
Bay 5		
Bay 6		
Bay 7		
Bay 8		
Bay 9		
Bay 10		
Bay 11		
Bay 12		
Bay 13		
Bay 14		

Appendix B. Accessibility

This section provides information about alternate keyboard navigation, which is a DS4000 Storage Manager accessibility feature. Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

By using the alternate keyboard operations that are described in this section, you can use keys or key combinations to perform Storage Manager tasks and initiate many menu actions that can also be done with a mouse.

Note: In addition to the keyboard operations that are described in this section, the DS4000 Storage Manager 9.14, 9.15, and 9.16 software installation packages for Windows include a screen reader software interface. To enable the screen reader, select Custom Installation when using the installation wizard to install Storage Manager 9.14, 9.15, or 9.16 on a Windows host/management station. Then, in the Select Product Features window, select Java Access Bridge in addition to the other required host software components.

Table 18 defines the keyboard operations that enable you to navigate, select, or activate user interface components. The following terms are used in the table:

- *Navigate* means to move the input focus from one user interface component to another.
- *Select* means to choose one or more components, typically for a subsequent action.
- *Activate* means to carry out the action of a particular component.

Note: In general, navigation between components requires the following keys:

- **Tab** - Moves keyboard focus to the next component or to the first member of the next group of components
- **Shift-Tab** - Moves keyboard focus to the previous component or to the first component in the previous group of components
- **Arrow keys** - Move keyboard focus within the individual components of a group of components

Table 18. DS4000 Storage Manager alternate keyboard operations

Short cut	Action
F1	Open the Help.
F10	Move keyboard focus to main menu bar and post first menu; use the arrow keys to navigate through the available options.
Alt+F4	Close the management window.
Alt+F6	Move keyboard focus between dialogs (non-modal) and between management windows.

Table 18. DS4000 Storage Manager alternate keyboard operations (continued)

Short cut	Action
Alt+ underlined letter	<p>Access menu items, buttons, and other interface components by using the keys associated with the underlined letters.</p> <p>For the menu options, select the Alt + underlined letter combination to access a main menu, and then select the underlined letter to access the individual menu item.</p> <p>For other interface components, use the Alt + underlined letter combination.</p>
Ctrl+F1	Display or conceal a tool tip when keyboard focus is on the toolbar.
Spacebar	Select an item or activate a hyperlink.
Ctrl+Spacebar (Contiguous/Non-contiguous) AMW Logical/Physical View	<p>Select multiple drives in the Physical View.</p> <p>To select multiple drives, select one drive by pressing Spacebar, and then press Tab to switch focus to the next drive you want to select; press Ctrl+Spacebar to select the drive.</p> <p>If you press Spacebar alone when multiple drives are selected then all selections are removed.</p> <p>Use the Ctrl+Spacebar combination to deselect a drive when multiple drives are selected.</p> <p>This behavior is the same for contiguous and non-contiguous selection of drives.</p>
End, Page Down	Move keyboard focus to the last item in the list.
Esc	Close the current dialog (does not require keyboard focus).
Home, Page Up	Move keyboard focus to the first item in the list.
Shift+Tab	Move keyboard focus through components in the reverse direction.
Ctrl+Tab	Move keyboard focus from a table to the next user interface component.
Tab	Navigate keyboard focus between components or select a hyperlink.
Down arrow	Move keyboard focus down one item in the list.
Left arrow	Move keyboard focus to the left.
Right arrow	Move keyboard focus to the right.
Up arrow	Move keyboard focus up one item in the list.

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Processor speeds indicate the internal clock speed of the microprocessor; other factors also affect application performance.

CD-ROM drive speeds list the variable read rate. Actual speeds vary and are often less than the maximum possible.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for approximately 1000 bytes, MB stands for approximately 1 000 000 bytes, and GB stands for approximately 1 000 000 000 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 may 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 available from IBM.

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Federal Communications Commission (FCC) statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates,

uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

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 may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Chinese class A compliance statement

Attention: This is a class A statement. In a domestic environment, this product might cause radio interference in which case the user might be required to take adequate measures.

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。

Industry Canada Class A emission compliance statement

This Class A digital apparatus complies with Canadian ICES-003.

Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Australia and New Zealand Class A statement

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

United Kingdom telecommunications safety requirement

Notice to Customers

This apparatus is approved under approval number NS/G/1234/J/100003 for indirect connection to public telecommunication systems in the United Kingdom.

European Union EMC Directive conformance statement

This product is in conformity with the protection requirements of EU Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any

failure to satisfy the protection requirements resulting from a nonrecommended modification of the product, including the fitting of non-IBM option cards.

This product has been tested and found to comply with the limits for Class A Information Technology Equipment according to CISPR 22/European Standard EN 55022. The limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Taiwan electrical emission 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。

Japanese Voluntary Control Council for Interference (VCCI) statement

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスA情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

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 outlet.

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.

IBM power cord part number	Used in these countries and regions
13F9940	Argentina, Australia, China (PRC), New Zealand, Papua New Guinea, Paraguay, Uruguay, Western Samoa
13F9979	Afghanistan, Algeria, Andorra, Angola, Austria, Belgium, Benin, Bulgaria, Burkina Faso, Burundi, Cameroon, Central African Rep., Chad, Czech Republic, Egypt, Finland, France, French Guiana, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Ivory Coast, Jordan, Lebanon, Luxembourg, Macao S.A.R. of China, Malagasy, Mali, Martinique, Mauritania, Mauritius, Monaco, Morocco, Mozambique, Netherlands, New Caledonia, Niger, Norway, Poland, Portugal, Romania, Senegal, Slovakia, Spain, Sudan, Sweden, Syria, Togo, Tunisia, Turkey, former USSR, Vietnam, former Yugoslavia, Zaire, Zimbabwe
13F9997	Denmark
14F0015	Bangladesh, Burma, Pakistan, South Africa, Sri Lanka
14F0033	Antigua, Bahrain, Brunei, Channel Islands, Cyprus, Dubai, Fiji, Ghana, Hong Kong S.A.R. of China, India, Iraq, Ireland, Kenya, Kuwait, Malawi, Malaysia, Malta, Nepal, Nigeria, Polynesia, Qatar, Sierra Leone, Singapore, Tanzania, Uganda, United Kingdom, Yemen, Zambia
14F0051	Liechtenstein, Switzerland
14F0069	Chile, Ethiopia, Italy, Libya, Somalia
14F0087	Israel
1838574	Thailand
6952301	Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Korea (South), Liberia, Mexico, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Suriname, Taiwan, Trinidad (West Indies), United States of America, Venezuela

Glossary

This glossary provides definitions for the terminology and abbreviations used in IBM TotalStorage DS4000 publications.

If you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* located at the following Web site:

www.ibm.com/ibm/terminology

This glossary also includes terms and definitions from:

- *Information Technology Vocabulary* by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.
- *IBM Glossary of Computing Terms*. New York: McGraw-Hill, 1994.

The following cross-reference conventions are used in this glossary:

See Refers you to (a) a term that is the expanded form of an abbreviation or acronym, or (b) a synonym or more preferred term.

See also

Refers you to a related term.

Abstract Windowing Toolkit (AWT). A Java graphical user interface (GUI).

accelerated graphics port (AGP). A bus specification that gives low-cost 3D graphics cards faster access to main memory on personal computers than the usual peripheral component interconnect (PCI) bus. AGP reduces the overall cost of creating high-end graphics subsystems by using existing system memory.

access volume. A special logical drive that allows the host-agent to communicate with the controllers in the storage subsystem.

adapter. A printed circuit assembly that transmits user data input/output (I/O) between the internal bus of the

host system and the external fibre-channel (FC) link and vice versa. Also called an I/O adapter, host adapter, or FC adapter.

advanced technology (AT) bus architecture. A bus standard for IBM compatibles. It extends the XT bus architecture to 16 bits and also allows for bus mastering, although only the first 16 MB of main memory are available for direct access.

agent. A server program that receives virtual connections from the network manager (the client program) in a Simple Network Management Protocol-Transmission Control Protocol/Internet Protocol (SNMP-TCP/IP) network-managing environment.

AGP. See *accelerated graphics port*.

AL_PA. See *arbitrated loop physical address*.

arbitrated loop. One of three existing fibre-channel topologies, in which 2 - 126 ports are interconnected serially in a single loop circuit. Access to the Fibre Channel-Arbitrated Loop (FC-AL) is controlled by an arbitration scheme. The FC-AL topology supports all classes of service and guarantees in-order delivery of FC frames when the originator and responder are on the same FC-AL. The default topology for the disk array is arbitrated loop. An arbitrated loop is sometimes referred to as a Stealth Mode.

arbitrated loop physical address (AL_PA). An 8-bit value that is used to uniquely identify an individual port within a loop. A loop can have one or more AL_PAs.

array. A collection of fibre-channel or SATA hard drives that are logically grouped together. All the drives in the array are assigned the same RAID level. An array is sometimes referred to as a "RAID set." See also *redundant array of independent disks (RAID)*, *RAID level*.

asynchronous write mode. In remote mirroring, an option that allows the primary controller to return a write I/O request completion to the host server before data has been successfully written by the secondary controller. See also *synchronous write mode*, *remote mirroring*, *Global Copy*, *Global Mirroring*.

AT. See *advanced technology (AT) bus architecture*.

ATA. See *AT-attached*.

AT-attached. Peripheral devices that are compatible with the original IBM AT computer standard in which signals on a 40-pin AT-attached (ATA) ribbon cable followed the timings and constraints of the Industry Standard Architecture (ISA) system bus on the IBM PC AT computer. Equivalent to integrated drive electronics (IDE).

auto-volume transfer/auto-disk transfer (AVT/ADT).

A function that provides automatic failover in case of controller failure on a storage subsystem.

AVT/ADT. See *auto-volume transfer/auto-disk transfer*.

AWT. See *Abstract Windowing Toolkit*.

basic input/output system (BIOS). The personal computer code that controls basic hardware operations, such as interactions with diskette drives, hard disk drives, and the keyboard.

BIOS. See *basic input/output system*.

BOOTP. See *bootstrap protocol*.

bootstrap protocol (BOOTP). In Transmission Control Protocol/Internet Protocol (TCP/IP) networking, an alternative protocol by which a diskless machine can obtain its Internet Protocol (IP) address and such configuration information as IP addresses of various servers from a BOOTP server.

bridge. A storage area network (SAN) device that provides physical and transport conversion, such as Fibre Channel to small computer system interface (SCSI) bridge.

bridge group. A bridge and the collection of devices connected to it.

broadcast. The simultaneous transmission of data to more than one destination.

cathode ray tube (CRT). A display device in which controlled electron beams are used to display alphanumeric or graphical data on an electroluminescent screen.

client. A computer system or process that requests a service of another computer system or process that is typically referred to as a server. Multiple clients can share access to a common server.

command. A statement used to initiate an action or start a service. A command consists of the command name abbreviation, and its parameters and flags if applicable. A command can be issued by typing it on a command line or selecting it from a menu.

community string. The name of a community contained in each Simple Network Management Protocol (SNMP) message.

concurrent download. A method of downloading and installing firmware that does not require the user to stop I/O to the controllers during the process.

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

CRU. See *customer replaceable unit*.

customer replaceable unit (CRU). An assembly or part that a customer can replace in its entirety when any of its components fail. Contrast with *field replaceable unit (FRU)*.

cyclic redundancy check (CRC). (1) A redundancy check in which the check key is generated by a cyclic algorithm. (2) An error detection technique performed at both the sending and receiving stations.

dac. See *disk array controller*.

dar. See *disk array router*.

DASD. See *direct access storage device*.

data striping. See *striping*.

default host group. A logical collection of discovered host ports, defined host computers, and defined host groups in the storage-partition topology that fulfill the following requirements:

- Are not involved in specific logical drive-to-LUN mappings
- Share access to logical drives with default logical drive-to-LUN mappings

device type. Identifier used to place devices in the physical map, such as the switch, hub, or storage.

DHCP. See *Dynamic Host Configuration Protocol*.

direct access storage device (DASD). A device in which access time is effectively independent of the location of the data. Information is entered and retrieved without reference to previously accessed data. (For example, a disk drive is a DASD, in contrast with a tape drive, which stores data as a linear sequence.) DASDs include both fixed and removable storage devices.

direct memory access (DMA). The transfer of data between memory and an input/output (I/O) device without processor intervention.

disk array controller (dac). A disk array controller device that represents the two controllers of an array. See also *disk array router*.

disk array router (dar). A disk array router that represents an entire array, including current and deferred paths to all logical unit numbers (LUNs) (hdisks on AIX). See also *disk array controller*.

DMA. See *direct memory access*.

domain. The most significant byte in the node port (N_port) identifier for the fibre-channel (FC) device. It is not used in the Fibre Channel-small computer system interface (FC-SCSI) hardware path ID. It is required to be the same for all SCSI targets logically connected to an FC adapter.

drive channels. The DS4200, DS4700, and DS4800 subsystems use dual-port drive channels that, from the physical point of view, are connected in the same way as two drive loops. However, from the point of view of the number of drives and enclosures, they are treated as a single drive loop instead of two different drive loops. A group of storage expansion enclosures are connected to the DS4000 storage subsystems using a drive channel from each controller. This pair of drive channels is referred to as a redundant drive channel pair.

drive loops. A drive loop consists of one channel from each controller combined to form one pair of redundant drive channels or a redundant drive loop. Each drive loop is associated with two ports. (There are two drive channels and four associated ports per controller.) For the DS4800, drive loops are more commonly referred to as drive channels. See *drive channels*.

DRAM. See *dynamic random access memory*.

Dynamic Host Configuration Protocol (DHCP). A protocol defined by the Internet Engineering Task Force that is used for dynamically assigning Internet Protocol (IP) addresses to computers in a network.

dynamic random access memory (DRAM). A storage in which the cells require repetitive application of control signals to retain stored data.

ECC. See *error correction coding*.

EEPROM. See *electrically erasable programmable read-only memory*.

EISA. See *Extended Industry Standard Architecture*.

electrically erasable programmable read-only memory (EEPROM). A type of memory chip which can retain its contents without consistent electrical power. Unlike the PROM which can be programmed only once, the EEPROM can be erased electrically. Because it can only be reprogrammed a limited number of times before it wears out, it is appropriate for storing small amounts of data that are changed infrequently.

electrostatic discharge (ESD). The flow of current that results when objects that have a static charge come into close enough proximity to discharge.

environmental service module (ESM) canister. A component in a storage expansion enclosure that monitors the environmental condition of the components in that enclosure. Not all storage subsystems have ESM canisters.

E_port. See *expansion port*.

error correction coding (ECC). A method for encoding data so that transmission errors can be detected and corrected by examining the data on the

receiving end. Most ECCs are characterized by the maximum number of errors they can detect and correct.

ESD. See *electrostatic discharge*.

ESM canister. See *environmental service module canister*.

automatic ESM firmware synchronization. When you install a new ESM into an existing storage expansion enclosure in a DS4000 storage subsystem that supports automatic ESM firmware synchronization, the firmware in the new ESM is automatically synchronized with the firmware in the existing ESM.

EXP. See *storage expansion enclosure*.

expansion port (E_port). A port that connects the switches for two fabrics.

Extended Industry Standard Architecture (EISA). A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to 32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

fabric. A Fibre Channel entity which interconnects and facilitates logins of N_ports attached to it. The fabric is responsible for routing frames between source and destination N_ports using address information in the frame header. A fabric can be as simple as a point-to-point channel between two N_ports, or as complex as a frame-routing switch that provides multiple and redundant internal pathways within the fabric between F_ports.

fabric port (F_port). In a fabric, an access point for connecting a user's N_port. An F_port facilitates N_port logins to the fabric from nodes connected to the fabric. An F_port is addressable by the N_port connected to it. See also *fabric*.

FC. See *Fibre Channel*.

FC-AL. See *arbitrated loop*.

feature enable identifier. A unique identifier for the storage subsystem, which is used in the process of generating a premium feature key. See also *premium feature key*.

Fibre Channel (FC). A set of standards for a serial input/output (I/O) bus capable of transferring data between two ports at up to 100 Mbps, with standards proposals to go to higher speeds. FC supports point-to-point, arbitrated loop, and switched topologies.

Fibre Channel-Arbitrated Loop (FC-AL). See *arbitrated loop*.

Fibre Channel Protocol (FCP) for small computer system interface (SCSI). A high-level fibre-channel mapping layer (FC-4) that uses lower-level fibre-channel

(FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit might contain other field replaceable units. Contrast with *customer replaceable unit (CRU)*.

FlashCopy. A premium feature for DS4000 that can make an instantaneous copy of the data in a volume.

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

gigabit interface converter (GBIC). A transceiver that performs serial, optical-to-electrical, and electrical-to-optical signal conversions for high-speed networking. A GBIC can be hot swapped. See also *small form-factor pluggable*.

Global Copy. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode without the write consistency group option. This is also referred to as "Asynchronous Mirroring without Consistency Group." Global Copy does not ensure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives. If it is critical that writes to the primary logical drives are carried out in the same order in the appropriate secondary logical drives, Global Mirroring should be used instead of Global Copy. See also *asynchronous write mode*, *Global Mirroring*, *remote mirroring*, *Metro Mirroring*.

Global Mirroring. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode with the write consistency group option. This is also referred to as "Asynchronous Mirroring with Consistency Group." Global Mirroring ensures that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives, preventing data on the secondary logical drives from becoming inconsistent with the data on the primary logical drives. See also *asynchronous write mode*, *Global Copy*, *remote mirroring*, *Metro Mirroring*.

graphical user interface (GUI). A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons, and the object-action relationship.

GUI. See *graphical user interface*.

HBA. See *host bus adapter*.

hdisk. An AIX term representing a logical unit number (LUN) on an array.

heterogeneous host environment. A host system in which multiple host servers, which use different operating systems with their own unique disk storage subsystem settings, connect to the same DS4000 storage subsystem at the same time. See also *host*.

host. A system that is directly attached to the storage subsystem through a fibre-channel input/output (I/O) path. This system is used to serve data (typically in the form of files) from the storage subsystem. A system can be both a storage management station and a host simultaneously.

host bus adapter (HBA). An interface between the fibre-channel network and a workstation or server.

host computer. See *host*.

host group. An entity in the storage partition topology that defines a logical collection of host computers that require shared access to one or more logical drives.

host port. Ports that physically reside on the host adapters and are automatically discovered by the DS4000 Storage Manager software. To give a host computer access to a partition, its associated host ports must be defined.

hot swap. To replace a hardware component without turning off the system.

hub. In a network, a point at which circuits are either connected or switched. For example, in a star network, the hub is the central node; in a star/ring network, it is the location of wiring concentrators.

IBMSAN driver. The device driver that is used in a Novell NetWare environment to provide multipath input/output (I/O) support to the storage controller.

IC. See *integrated circuit*.

IDE. See *integrated drive electronics*.

in-band. Transmission of management protocol over the fibre-channel transport.

Industry Standard Architecture (ISA). Unofficial name for the bus architecture of the IBM PC/XT personal computer. This bus design included expansion slots for plugging in various adapter boards. Early versions had an 8-bit data path, later expanded to 16 bits. The "Extended Industry Standard Architecture" (EISA) further expanded the data path to 32 bits. See also *Extended Industry Standard Architecture*.

initial program load (IPL). The initialization procedure that causes an operating system to commence operation. Also referred to as a system restart, system startup, and boot.

integrated circuit (IC). A microelectronic semiconductor device that consists of many interconnected transistors and other components. ICs are constructed on a small rectangle cut from a silicon crystal or other semiconductor material. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. Also known as a *chip*.

integrated drive electronics (IDE). A disk drive interface based on the 16-bit IBM personal computer Industry Standard Architecture (ISA) in which the controller electronics reside on the drive itself, eliminating the need for a separate adapter card. Also known as an Advanced Technology Attachment Interface (ATA).

Internet Protocol (IP). A protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network.

Internet Protocol (IP) address. The unique 32-bit address that specifies the location of each device or workstation on the Internet. For example, 9.67.97.103 is an IP address.

interrupt request (IRQ). A type of input found on many processors that causes the processor to suspend normal processing temporarily and start running an interrupt handler routine. Some processors have several interrupt request inputs that allow different priority interrupts.

IP. See *Internet Protocol*.

IPL. See *initial program load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

Java Runtime Environment (JRE). A subset of the Java Development Kit (JDK) for end users and developers who want to redistribute the Java Runtime Environment (JRE). The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

JRE. See *Java Runtime Environment*.

label. A discovered or user entered property value that is displayed underneath each device in the Physical and Data Path maps.

LAN. See *local area network*.

LBA. See *logical block address*.

local area network (LAN). A computer network located on a user's premises within a limited geographic area.

logical block address (LBA). The address of a logical block. Logical block addresses are typically used in hosts' I/O commands. The SCSI disk command protocol, for example, uses logical block addresses.

logical partition (LPAR). (1) A subset of a single system that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system. (2) A fixed-size portion of a logical volume. A logical partition is the same size as the physical partitions in its volume group. Unless the logical volume of which it is a part is mirrored, each logical partition corresponds to, and its contents are stored on, a single physical partition. (3) One to three physical partitions (copies). The number of logical partitions within a logical volume is variable.

logical unit number (LUN). An identifier used on a small computer system interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

loop address. The unique ID of a node in fibre-channel loop topology sometimes referred to as a loop ID.

loop group. A collection of storage area network (SAN) devices that are interconnected serially in a single loop circuit.

loop port. A node port (N_port) or fabric port (F_port) that supports arbitrated loop functions associated with an arbitrated loop topology.

LPAR. See *logical partition*.

LUN. See *logical unit number*.

MAC. See *medium access control*.

management information base (MIB). The information that is on an agent. It is an abstraction of configuration and status information.

man pages. In UNIX-based operating systems, online documentation for operating system commands, subroutines, system calls, file formats, special files, stand-alone utilities, and miscellaneous facilities. Invoked by the **man** command.

MCA. See *micro channel architecture*.

media scan. A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all

logical drive data to verify that it can be accessed, and optionally scans the logical drive redundancy information.

medium access control (MAC). In local area networks (LANs), the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. The MAC sublayer includes the method of determining when a device has access to the transmission medium.

Metro Mirroring. This term is used to refer to a remote logical drive mirror pair which is set up with synchronous write mode. See also *remote mirroring*, *Global Mirroring*.

MIB. See *management information base*.

micro channel architecture (MCA). Hardware that is used for PS/2 Model 50 computers and above to provide better growth potential and performance characteristics when compared with the original personal computer design.

Microsoft Cluster Server (MSCS). MSCS, a feature of Windows NT Server (Enterprise Edition), supports the connection of two servers into a cluster for higher availability and easier manageability. MSCS can automatically detect and recover from server or application failures. It can also be used to balance server workload and provide for planned maintenance.

mini hub. An interface card or port device that receives short-wave fiber channel GBICs or SFPs. These devices enable redundant Fibre Channel connections from the host computers, either directly or through a Fibre Channel switch or managed hub, over optical fiber cables to the DS4000 Storage Server controllers. Each DS4000 controller is responsible for two mini hubs. Each mini hub has two ports. Four host ports (two on each controller) provide a cluster solution without use of a switch. Two host-side mini hubs are shipped as standard. See also *host port*, *gigabit interface converter (GBIC)*, *small form-factor pluggable (SFP)*.

mirroring. A fault-tolerance technique in which information on a hard disk is duplicated on additional hard disks. See also *remote mirroring*.

model. The model identification that is assigned to a device by its manufacturer.

MSCS. See *Microsoft Cluster Server*.

network management station (NMS). In the Simple Network Management Protocol (SNMP), a station that runs management application programs that monitor and control network elements.

NMI. See *non-maskable interrupt*.

NMS. See *network management station*.

non-maskable interrupt (NMI). A hardware interrupt that another service request cannot overrule (mask). An NMI bypasses and takes priority over interrupt requests generated by software, the keyboard, and other such devices and is issued to the microprocessor only in disastrous circumstances, such as severe memory errors or impending power failures.

node. A physical device that allows for the transmission of data within a network.

node port (N_port). A fibre-channel defined hardware entity that performs data communications over the fibre-channel link. It is identifiable by a unique worldwide name. It can act as an originator or a responder.

nonvolatile storage (NVS). A storage device whose contents are not lost when power is cut off.

N_port. See *node port*.

NVS. See *nonvolatile storage*.

NVSRAM. Nonvolatile storage random access memory. See *nonvolatile storage*.

Object Data Manager (ODM). An AIX proprietary storage mechanism for ASCII stanza files that are edited as part of configuring a drive into the kernel.

ODM. See *Object Data Manager*.

out-of-band. Transmission of management protocols outside of the fibre-channel network, typically over Ethernet.

partitioning. See *storage partition*.

parity check. (1) A test to determine whether the number of ones (or zeros) in an array of binary digits is odd or even. (2) A mathematical operation on the numerical representation of the information communicated between two pieces. For example, if parity is odd, any character represented by an even number has a bit added to it, making it odd, and an information receiver checks that each unit of information has an odd value.

PCI local bus. See *peripheral component interconnect local bus*.

PDF. See *portable document format*.

performance events. Events related to thresholds set on storage area network (SAN) performance.

peripheral component interconnect local bus (PCI local bus). A local bus for PCs, from Intel, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry

Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture, Extended Industry Standard Architecture*.

polling delay. The time in seconds between successive discovery processes during which discovery is inactive.

port. A part of the system unit or remote controller to which cables for external devices (such as display stations, terminals, printers, switches, or external storage units) are attached. The port is an access point for data entry or exit. A device can contain one or more ports.

portable document format (PDF). A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by e-mail, the Web, intranets, or CD-ROM; and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

premium feature key. A file that the storage subsystem controller uses to enable an authorized premium feature. The file contains the feature enable identifier of the storage subsystem for which the premium feature is authorized, and data about the premium feature. See also *feature enable identifier*.

private loop. A freestanding arbitrated loop with no fabric attachment. See also *arbitrated loop*.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

PTF. See *program temporary fix*.

RAID. See *redundant array of independent disks (RAID)*.

RAID level. An array's RAID level is a number that refers to the method used to achieve redundancy and fault tolerance in the array. See also *array, redundant array of independent disks (RAID)*.

RAID set. See *array*.

RAM. See *random-access memory*.

random-access memory (RAM). A temporary storage location in which the central processing unit (CPU) stores and executes its processes. Contrast with *DASD*.

RDAC. See *redundant disk array controller*.

read-only memory (ROM). Memory in which stored data cannot be changed by the user except under special conditions.

recoverable virtual shared disk (RVSD). A virtual shared disk on a server node configured to provide continuous access to data and file systems in a cluster.

redundant array of independent disks (RAID). A collection of disk drives (*array*) that appears as a single volume to the server, which is fault tolerant through an assigned method of data striping, mirroring, or parity checking. Each array is assigned a RAID level, which is a specific number that refers to the method used to achieve redundancy and fault tolerance. See also *array, parity check, mirroring, RAID level, striping*.

redundant disk array controller (RDAC). (1) In hardware, a redundant set of controllers (either active/passive or active/active). (2) In software, a layer that manages the input/output (I/O) through the active controller during normal operation and transparently reroutes I/Os to the other controller in the redundant set if a controller or I/O path fails.

remote mirroring. Online, real-time replication of data between storage subsystems that are maintained on separate media. The Enhanced Remote Mirror Option is a DS4000 premium feature that provides support for remote mirroring. See also *Global Mirroring, Metro Mirroring*.

ROM. See *read-only memory*.

router. A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses.

RVSD. See *recoverable virtual shared disk*.

SAI. See *Storage Array Identifier*.

SA Identifier. See *Storage Array Identifier*.

SAN. See *storage area network*.

SATA. See *serial ATA*.

scope. Defines a group of controllers by their Internet Protocol (IP) addresses. A scope must be created and defined so that dynamic IP addresses can be assigned to controllers on the network.

SCSI. See *small computer system interface*.

segmented loop port (SL_port). A port that allows division of a fibre-channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

sense data. (1) Data sent with a negative response, indicating the reason for the response. (2) Data describing an I/O error. Sense data is presented to a host system in response to a sense request command.

serial ATA. The standard for a high-speed alternative to small computer system interface (SCSI) hard drives. The SATA-1 standard is equivalent in performance to a 10 000 RPM SCSI drive.

serial storage architecture (SSA). An interface specification from IBM in which devices are arranged in a ring topology. SSA, which is compatible with small computer system interface (SCSI) devices, allows full-duplex packet multiplexed serial data transfers at rates of 20 Mbps in each direction.

server. A functional hardware and software unit that delivers shared resources to workstation client units on a computer network.

server/device events. Events that occur on the server or a designated device that meet criteria that the user sets.

SFP. See *small form-factor pluggable*.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SL_port. See *segmented loop port*.

SMagent. The DS4000 Storage Manager optional Java-based host-agent software, which can be used on Microsoft Windows, Novell NetWare, AIX, HP-UX, Solaris, and Linux on POWER host systems to manage storage subsystems through the host fibre-channel connection.

SMclient. The DS4000 Storage Manager client software, which is a Java-based graphical user interface (GUI) that is used to configure, manage, and troubleshoot storage servers and storage expansion enclosures in a DS4000 storage subsystem. SMclient can be used on a host system or on a storage management station.

SMruntime. A Java compiler for the SMclient.

SMutil. The DS4000 Storage Manager utility software that is used on Microsoft Windows, AIX, HP-UX, Solaris, and Linux on POWER host systems to register and map new logical drives to the operating system. In Microsoft Windows, it also contains a utility to flush the cached data of the operating system for a particular drive before creating a FlashCopy.

small computer system interface (SCSI). A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

small form-factor pluggable (SFP). An optical transceiver that is used to convert signals between

optical fiber cables and switches. An SFP is smaller than a gigabit interface converter (GBIC). See also *gigabit interface converter*.

SNMP. See *Simple Network Management Protocol and SNMPv1*.

SNMP trap event. (1) (2) An event notification sent by the SNMP agent that identifies conditions, such as thresholds, that exceed a predetermined value. See also *Simple Network Management Protocol*.

SNMPv1. The original standard for SNMP is now referred to as SNMPv1, as opposed to SNMPv2, a revision of SNMP. See also *Simple Network Management Protocol*.

SRAM. See *static random access memory*.

SSA. See *serial storage architecture*.

static random access memory (SRAM). Random access memory based on the logic circuit known as flip-flop. It is called static because it retains a value as long as power is supplied, unlike dynamic random access memory (DRAM), which must be regularly refreshed. It is however, still volatile, meaning that it can lose its contents when the power is turned off.

storage area network (SAN). A dedicated storage network tailored to a specific environment, combining servers, storage products, networking products, software, and services. See also *fabric*.

Storage Array Identifier (SAI or SA Identifier). The Storage Array Identifier is the identification value used by the DS4000 Storage Manager host software (SMClient) to uniquely identify each managed storage server. The DS4000 Storage Manager SMClient program maintains Storage Array Identifier records of previously-discovered storage servers in the host resident file, which allows it to retain discovery information in a persistent fashion.

storage expansion enclosure (EXP). A feature that can be connected to a system unit to provide additional storage and processing capacity.

storage management station. A system that is used to manage the storage subsystem. A storage management station does not need to be attached to the storage subsystem through the fibre-channel input/output (I/O) path.

storage partition. Storage subsystem logical drives that are visible to a host computer or are shared among host computers that are part of a host group.

storage partition topology. In the DS4000 Storage Manager client, the Topology view of the Mappings window displays the default host group, the defined host group, the host computer, and host-port nodes. The host port, host computer, and host group topological

elements must be defined to grant access to host computers and host groups using logical drive-to-LUN mappings.

striping. Splitting data to be written into equal blocks and writing blocks simultaneously to separate disk drives. Striping maximizes performance to the disks. Reading the data back is also scheduled in parallel, with a block being read concurrently from each disk then reassembled at the host.

subnet. An interconnected but independent segment of a network that is identified by its Internet Protocol (IP) address.

sweep method. A method of sending Simple Network Management Protocol (SNMP) requests for information to all the devices on a subnet by sending the request to every device in the network.

switch. A fibre-channel device that provides full bandwidth per port and high-speed routing of data by using link-level addressing.

switch group. A switch and the collection of devices connected to it that are not in other groups.

switch zoning. See *zoning*.

synchronous write mode. In remote mirroring, an option that requires the primary controller to wait for the acknowledgment of a write operation from the secondary controller before returning a write I/O request completion to the host. See also *asynchronous write mode*, *remote mirroring*, *Metro Mirroring*.

system name. Device name assigned by the vendor's third-party software.

TCP. See *Transmission Control Protocol*.

TCP/IP. See *Transmission Control Protocol/Internet Protocol*.

terminate and stay resident program (TSR program). A program that installs part of itself as an extension of DOS when it is executed.

topology. The physical or logical arrangement of devices on a network. The three fibre-channel topologies are fabric, arbitrated loop, and point-to-point. The default topology for the disk array is arbitrated loop.

TL_port. See *translated loop port*.

transceiver. A device that is used to transmit and receive data. Transceiver is an abbreviation of transmitter-receiver.

translated loop port (TL_port). A port that connects to a private loop and allows connectivity between the private loop devices and off loop devices (devices not connected to that particular TL_port).

Transmission Control Protocol (TCP). A communication protocol used in the Internet and in any network that follows the Internet Engineering Task Force (IETF) standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packed-switched communication networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP). A set of communication protocols that provide peer-to-peer connectivity functions for both local and wide-area networks.

trap. In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition.

trap recipient. Receiver of a forwarded Simple Network Management Protocol (SNMP) trap. Specifically, a trap receiver is defined by an Internet Protocol (IP) address and port to which traps are sent. Presumably, the actual recipient is a software application running at the IP address and listening to the port.

TSR program. See *terminate and stay resident program*.

uninterruptible power supply. A source of power from a battery that is installed between a computer system and its power source. The uninterruptible power supply keeps the system running if a commercial power failure occurs, until an orderly shutdown of the system can be performed.

user action events. Actions that the user takes, such as changes in the storage area network (SAN), changed settings, and so on.

worldwide port name (WWPN). A unique identifier for a switch on local and global networks.

worldwide name (WWN). A globally unique 64-bit identifier assigned to each Fibre Channel port.

WORM. See *write-once read-many*.

write-once read many (WORM). Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered.

WWN. See *worldwide name*.

zoning. (1) In Fibre Channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones. (2) A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

Abstract Windowing Toolkit (AWT). A Java graphical user interface (GUI).

accelerated graphics port (AGP). A bus specification that gives low-cost 3D graphics cards faster access to main memory on personal computers than the usual peripheral component interconnect (PCI) bus. AGP reduces the overall cost of creating high-end graphics subsystems by using existing system memory.

access volume. A special logical drive that allows the host-agent to communicate with the controllers in the storage subsystem.

adapter. A printed circuit assembly that transmits user data input/output (I/O) between the internal bus of the host system and the external fibre-channel (FC) link and vice versa. Also called an I/O adapter, host adapter, or FC adapter.

advanced technology (AT) bus architecture. A bus standard for IBM compatibles. It extends the XT bus architecture to 16 bits and also allows for bus mastering, although only the first 16 MB of main memory are available for direct access.

agent. A server program that receives virtual connections from the network manager (the client program) in a Simple Network Management Protocol-Transmission Control Protocol/Internet Protocol (SNMP-TCP/IP) network-managing environment.

AGP. See *accelerated graphics port*.

AL_PA. See *arbitrated loop physical address*.

arbitrated loop. One of three existing fibre-channel topologies, in which 2 - 126 ports are interconnected serially in a single loop circuit. Access to the Fibre Channel-Arbitrated Loop (FC-AL) is controlled by an arbitration scheme. The FC-AL topology supports all classes of service and guarantees in-order delivery of FC frames when the originator and responder are on the same FC-AL. The default topology for the disk array is arbitrated loop. An arbitrated loop is sometimes referred to as a Stealth Mode.

arbitrated loop physical address (AL_PA). An 8-bit value that is used to uniquely identify an individual port within a loop. A loop can have one or more AL_PAs.

array. A collection of fibre-channel or SATA hard drives that are logically grouped together. All the drives in the array are assigned the same RAID level. An array is sometimes referred to as a "RAID set." See also *redundant array of independent disks (RAID)*, *RAID level*.

asynchronous write mode. In remote mirroring, an option that allows the primary controller to return a write I/O request completion to the host server before data has been successfully written by the secondary

controller. See also *synchronous write mode*, *remote mirroring*, *Global Copy*, *Global Mirroring*.

AT. See *advanced technology (AT) bus architecture*.

ATA. See *AT-attached*.

AT-attached. Peripheral devices that are compatible with the original IBM AT computer standard in which signals on a 40-pin AT-attached (ATA) ribbon cable followed the timings and constraints of the Industry Standard Architecture (ISA) system bus on the IBM PC AT computer. Equivalent to integrated drive electronics (IDE).

auto-volume transfer/auto-disk transfer (AVT/ADT). A function that provides automatic failover in case of controller failure on a storage subsystem.

AVT/ADT. See *auto-volume transfer/auto-disk transfer*.

AWT. See *Abstract Windowing Toolkit*.

basic input/output system (BIOS). The personal computer code that controls basic hardware operations, such as interactions with diskette drives, hard disk drives, and the keyboard.

BIOS. See *basic input/output system*.

BOOTP. See *bootstrap protocol*.

bootstrap protocol (BOOTP). In Transmission Control Protocol/Internet Protocol (TCP/IP) networking, an alternative protocol by which a diskless machine can obtain its Internet Protocol (IP) address and such configuration information as IP addresses of various servers from a BOOTP server.

bridge. A storage area network (SAN) device that provides physical and transport conversion, such as fibre channel to small computer system interface (SCSI) bridge.

bridge group. A bridge and the collection of devices connected to it.

broadcast. The simultaneous transmission of data to more than one destination.

cathode ray tube (CRT). A display device in which controlled electron beams are used to display alphanumeric or graphical data on an electroluminescent screen.

client. A computer system or process that requests a service of another computer system or process that is typically referred to as a server. Multiple clients can share access to a common server.

command. A statement used to initiate an action or start a service. A command consists of the command name abbreviation, and its parameters and flags if

applicable. A command can be issued by typing it on a command line or selecting it from a menu.

community string. The name of a community contained in each Simple Network Management Protocol (SNMP) message.

concurrent download. A method of downloading and installing firmware that does not require the user to stop I/O to the controllers during the process.

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

CRU. See *customer replaceable unit*.

customer replaceable unit (CRU). An assembly or part that a customer can replace in its entirety when any of its components fail. Contrast with *field replaceable unit (FRU)*.

cyclic redundancy check (CRC). (1) A redundancy check in which the check key is generated by a cyclic algorithm. (2) An error detection technique performed at both the sending and receiving stations.

dac. See *disk array controller*.

dar. See *disk array router*.

DASD. See *direct access storage device*.

data striping. See *striping*.

default host group. A logical collection of discovered host ports, defined host computers, and defined host groups in the storage-partition topology that fulfill the following requirements:

- Are not involved in specific logical drive-to-LUN mappings
- Share access to logical drives with default logical drive-to-LUN mappings

device type. Identifier used to place devices in the physical map, such as the switch, hub, or storage.

DHCP. See *Dynamic Host Configuration Protocol*.

direct access storage device (DASD). A device in which access time is effectively independent of the location of the data. Information is entered and retrieved without reference to previously accessed data. (For example, a disk drive is a DASD, in contrast with a tape drive, which stores data as a linear sequence.) DASDs include both fixed and removable storage devices.

direct memory access (DMA). The transfer of data between memory and an input/output (I/O) device without processor intervention.

disk array controller (dac). A disk array controller device that represents the two controllers of an array. See also *disk array router*.

disk array router (dar). A disk array router that represents an entire array, including current and deferred paths to all logical unit numbers (LUNs) (hdisks on AIX). See also *disk array controller*.

DMA. See *direct memory access*.

domain. The most significant byte in the node port (N_port) identifier for the fibre-channel (FC) device. It is not used in the fibre channel-small computer system interface (FC-SCSI) hardware path ID. It is required to be the same for all SCSI targets logically connected to an FC adapter.

DRAM. See *dynamic random access memory*.

Dynamic Host Configuration Protocol (DHCP). A protocol defined by the Internet Engineering Task Force that is used for dynamically assigning Internet Protocol (IP) addresses to computers in a network.

dynamic random access memory (DRAM). A storage in which the cells require repetitive application of control signals to retain stored data.

ECC. See *error correction coding*.

EEPROM. See *electrically erasable programmable read-only memory*.

EISA. See *Extended Industry Standard Architecture*.

electrically erasable programmable read-only memory (EEPROM). A type of memory chip which can retain its contents without consistent electrical power. Unlike the PROM which can be programmed only once, the EEPROM can be erased electrically. Because it can only be reprogrammed a limited number of times before it wears out, it is appropriate for storing small amounts of data that are changed infrequently.

electrostatic discharge (ESD). The flow of current that results when objects that have a static charge come into close enough proximity to discharge.

environmental service module (ESM) canister. A component in a storage expansion enclosure that monitors the environmental condition of the components in that enclosure. Not all storage subsystems have ESM canisters.

E_port. See *expansion port*.

error correction coding (ECC). A method for encoding data so that transmission errors can be detected and corrected by examining the data on the receiving end. Most ECCs are characterized by the maximum number of errors they can detect and correct.

ESD. See *electrostatic discharge*.

ESM canister. See *environmental service module canister*.

EXP. See *storage expansion enclosure*.

expansion port (E_port). A port that connects the switches for two fabrics.

Extended Industry Standard Architecture (EISA). A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to 32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

fabric. A Fibre Channel entity which interconnects and facilitates logins of N_ports attached to it. The fabric is responsible for routing frames between source and destination N_ports using address information in the frame header. A fabric can be as simple as a point-to-point channel between two N_ports, or as complex as a frame-routing switch that provides multiple and redundant internal pathways within the fabric between F_ports.

fabric port (F_port). In a fabric, an access point for connecting a user's N_port. An F_port facilitates N_port logins to the fabric from nodes connected to the fabric. An F_port is addressable by the N_port connected to it. See also *fabric*.

FAST MSJ. See *FAST Management Suite Java*.

FAST Management Suite Java (FAST MSJ). A diagnostic and configuration utility that can be used on Linux, Microsoft Windows, and Novell NetWare host systems. In Linux, it is also used with the QLRemote agent to define preferred and non-preferred paths for logical drives.

FC. See *fibre channel*.

FC-AL. See *arbitrated loop*.

feature enable identifier. A unique identifier for the storage subsystem, which is used in the process of generating a premium feature key. See also *premium feature key*.

fibre channel (FC). A set of standards for a serial input/output (I/O) bus capable of transferring data between two ports at up to 100 Mbps, with standards proposals to go to higher speeds. FC supports point-to-point, arbitrated loop, and switched topologies.

Fibre Channel-Arbitrated Loop (FC-AL). See *arbitrated loop*.

Fibre Channel Protocol (FCP) for small computer system interface (SCSI). A high-level fibre-channel mapping layer (FC-4) that uses lower-level fibre-channel (FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit might contain other field replaceable units. Contrast with *customer replaceable unit (CRU)*.

FlashCopy. A premium feature for DS4000 that can make an instantaneous copy of the data in a volume.

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

gigabit interface converter (GBIC). A transceiver that performs serial, optical-to-electrical, and electrical-to-optical signal conversions for high-speed networking. A GBIC can be hot swapped. See also *small form-factor pluggable*.

Global Copy. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode without the write consistency group option. This is also referred to as "Asynchronous Mirroring without Consistency Group." Global Copy does not ensure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives. If it is critical that writes to the primary logical drives are carried out in the same order in the appropriate secondary logical drives, Global Mirroring should be used instead of Global Copy. See also *asynchronous write mode*, *Global Mirroring*, *remote mirroring*, *Metro Mirroring*.

Global Mirroring. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode with the write consistency group option. This is also referred to as "Asynchronous Mirroring with Consistency Group." Global Mirroring ensures that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives, preventing data on the secondary logical drives from becoming inconsistent with the data on the primary logical drives. See also *asynchronous write mode*, *Global Copy*, *remote mirroring*, *Metro Mirroring*.

graphical user interface (GUI). A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons, and the object-action relationship.

GUI. See *graphical user interface*.

HBA. See *host bus adapter*.

hdisk. An AIX term representing a logical unit number (LUN) on an array.

host. A system that is directly attached to the storage subsystem through a fibre-channel input/output (I/O) path. This system is used to serve data (typically in the form of files) from the storage subsystem. A system can be both a storage management station and a host simultaneously.

host bus adapter (HBA). An interface between the fibre-channel network and a workstation or server.

host computer. See *host*.

host group. An entity in the storage partition topology that defines a logical collection of host computers that require shared access to one or more logical drives.

host port. Ports that physically reside on the host adapters and are automatically discovered by the DS4000 Storage Manager software. To give a host computer access to a partition, its associated host ports must be defined.

hot swap. To replace a hardware component without turning off the system.

hub. In a network, a point at which circuits are either connected or switched. For example, in a star network, the hub is the central node; in a star/ring network, it is the location of wiring concentrators.

IBMSAN driver. The device driver that is used in a Novell NetWare environment to provide multipath input/output (I/O) support to the storage controller.

IC. See *integrated circuit*.

IDE. See *integrated drive electronics*.

in-band. Transmission of management protocol over the fibre-channel transport.

Industry Standard Architecture (ISA). Unofficial name for the bus architecture of the IBM PC/XT personal computer. This bus design included expansion slots for plugging in various adapter boards. Early versions had an 8-bit data path, later expanded to 16 bits. The "Extended Industry Standard Architecture" (EISA) further expanded the data path to 32 bits. See also *Extended Industry Standard Architecture*.

initial program load (IPL). The initialization procedure that causes an operating system to commence operation. Also referred to as a system restart, system startup, and boot.

integrated circuit (IC). A microelectronic semiconductor device that consists of many interconnected transistors and other components. ICs are constructed on a small rectangle cut from a silicon crystal or other semiconductor material. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. Also known as a *chip*.

integrated drive electronics (IDE). A disk drive interface based on the 16-bit IBM personal computer Industry Standard Architecture (ISA) in which the controller electronics reside on the drive itself, eliminating the need for a separate adapter card. Also known as an Advanced Technology Attachment Interface (ATA).

Internet Protocol (IP). A protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network.

Internet Protocol (IP) address. The unique 32-bit address that specifies the location of each device or workstation on the Internet. For example, 9.67.97.103 is an IP address.

interrupt request (IRQ). A type of input found on many processors that causes the processor to suspend normal processing temporarily and start running an interrupt handler routine. Some processors have several interrupt request inputs that allow different priority interrupts.

IP. See *Internet Protocol*.

IPL. See *initial program load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

Java Runtime Environment (JRE). A subset of the Java Development Kit (JDK) for end users and developers who want to redistribute the Java Runtime Environment (JRE). The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

JRE. See *Java Runtime Environment*.

label. A discovered or user entered property value that is displayed underneath each device in the Physical and Data Path maps.

LAN. See *local area network*.

LBA. See *logical block address*.

local area network (LAN). A computer network located on a user's premises within a limited geographic area.

logical block address (LBA). The address of a logical block. Logical block addresses are typically used in hosts' I/O commands. The SCSI disk command protocol, for example, uses logical block addresses.

logical partition (LPAR). (1) A subset of a single system that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system. (2) A fixed-size portion of a logical volume. A logical

partition is the same size as the physical partitions in its volume group. Unless the logical volume of which it is a part is mirrored, each logical partition corresponds to, and its contents are stored on, a single physical partition. (3) One to three physical partitions (copies). The number of logical partitions within a logical volume is variable.

logical unit number (LUN). An identifier used on a small computer system interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

loop address. The unique ID of a node in fibre-channel loop topology sometimes referred to as a loop ID.

loop group. A collection of storage area network (SAN) devices that are interconnected serially in a single loop circuit.

loop port. A node port (N_port) or fabric port (F_port) that supports arbitrated loop functions associated with an arbitrated loop topology.

LPAR. See *logical partition*.

LUN. See *logical unit number*.

MAC. See *medium access control*.

management information base (MIB). The information that is on an agent. It is an abstraction of configuration and status information.

man pages. In UNIX-based operating systems, online documentation for operating system commands, subroutines, system calls, file formats, special files, stand-alone utilities, and miscellaneous facilities. Invoked by the **man** command.

MCA. See *micro channel architecture*.

media scan. A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all logical drive data to verify that it can be accessed, and optionally scans the logical drive redundancy information.

medium access control (MAC). In local area networks (LANs), the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. The MAC sublayer includes the method of determining when a device has access to the transmission medium.

Metro Mirroring. This term is used to refer to a remote logical drive mirror pair which is set up with synchronous write mode. See also *remote mirroring*, *Global Mirroring*.

MIB. See *management information base*.

micro channel architecture (MCA). Hardware that is used for PS/2 Model 50 computers and above to provide better growth potential and performance characteristics when compared with the original personal computer design.

Microsoft Cluster Server (MSCS). MSCS, a feature of Windows NT Server (Enterprise Edition), supports the connection of two servers into a cluster for higher availability and easier manageability. MSCS can automatically detect and recover from server or application failures. It can also be used to balance server workload and provide for planned maintenance.

mini hub. An interface card or port device that receives short-wave fiber channel GBICs or SFPs. These devices enable redundant fibre channel connections from the host computers, either directly or through a fibre channel switch or managed hub, over optical fiber cables to the DS4000 Storage Server controllers. Each DS4000 controller is responsible for two mini hubs. Each mini hub has two ports. Four host ports (two on each controller) provide a cluster solution without use of a switch. Two host-side mini hubs are shipped as standard. See also *host port*, *gigabit interface converter (GBIC)*, *small form-factor pluggable (SFP)*.

mirroring. A fault-tolerance technique in which information on a hard disk is duplicated on additional hard disks. See also *remote mirroring*.

model. The model identification that is assigned to a device by its manufacturer.

MSCS. See *Microsoft Cluster Server*.

network management station (NMS). In the Simple Network Management Protocol (SNMP), a station that runs management application programs that monitor and control network elements.

NMI. See *non-maskable interrupt*.

NMS. See *network management station*.

non-maskable interrupt (NMI). A hardware interrupt that another service request cannot overrule (mask). An NMI bypasses and takes priority over interrupt requests generated by software, the keyboard, and other such devices and is issued to the microprocessor only in disastrous circumstances, such as severe memory errors or impending power failures.

node. A physical device that allows for the transmission of data within a network.

node port (N_port). A fibre-channel defined hardware entity that performs data communications over the fibre-channel link. It is identifiable by a unique worldwide name. It can act as an originator or a responder.

nonvolatile storage (NVS). A storage device whose contents are not lost when power is cut off.

N_port. See *node port*.

NVS. See *nonvolatile storage*.

NVSRAM. Nonvolatile storage random access memory. See *nonvolatile storage*.

Object Data Manager (ODM). An AIX proprietary storage mechanism for ASCII stanza files that are edited as part of configuring a drive into the kernel.

ODM. See *Object Data Manager*.

out-of-band. Transmission of management protocols outside of the fibre-channel network, typically over Ethernet.

partitioning. See *storage partition*.

parity check. (1) A test to determine whether the number of ones (or zeros) in an array of binary digits is odd or even. (2) A mathematical operation on the numerical representation of the information communicated between two pieces. For example, if parity is odd, any character represented by an even number has a bit added to it, making it odd, and an information receiver checks that each unit of information has an odd value.

PCI local bus. See *peripheral component interconnect local bus*.

PDF. See *portable document format*.

performance events. Events related to thresholds set on storage area network (SAN) performance.

peripheral component interconnect local bus (PCI local bus). A local bus for PCs, from Intel, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture*, *Extended Industry Standard Architecture*.

polling delay. The time in seconds between successive discovery processes during which discovery is inactive.

port. A part of the system unit or remote controller to which cables for external devices (such as display stations, terminals, printers, switches, or external storage units) are attached. The port is an access point for data entry or exit. A device can contain one or more ports.

portable document format (PDF). A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by e-mail, the Web, intranets, or CD-ROM; and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

premium feature key. A file that the storage subsystem controller uses to enable an authorized premium feature. The file contains the feature enable identifier of the storage subsystem for which the premium feature is authorized, and data about the premium feature. See also *feature enable identifier*.

private loop. A freestanding arbitrated loop with no fabric attachment. See also *arbitrated loop*.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

PTF. See *program temporary fix*.

RAID. See *redundant array of independent disks (RAID)*.

RAID level. An array's RAID level is a number that refers to the method used to achieve redundancy and fault tolerance in the array. See also *array*, *redundant array of independent disks (RAID)*.

RAID set. See *array*.

RAM. See *random-access memory*.

random-access memory (RAM). A temporary storage location in which the central processing unit (CPU) stores and executes its processes. Contrast with *DASD*.

RDAC. See *redundant disk array controller*.

read-only memory (ROM). Memory in which stored data cannot be changed by the user except under special conditions.

recoverable virtual shared disk (RVSD). A virtual shared disk on a server node configured to provide continuous access to data and file systems in a cluster.

redundant array of independent disks (RAID). A collection of disk drives (*array*) that appears as a single volume to the server, which is fault tolerant through an assigned method of data striping, mirroring, or parity checking. Each array is assigned a RAID level, which is a specific number that refers to the method used to achieve redundancy and fault tolerance. See also *array*, *parity check*, *mirroring*, *RAID level*, *striping*.

redundant disk array controller (RDAC). (1) In hardware, a redundant set of controllers (either active/passive or active/active). (2) In software, a layer that manages the input/output (I/O) through the active

controller during normal operation and transparently reroutes I/Os to the other controller in the redundant set if a controller or I/O path fails.

remote mirroring. Online, real-time replication of data between storage subsystems that are maintained on separate media. The Enhanced Remote Mirror Option is a DS4000 premium feature that provides support for remote mirroring. See also *Global Mirroring*, *Metro Mirroring*.

ROM. See *read-only memory*.

router. A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses.

RVSD. See *recoverable virtual shared disk*.

SAI. See *Storage Array Identifier*.

SA Identifier. See *Storage Array Identifier*.

SAN. See *storage area network*.

SATA. See *serial ATA*.

scope. Defines a group of controllers by their Internet Protocol (IP) addresses. A scope must be created and defined so that dynamic IP addresses can be assigned to controllers on the network.

SCSI. See *small computer system interface*.

segmented loop port (SL_port). A port that allows division of a fibre-channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

sense data. (1) Data sent with a negative response, indicating the reason for the response. (2) Data describing an I/O error. Sense data is presented to a host system in response to a sense request command.

serial ATA. The standard for a high-speed alternative to small computer system interface (SCSI) hard drives. The SATA-1 standard is equivalent in performance to a 10 000 RPM SCSI drive.

serial storage architecture (SSA). An interface specification from IBM in which devices are arranged in a ring topology. SSA, which is compatible with small computer system interface (SCSI) devices, allows full-duplex packet multiplexed serial data transfers at rates of 20 Mbps in each direction.

server. A functional hardware and software unit that delivers shared resources to workstation client units on a computer network.

server/device events. Events that occur on the server or a designated device that meet criteria that the user sets.

SFP. See *small form-factor pluggable*.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SL_port. See *segmented loop port*.

SMagent. The DS4000 Storage Manager optional Java-based host-agent software, which can be used on Microsoft Windows, Novell NetWare, HP-UX, and Solaris host systems to manage storage subsystems through the host fibre-channel connection.

SMclient. The DS4000 Storage Manager client software, which is a Java-based graphical user interface (GUI) that is used to configure, manage, and troubleshoot storage servers and storage expansion enclosures in a DS4000 storage subsystem. SMclient can be used on a host system or on a storage management station.

SMruntime. A Java compiler for the SMclient.

SMutil. The DS4000 Storage Manager utility software that is used on Microsoft Windows, HP-UX, and Solaris host systems to register and map new logical drives to the operating system. In Microsoft Windows, it also contains a utility to flush the cached data of the operating system for a particular drive before creating a FlashCopy.

small computer system interface (SCSI). A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

small form-factor pluggable (SFP). An optical transceiver that is used to convert signals between optical fiber cables and switches. An SFP is smaller than a gigabit interface converter (GBIC). See also *gigabit interface converter*.

SNMP. See *Simple Network Management Protocol* and *SNMPv1*.

SNMP trap event. (1) (2) An event notification sent by the SNMP agent that identifies conditions, such as thresholds, that exceed a predetermined value. See also *Simple Network Management Protocol*.

SNMPv1. The original standard for SNMP is now referred to as SNMPv1, as opposed to SNMPv2, a revision of SNMP. See also *Simple Network Management Protocol*.

SRAM. See *static random access memory*.

SSA. See *serial storage architecture*.

static random access memory (SRAM). Random access memory based on the logic circuit known as flip-flop. It is called static because it retains a value as long as power is supplied, unlike dynamic random access memory (DRAM), which must be regularly refreshed. It is however, still volatile, meaning that it can lose its contents when the power is turned off.

storage area network (SAN). A dedicated storage network tailored to a specific environment, combining servers, storage products, networking products, software, and services. See also *fabric*.

Storage Array Identifier (SAI or SA Identifier). The Storage Array Identifier is the identification value used by the DS4000 Storage Manager host software (SMClient) to uniquely identify each managed storage server. The DS4000 Storage Manager SMClient program maintains Storage Array Identifier records of previously-discovered storage servers in the host resident file, which allows it to retain discovery information in a persistent fashion.

storage expansion enclosure (EXP). A feature that can be connected to a system unit to provide additional storage and processing capacity.

storage management station. A system that is used to manage the storage subsystem. A storage management station does not need to be attached to the storage subsystem through the fibre-channel input/output (I/O) path.

storage partition. Storage subsystem logical drives that are visible to a host computer or are shared among host computers that are part of a host group.

storage partition topology. In the DS4000 Storage Manager client, the Topology view of the Mappings window displays the default host group, the defined host group, the host computer, and host-port nodes. The host port, host computer, and host group topological elements must be defined to grant access to host computers and host groups using logical drive-to-LUN mappings.

striping. Splitting data to be written into equal blocks and writing blocks simultaneously to separate disk drives. Striping maximizes performance to the disks. Reading the data back is also scheduled in parallel, with a block being read concurrently from each disk then reassembled at the host.

subnet. An interconnected but independent segment of a network that is identified by its Internet Protocol (IP) address.

sweep method. A method of sending Simple Network Management Protocol (SNMP) requests for information to all the devices on a subnet by sending the request to every device in the network.

switch. A fibre-channel device that provides full bandwidth per port and high-speed routing of data by using link-level addressing.

switch group. A switch and the collection of devices connected to it that are not in other groups.

switch zoning. See *zoning*.

synchronous write mode. In remote mirroring, an option that requires the primary controller to wait for the acknowledgment of a write operation from the secondary controller before returning a write I/O request completion to the host. See also *asynchronous write mode*, *remote mirroring*, *Metro Mirroring*.

system name. Device name assigned by the vendor's third-party software.

TCP. See *Transmission Control Protocol*.

TCP/IP. See *Transmission Control Protocol/Internet Protocol*.

terminate and stay resident program (TSR program). A program that installs part of itself as an extension of DOS when it is executed.

topology. The physical or logical arrangement of devices on a network. The three fibre-channel topologies are fabric, arbitrated loop, and point-to-point. The default topology for the disk array is arbitrated loop.

TL_port. See *translated loop port*.

transceiver. A device that is used to transmit and receive data. Transceiver is an abbreviation of transmitter-receiver.

translated loop port (TL_port). A port that connects to a private loop and allows connectivity between the private loop devices and off loop devices (devices not connected to that particular TL_port).

Transmission Control Protocol (TCP). A communication protocol used in the Internet and in any network that follows the Internet Engineering Task Force (IETF) standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packet-switched communication networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP). A set of communication protocols that provide peer-to-peer connectivity functions for both local and wide-area networks.

trap. In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition.

trap recipient. Receiver of a forwarded Simple Network Management Protocol (SNMP) trap. Specifically, a trap receiver is defined by an Internet Protocol (IP) address and port to which traps are sent. Presumably, the actual recipient is a software application running at the IP address and listening to the port.

TSR program. See *terminate and stay resident program*.

uninterruptible power supply. A source of power from a battery that is installed between a computer system and its power source. The uninterruptible power supply keeps the system running if a commercial power failure occurs, until an orderly shutdown of the system can be performed.

user action events. Actions that the user takes, such as changes in the storage area network (SAN), changed settings, and so on.

worldwide port name (WWPN). A unique identifier for a switch on local and global networks.

worldwide name (WWN). A globally unique 64-bit identifier assigned to each Fibre Channel port.

WORM. See *write-once read-many*.

write-once read many (WORM). Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered.

WWN. See *worldwide name*.

zoning. (1) In Fibre Channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones. (2) A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

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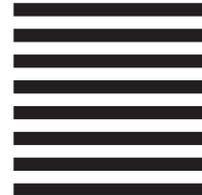
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