

IBM TotalStorage DS4500
Fibre Channel Storage Server



User's Guide

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Fibre Channel Storage Server



User's Guide

Note

Before using this information and the product it supports, be sure to read the general information under "Notices" on page 69.

First Edition (January 2005)

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Contents

Figures	vii
Tables	ix
Safety	xi
About this document	xvii
FAST product renaming	xvii
Who should read this document	xviii
DS4000 installation process overview	xviii
DS4000 Storage Server publications	xviii
DS4500 storage server library	xix
DS4400 storage server library	xx
DS4300 storage server library	xxi
DS4100 storage server library	xxii
DS4000 Storage Manager Version 9 publications	xxiii
Other DS4000 and DS4000-related documents	xxiv
How this document is organized	xxv
Notices and statements in this document	xxvi
Getting information, help, and service	xxvi
Before you call	xxvi
Using the documentation	xxvii
Web sites	xxvii
Software service and support	xxvii
Hardware service and support	xxviii
Fire suppression systems	xxviii
How to send your comments	xxviii
Chapter 1. Introduction	1
DS4500 Storage Server overview	1
Product updates	1
Front view	2
Back view	3
Fibre Channel connections	4
Handling fiber-optic cables	5
Using LC-LC Fibre Channel cables	5
Connecting an LC-LC Fibre Channel cable to an SFP module	6
Removing an LC-LC Fibre Channel cable from an SFP module	8
Using LC-SC Fibre Channel cable adapters	9
Connecting an LC-SC cable to a device	10
Removing an LC-LC cable from an LC-SC cable adapter	11
Types of interface ports	12
Host interface ports	13
Drive interface ports	13
Intermixing storage expansion enclosure models	14
Ethernet interface ports	17
Chapter 2. Operating the DS4500 Storage Server	19
Best practices guidelines	19
Tasks overview	19
Removing and replacing the front bezel to access the DS4000 Storage Server components	20
Turning on the power	22

Turning off the power	23
Monitoring status through software	25
Firmware updates	25
Checking the indicator lights	26
Storage server indicator lights	26
RAID controller indicator lights	28
Battery indicator lights	30
Fan and communications module indicator light	31
Power supply indicator light	32
Mini-hub indicator lights.	32
Overtemperature condition and power supply shutdown	37
Turning on the power after an overtemperature shutdown	38
Turning on the power after an emergency shutdown	38
Checking the battery service date	38
Preparing to move the DS4500 Storage Server	39
Moving or relocating the DS4500 Storage Server	40
Chapter 3. Replacing the DS4500 Storage Server components	43
Handling static-sensitive devices	43
DS4500 Storage Server controller	43
Servicing notes	44
Replacing a failed controller	45
Battery	46
Servicing notes	46
Replacing a failed battery	47
Storage server fan	50
Servicing notes	51
Replacing a failed storage server fan.	52
Fan and communications module	53
Servicing notes	54
Replacing a failed fan and communications module	54
Power supply	56
Servicing notes	56
Replacing a failed power supply	57
Small Form-Factor Pluggable (SFP) modules.	59
Servicing notes	59
Replacing a failed SFP module	60
Mini hubs	63
Servicing notes	63
Replacing a failed mini hub	64
Appendix. Accessibility	67
Notices	69
Trademarks	69
Important notes.	70
Electronic emission notices	71
Federal Communications Commission (FCC) statement	71
Industry Canada Class A emission compliance statement	72
Australia and New Zealand Class A statement	72
United Kingdom telecommunications safety requirement.	72
European Union EMC Directive conformance statement.	72
Taiwan electrical emission statement	72
Japanese Voluntary Control Council for Interference (VCCI) statement	73
Power cords	73

Glossary	75
Index	85

Figures

1. Installation process flow by current publications	xviii
2. IBM TotalStorage DS4500 Fibre Channel Storage Server front bezel	3
3. IBM TotalStorage DS4500 Fibre Channel Storage Server front view	3
4. IBM TotalStorage DS4500 Fibre Channel Storage Server - back view	4
5. Fibre Channel interface connections	4
6. LC-LC Fibre Channel cable	6
7. Removing the fiber-optic cable protective caps	7
8. Inserting an LC-LC Fibre Channel cable into an SFP module	7
9. Inserting an LC-LC Fibre Channel cable into an installed SFP module.	8
10. LC-LC Fibre Channel Cable lever and latches	9
11. Removing the LC-LC Fibre Channel cable	9
12. LC-SC Fibre Channel cable	10
13. Removing the LC-SC cable adapter protective caps	11
14. LC-LC cable connected into the LC-SC cable adapter	11
15. LC-LS Fibre Channel cable lever and latches	12
16. Removing the LC-LC Fibre Channel cable from an LC-SC Fibre Channel cable adapter.	12
17. DS4500 Storage Server interface ports.	13
18. Host-side mini-hub interface ports	13
19. Drive-side mini-hub interface ports	14
20. Ethernet interface ports	18
21. Removing the DS4500 Storage Server bezel	21
22. Replacing the DS4500 Storage Server bezel	22
23. Connecting the power cords and power switch locations	23
24. Storage server indicator lights	27
25. RAID controller indicator lights	29
26. Battery indicator lights	30
27. Fan and communications module indicator light	31
28. Power supply indicator light	32
29. Mini-hub indicator lights	32
30. Fan and communications and power supply fault indicators	37
31. Storage server fan indicator.	37
32. Checking the battery service date.	39
33. Controller status indicator lights	44
34. Removing and replacing a failed controller CRU	45
35. Indicator lights on the DS4500 Storage Server bezel.	46
36. Removing and installing a battery.	48
37. Recording the battery support information.	49
38. Battery CRU indicator lights	50
39. DS4500 Storage Server airflow	51
40. Removing and installing the storage server fan.	52
41. Storage server indicator lights	53
42. Fan and communications module ports and indicator light	55
43. Removing and installing a fan and communications module	55
44. Power supply switch, ac power connectors, and indicator lights.	57
45. Removing and installing a power supply CRU	59
46. Replacing a failed SFP module	61
47. Unlocking the SFP module latch - plastic variety	61
48. Unlocking the SFP module latch - wire variety	62
49. Small Form-Factor Pluggable (SFP) Module	62
50. Installing an SFP module in a mini hub.	63
51. Removing the fiber-optic cable from the SFP module	64
52. Removing and installing a mini hub	65

Tables

1. Mapping of FAST names to DS4000 Series names.	xvii
2. TotalStorage DS4500 Fibre Channel Storage Server document titles by user tasks	xix
3. TotalStorage DS4400 Fibre Channel Storage Server document titles by user tasks	xx
4. TotalStorage DS4300 Fibre Channel Storage Server document titles by user tasks	xxi
5. TotalStorage DS4100 SATA Storage Server document titles by user tasks	xxii
6. TotalStorage DS4000 Storage Manager Version 9 titles by user tasks	xxiii
7. TotalStorage DS4000 and DS4000–related document titles by user tasks	xxiv
8. Possible combinations of FAST EXP500 and DS4000 EXP700 storage expansion enclosures per drive loop	15
9. Tasks overview	20
10. Storage server indicator lights	28
11. RAID controller indicator lights	30
12. Battery indicator lights	31
13. Fan and communications module indicator light	31
14. Power supply indicator light	32
15. Host-side and drive-side mini-hub indicator lights	33
16. DS4000 Storage Manager alternate keyboard operations	67

Safety

Before installing this product, read the Safety Information.

مج، يجب قراءة دات السلامة

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

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

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtete příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

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

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

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

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

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

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

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

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

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

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

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

Перед установкой продукта прочтите инструкции по технике безопасности.

Pred inštaláciou tohto zariadenia si 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 Danger notices and Caution notices are printed in English throughout this document. For translations of these notices, see *IBM® Safety Information*.

Statement 1:



DANGER

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

To avoid a shock hazard:

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

To Connect:	To Disconnect:
<ol style="list-style-type: none">1. Turn everything OFF.2. First, attach all cables to devices.3. Attach signal cables to connectors.4. Attach power cords to outlet.5. Turn device ON.	<ol style="list-style-type: none">1. Turn everything OFF.2. First, remove power cords from outlet.3. Remove signal cables from connectors.4. Remove all cables from devices.

Statement 2:



CAUTION:

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

Do not:

- Throw or immerse into water
- Heat to more than 100°C (212°F)
- Repair or disassemble

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

Statement 3:



CAUTION:

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

- Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.
- Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.



DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

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

Class 1 Laser Statement

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

GS000002

Statement 4:



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

CAUTION:

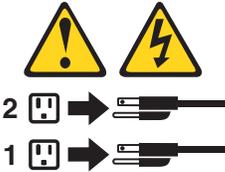
Use safe practices when lifting.

Statement 5:



CAUTION:

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



Statement 8:



CAUTION:

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



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

About this document

This document provides an overview of the IBM TotalStorage® DS4500 Fibre Channel Storage Server, hereafter referred to as the DS4500 Storage Server, and contains information about routine operations and replacement procedures for all customer replaceable units (CRUs).

Before you use this document, install the hardware and software. For more information, refer to the *IBM TotalStorage DS4500 Fibre Channel Storage Server Installation and Support Guide* and the IBM DS4000 Storage Manager installation guide appropriate for your operating system.

FAST product renaming

IBM is in the process of renaming some FAST family products. Table 1 identifies each new DS4000 product name with its corresponding 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

Current FAST Product Name	New 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 user's guide is intended for system operators and service technicians who have extensive knowledge of Fibre Channel, network technology, computer-system operation, maintenance, and repair. Use this guide to:

- Become familiar with the components of the DS4500 Storage Server
- Learn how to operate the DS4500 Storage Server
- Learn how to replace failed components in the DS4500 Storage Server

DS4000 installation process overview

The following flow chart gives an overview of the DS4000 hardware and the DS4000 Storage Manager software installation process. Lined arrows in the flow chart indicate consecutive steps in the hardware and software installation process. Labeled arrows indicate which current documents provide detailed information about those steps.

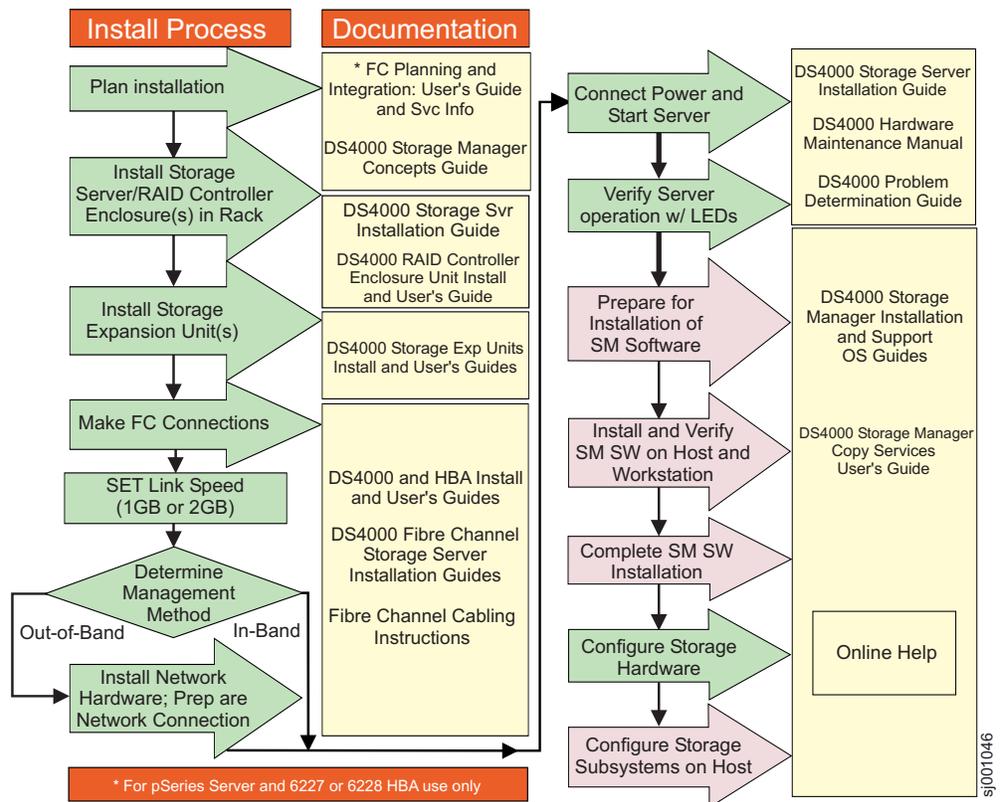


Figure 1. Installation process flow by current publications

DS4000 Storage Server publications

The following tables present an overview of the DS4500, DS4400, DS4300 Fibre Channel, and DS4100 SATA Storage Server product libraries, as well as other related documents. Each table lists documents that are included in the libraries and what common tasks they address.

You can access the documents listed in these tables at one of the following Web sites:

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

www.ibm.com/shop/publications/order/

DS4500 storage server library

Table 2 associates each document in the DS4500 (previously FAStT900) storage server library with its related common user tasks.

Table 2. TotalStorage DS4500 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4500 Installation and Support Guide, GC26-7727</i>	✓	✓		✓		
<i>IBM TotalStorage DS4500 Fibre Channel Cabling Instructions, GC26-7729</i>	✓	✓				
<i>IBM TotalStorage DS4500 Storage Server User's Guide, GC26-7726</i>				✓	✓	✓
<i>IBM TotalStorage DS4500 Rack Mounting Instructions, GC26-7728</i>	✓	✓				

DS4400 storage server library

Table 3 associates each document in the DS4400 (previously FAStT700) storage server library with its related common user tasks.

Table 3. TotalStorage DS4400 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM DS4400 Fibre Channel Storage Server User's Guide, GC26-7730</i>	✓	✓		✓	✓	✓
<i>IBM DS4400 Fibre Channel Storage Server Installation and Support Guide, GC26-7731</i>	✓	✓		✓	✓	
<i>IBM DS4400 Fibre Channel Cabling Instructions, GC26-7732</i>	✓	✓				

DS4300 storage server library

Table 4 associates each document in the DS4300 (previously FAStT600) storage server library with its related common user tasks.

Table 4. TotalStorage DS4300 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4300 Fibre Channel Storage Server Installation and User's Guide, GC26-7722</i>	✓	✓		✓		
<i>IBM TotalStorage DS4300 Rack Mounting Instructions, GC26-7724</i>	✓	✓				
<i>IBM TotalStorage DS4300 Fibre Channel Cabling Instructions, GC26-7725</i>	✓	✓				
<i>IBM TotalStorage DS4300 SCU Base Upgrade Kit, GC26-7740</i>		✓	✓			
<i>IBM TotalStorage DS4300 SCU Turbo Upgrade Kit, GC26-7741</i>		✓	✓			
<i>IBM TotalStorage DS4300 Turbo Models 6LU/6LX Upgrade Kit, GC26-7723</i>		✓	✓			

DS4100 storage server library

Table 5 associates each document in the DS4100 (previously FAStT100) storage server library with its related common user tasks.

Table 5. TotalStorage DS4100 SATA Storage Server document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4100 Installation, User's and Maintenance Guide, GC26-7733</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4100 Cabling Guide, 24P8973</i>		✓				

DS4000 Storage Manager Version 9 publications

Table 6 associates each document in the DS4000 Storage Manager (previously FAST Storage Manager) library with its related common user tasks.

Table 6. TotalStorage DS4000 Storage Manager Version 9 titles by user tasks

Title	User tasks					
	Planning	Hardware installation	Software installation	Configuration	Operation and administration	Diagnosis and maintenance
<i>IBM TotalStorage DS4000 Storage Manager Version 9 Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux, GC26-7706</i>	✓		✓	✓		
<i>IBM TotalStorage DS4000 Storage Manager Version 9 Installation and Support Guide for AIX, UNIX, Solaris and Linux on POWER, GC26-7705</i>	✓		✓	✓		
<i>IBM TotalStorage DS4000 Storage Manager Version 9 Copy Services User's Guide, GC26-7707</i>	✓		✓	✓	✓	
<i>IBM TotalStorage DS4000 Storage Manager Version 9 Concepts Guide, GC26-7734</i>	✓	✓	✓	✓	✓	✓

Other DS4000 and DS4000-related documents

Table 7 associates each of the following documents with its related common user tasks.

Table 7. TotalStorage DS4000 and DS4000–related document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM Safety Information, P48P9741</i>					✓	
<i>IBM TotalStorage DS4000 Quick Start Guide, GC26-7738</i>	✓	✓				
<i>IBM TotalStorage DS4000 Hardware Maintenance Manual,GC26-7702</i>						✓
<i>IBM TotalStorage DS4000 Problem Determination Guide, GC26-7703</i>						✓
<i>IBM Fibre Channel Planning and Integration: User's Guide and Service Information, SC23-4329</i>	✓	✓			✓	✓
<i>IBM TotalStorage DS4000 FC2-133 Host Bus Adapter Installation and User's Guide, GC26-7736</i>		✓			✓	
<i>IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7737</i>		✓			✓	
<i>IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview GC26-7713</i>	✓	✓	✓	✓		
<i>Fibre Channel Solutions - IBM DS4000 EXP500 Installation and User's Guide, 59p5637</i>	✓	✓		✓	✓	✓

Table 7. TotalStorage DS4000 and DS4000–related document titles by user tasks (continued)

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
<i>IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide, GC26-7735</i>	✓	✓		✓	✓	✓
<i>IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosures Installation and Migration Guide, GC26-7704</i>	✓	✓				
<i>IBM DS4000 Management Suite Java User's Guide, 32P0081</i>					✓	✓
<i>IBM Netfinity® Fibre Channel Cabling Instructions, 19K0906</i>		✓				
<i>IBM Fibre Channel SAN Configuration Setup Guide, 25P2509</i>	✓		✓	✓	✓	

How this document is organized

Chapter 1, “Introduction,” on page 1 introduces the DS4500 Storage Server and its primary components.

Chapter 2, “Operating the DS4500 Storage Server,” on page 19 describes the tasks required to operate the DS4500 Storage Server.

Chapter 3, “Replacing the DS4500 Storage Server components,” on page 43 describes how to service and replace components of the DS4500 Storage Server.

“Accessibility,” on page 67 provides information about DS4000 Storage Manager accessibility features.

“Notices” on page 69 provides product notices.

Notices and statements in this document

The caution and danger statements that this document uses also appear in the multilingual *Safety Information* document provided with your DS4500 Storage Server. Each caution and danger statement is numbered for easy reference to the corresponding statements in the safety document.

This document uses the following types of notices and statements:

- **Note:** These notices provide important tips, guidance, or advice.
- **Important:** These notices provide information or advice that might help you avoid inconvenient or problem situations.
- **Attention:** These notices indicate 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.

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 site:
www.ibm.com/servers/storage/support/disk/
- 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 on how to use 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.ibm.com/servers/storage/support/disk/
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 the following web site:
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 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-132.ibm.com/content/home/store_IBMPublicUSA/en_US/IntelliStation_workstations.html
- 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

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.

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Chapter 1. Introduction

The IBM TotalStorage DS4500 Fibre Channel Storage Server (referred to throughout this book as the DS4500 Storage Server) is a high-performance unit that provides dual, redundant array of independent disks (RAID) controllers and Fibre Channel interfaces to both the host and drive channels.

DS4500 Storage Server overview

The DS4500 Storage Server (Machine type 1742, models 90U and 90X) supports direct attachment of up to four hosts that contain two host adapters each, and is designed to provide maximum host-side and drive-side redundancy. By using external Fibre Channel switches in conjunction with the DS4500 Storage Server, you can attach up to 64 hosts with two adapters each to a DS4500 Storage Server.

Each DS4500 Storage Server contains several removable components, called *customer replaceable units (CRUs)*, that you can access from either the front or back of the unit. These CRUs include the battery, RAID controllers, storage server fan, power supplies, fan and communications module, mini hubs, and Small Form-Factor Pluggable (SFP) modules. The DS4500 Storage Server also has a removable front bezel.

The DS4500 Storage Server functions with at least one external storage expansion enclosure containing Fibre Channel or SATA hard drives. The DS4500 Storage Server supports a maximum of 224 hard drives when the drives are configured using IBM DS4000 EXP700, DS4000 EXP710, or DS4000 EXP100 storage expansion enclosures. If the drives are configured using IBM FASTT EXP500 storage expansion enclosures only, a maximum of 220 hard drives are supported.

Attention:

- In order to attach DS4000 EXP100 or EXP710 storage expansion enclosures to a DS4500 Storage Server, the DS4500 Storage Server controller firmware must be at version 06.xx.xx.xx or higher. In addition, you must purchase the FC/SATA Enclosure Intermix premium option to combine EXP100s with EXP700s or EXP710s in the same DS4500 Storage Server configuration.
- The DS4500 controller units are not compatible with the DS4400 or FASTT500 controller units. The DS4500 controller units are keyed to prevent them from being mistakenly inserted in the non-supported storage server units. Do not force fit the controller units or the backplane might be damaged.

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 version of the DS4000 Storage Manager host software and the any appropriate DS4000 product series 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.ibm.com/support/us/

Go to the **Personalized Support** section of the web page and 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**. Using the pull downs in the **Products** area, select **Storage** → **Computer Storage** → **Disk Storage Systems** → **TotalStorage DS4000 Midrange Disk Systems & FASTT Stor Svrs**.
3. 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. Select **Add products**. The **My support** page reopens.
4. Select **Subscribe to email**. In the **Documents** area on the next page, use the pull down and select **Storage**.
5. On the next page, place a check in the following boxes:
 - a. **Please send these documents by weekly email**
 - b. **Downloads and drivers**
 - c. **Flashes**

and any others you may be interested in, and then click **Update**.

Front view

Figure 2 on page 3 shows the bezel. The bezel is a removable front cover with holes for viewing the status lights and for boosting air circulation.

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

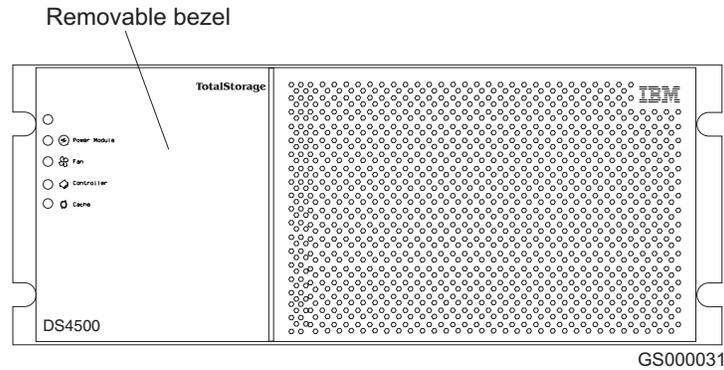


Figure 2. IBM TotalStorage DS4500 Fibre Channel Storage Server front bezel

Figure 3 shows the following components on the DS4500 Storage Server without the front bezel:

- **Storage server fan** - A removable unit that contains two cooling fans and indicator lights
- **Battery** - A removable unit that contains the cache battery for the controllers, battery charger circuitry, and status indicator lights
- **Controllers** - Two removable units that each contain one RAID controller with 1 Gb cache memory and status indicator lights

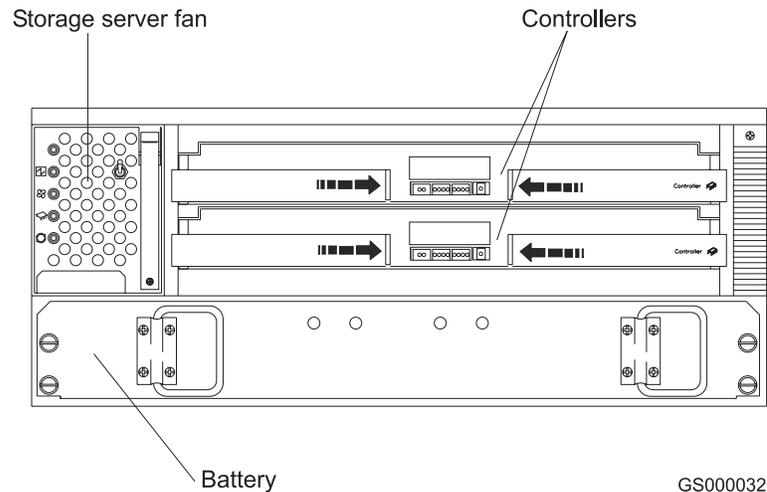


Figure 3. IBM TotalStorage DS4500 Fibre Channel Storage Server front view

Back view

Figure 4 on page 4 shows the DS4500 Storage Server back view and the following components:

- **Host-side and drive-side mini hubs** - Up to eight removable mini hubs with indicator lights. You can insert SFP modules into the mini hubs and connect fiber-optic host and drive interface cables to the DS4000 Storage Server. (The standard DS4500 configuration includes two host and two drive mini hubs.)
- **Power supplies** - Two removable units that each contain a power supply and an indicator light.

- **Fan and communications module** - A removable unit that contains the power supply cooling fans, an indicator light, and Ethernet ports.

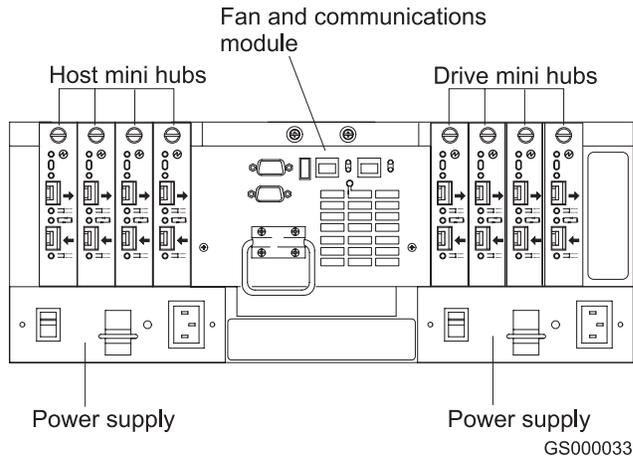


Figure 4. IBM TotalStorage DS4500 Fibre Channel Storage Server - back view

Fibre Channel connections

When fully configured, the back of the DS4500 Storage Server can accommodate up to four host-side and four drive-side mini hubs. Each mini hub is a single, removable unit that provides the Fibre Channel interface between a DS4500 Storage Server, host computers, and drives. Each mini hub has two SFP module ports. An SFP module is inserted into a mini-hub port. Figure 5 shows the Fibre Channel components.

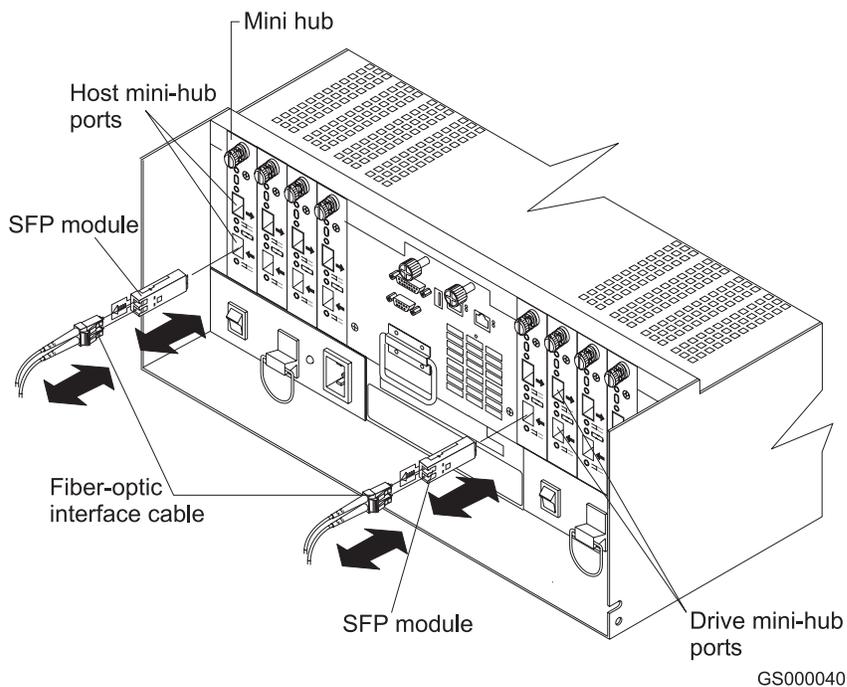


Figure 5. Fibre Channel interface connections

The DS4500 Storage Server uses fiber-optic cables to connect to other Fibre Channel devices. The fiber-optic cables that you need depend on the type of optical connectors in the device to which you are connecting the DS4500 Storage Server. If the device uses SFP modules or optical interface connectors, then you must use LC-LC Fibre Channel cables. If the device uses Gigabit Interface Converters (GBICs) as the optical interface connector, you must use LC-LC Fibre Channel cables and LC-SC Fibre Channel cable adapters (Part number 19K1250) to connect to the DS4500 Storage Server.

Handling fiber-optic cables

Before you use fiber-optic cables, read the following precautions.

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

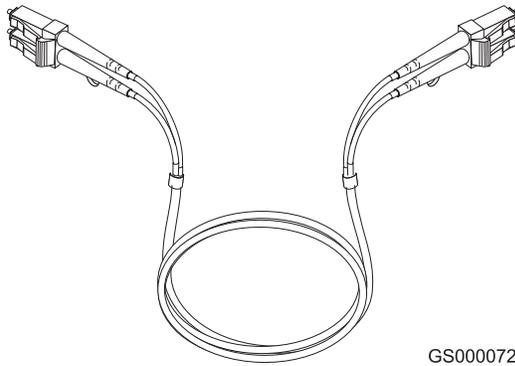
- Do not route the cable along a folding cable-management arm.
- When attaching to a device on slide rails, leave enough slack in the cable so that it does not bend to a radius of less than 38 mm (1.5 in.) when extended or become pinched when retracted.
- Route the cable away from places where it can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

Using LC-LC Fibre Channel cables

The LC-LC Fibre Channel cable is a fiber-optic cable that is used to connect into one of the following devices:

- SFP module installed in a DS4500 Storage Server mini hub
- SFP module installed in an IBM Fibre Channel switch
- SFP module installed in an IBM DS4000 EXP700 or DS4000 EXP710 storage expansion enclosure
- SFP module installed in an IBM DS4000 EXP100 storage expansion enclosure
- Optical interface connector on an IBM DS4000 FC-2 Host Bus Adapter (part number 19K1246), IBM DS4000 single port FC2-133 Host Bus Adapter (part number 24P0960), or dual port FC2-133 Host Bus Adapter (part number 24P8053)

Figure 6 on page 6 shows an LC-LC Fibre Channel cable.



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Figure 6. LC-LC Fibre Channel cable

The following sections provide the procedures for properly connecting and removing an LC-LC Fibre Channel cable.

Note: If you are connecting a DS4500 Storage Server to a FASiT EXP500 storage expansion enclosure or to an IBM DS4000 host adapter, you must also use a Fibre Channel cable adapter. For more information about how to use the LC-SC Fibre Channel cable adapter, see “Using LC-SC Fibre Channel cable adapters” on page 9.

Connecting an LC-LC Fibre Channel cable to an SFP module

To connect an LC-LC Fibre Channel cable to 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 precautions:

- 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 precautions. 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 5.

2. If necessary, remove the protective cap from the SFP module, as shown in Figure 49 on page 62. 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 7. Save the protective caps for future use.

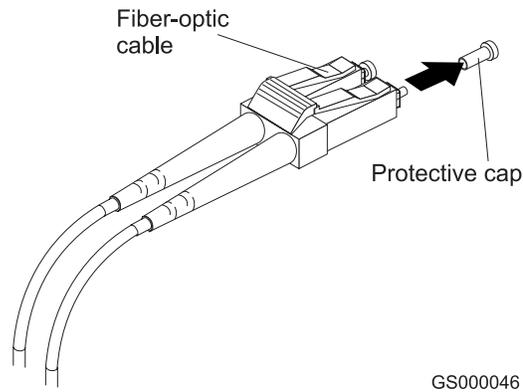


Figure 7. Removing the fiber-optic cable protective caps

4. Carefully insert that same end of the LC-LC cable into an SFP module that is installed in a DS4500 Storage Server mini hub. The cable connector is keyed to ensure it is inserted into the SFP module correctly. While you hold the connector, push in the connector until it clicks into place.

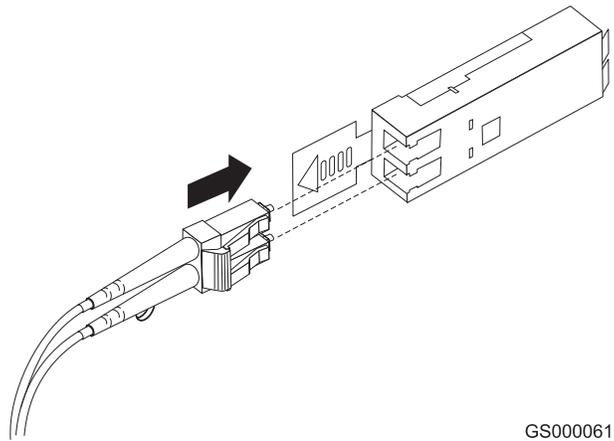


Figure 8. Inserting an LC-LC Fibre Channel cable into an SFP module

Figure 9 shows an LC-LC Fibre Channel cable that connects into an SFP module that is installed in a DS4500 Storage Server mini hub.

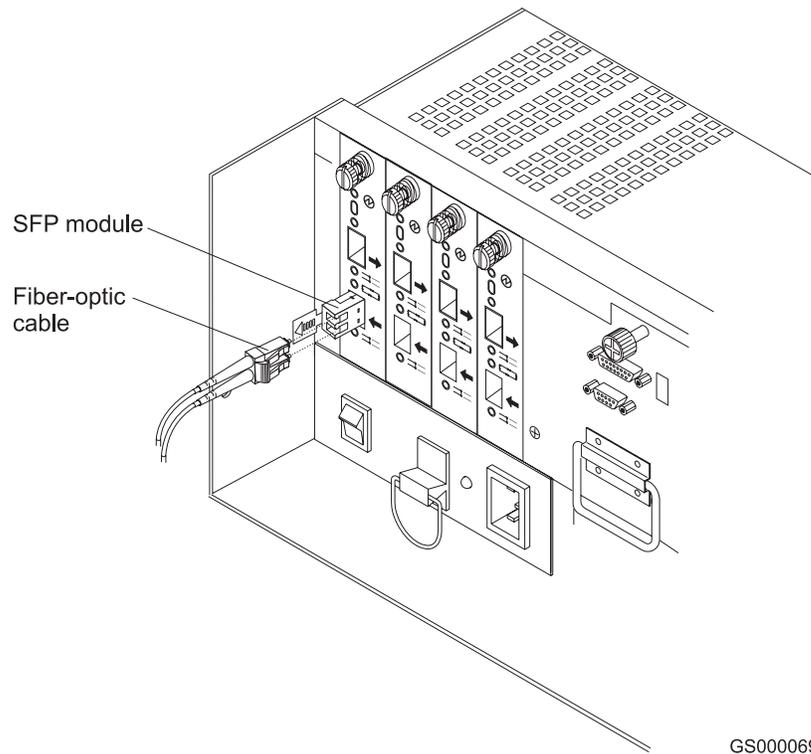


Figure 9. Inserting an LC-LC Fibre Channel cable into an installed SFP module

5. Remove the two protective caps from the other end of the LC-LC cable, as shown in Figure 7 on page 7. Save the protective caps for future use.
6. Connect the end of the LC-LC Fibre Channel cable to one of the following devices:
 - SFP module that is installed in an IBM Fibre Channel switch
 - Optical interface connector on an IBM DS4000 FC-2 Host Bus Adapter (part number 19K1246)
 - LC-SC Fibre Channel cable adapter (For information about how to use an LC-SC cable adapter, see “Using LC-SC Fibre Channel cable adapters” on page 9.)

Removing an LC-LC Fibre Channel cable from an SFP module

To remove an LC-LC Fibre Channel cable, perform the following steps:

Attention: To avoid damaging the LC-LC cable or SFP module, make sure you press and hold the lever to release the latches as you remove the cable from the SFP module.

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 10 on page 9. Carefully pull on the connector to remove the cable from the SFP module, (ensure that the levers are in the released position when you remove the cable) as shown in Figure 11 on page 9. If you use the SFP module with the pull tab, make sure you do not grasp the plastic tab when you remove the cable.

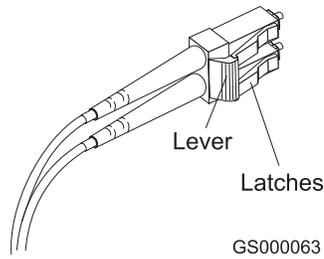


Figure 10. LC-LC Fibre Channel Cable lever and latches

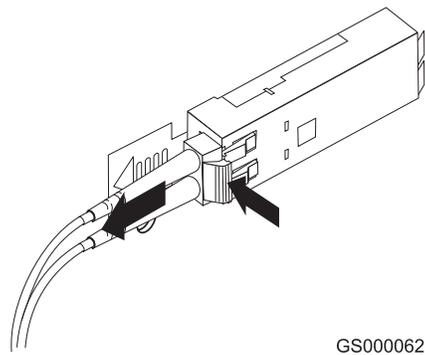


Figure 11. Removing the LC-LC Fibre Channel cable

2. Replace the protective caps on the cable ends.
3. 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 you use to connect the LC connector into one of the following devices that require SC connectors:

- DS4000 host adapter (Part number 00N6881)
- FASTT EXP500 storage expansion enclosure (Machine type 3560)
- 1 Gb Fibre Channel switch (Machine type 2109)
- 1 Fibre Channel Managed hub (Machine type 3534)

Figure 12 shows an LC-SC Fibre Channel cable adapter.

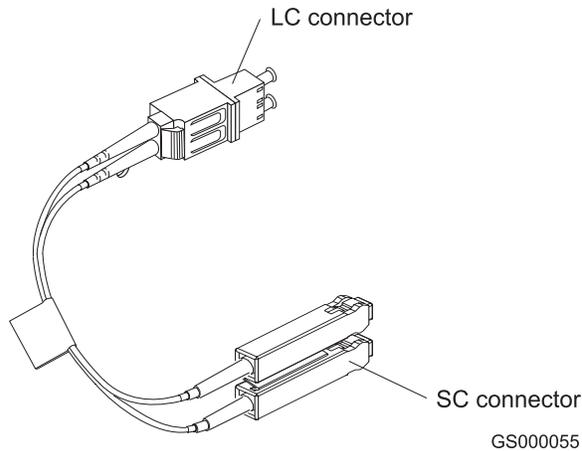


Figure 12. LC-SC Fibre Channel cable

The following sections provide the procedures for properly connecting and removing an LC-SC Fiber Channel cable adapter.

Connecting an LC-SC cable to a device

To connect an LC-SC cable adapter to a device or LC-LC cable, 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 precautions:

- 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.

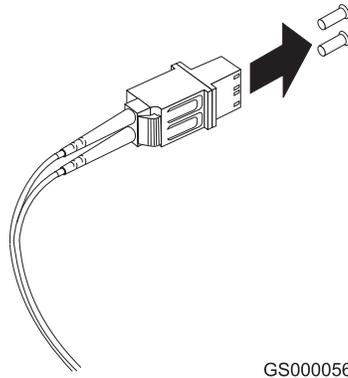


DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following precautions. 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 5.

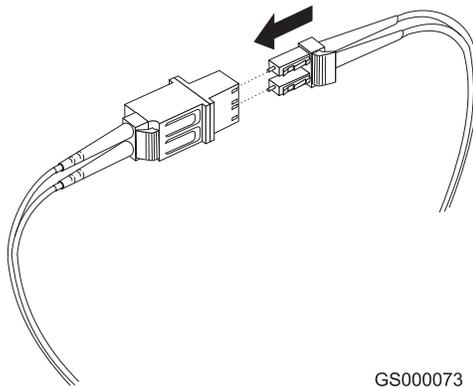
2. Connect an LC-LC cable to an SFP module in the DS4500 Storage Server mini hub. For instructions, see “Connecting an LC-LC Fibre Channel cable to an SFP module” on page 6.
3. Remove the two protective caps from the LC connector end of the LC-SC cable, as shown in Figure 13. Save the protective caps for future use.



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Figure 13. Removing the LC-SC cable adapter protective caps

4. Carefully insert one end of an LC-LC cable into the LC connector end of the LC-SC cable. Push in the connector until it clicks into place.



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Figure 14. LC-LC cable connected into the LC-SC cable adapter

5. Connect the SC connector end of the LC-SC cable to one of the following devices:
 - Optical interface connector on an IBM DS4000 Host Bus Adapter (Part number 00N6881)
 - GBIC installed in a FAStT EXP500 storage expansion enclosure (Machine type 3560)
 - 1 Gb Fibre Channel switch (Machine type 2109)
 - 1 Gb Fibre Channel managed hub (Machine type 3534)

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

To remove an LC-LC cable from an LC-SC cable adapter, perform the following steps:

Attention: To avoid damaging the LC-LC cable, make sure you press and hold the lever to release the latches while you remove the cable from an LC-SC cable adapter. Ensure that both levers on the LC-LC cable are in the released position when you remove the cable.

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 15 shows the location of the lever and latches.

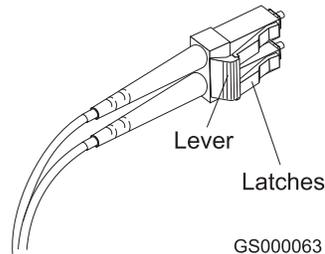


Figure 15. LC-LS Fibre Channel cable lever and latches

2. Carefully pull on the connector to remove it. Make sure you grasp the connector and not the cable when you remove the LC-LC cable from the LC-SC cable adapter, as shown in Figure 16.

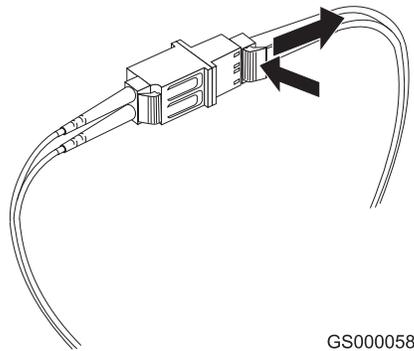


Figure 16. Removing the LC-LC Fibre Channel cable from an LC-SC Fibre Channel cable adapter

3. Replace the protective caps on the cable ends.

Types of interface ports

The DS4500 Storage Server has the following types of interface ports:

- Host mini hub
- Drive mini hub
- Ethernet

The host and drive mini-hub ports are used for data transfer between hosts or storage expansion enclosures and RAID controllers in the DS4500 Storage Server. Ethernet ports are available for storage subsystem-management. The DS4500

Storage Server interface ports are shown in Figure 17.

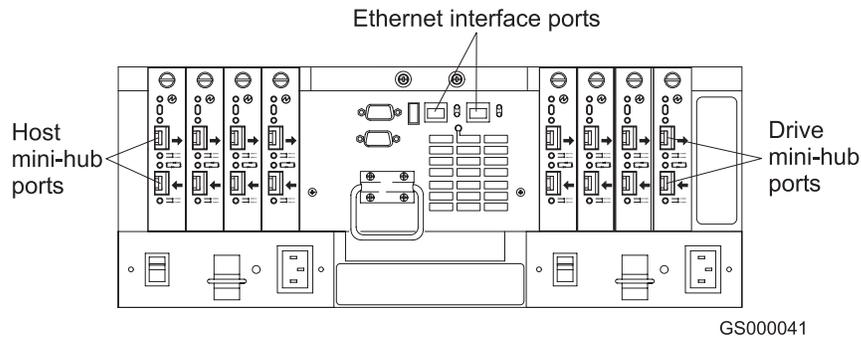


Figure 17. DS4500 Storage Server interface ports

For more information about how to connect the DS4500 Storage Server and storage expansion enclosures by using the host and drive interface ports, refer to the *IBM DS4500 Fibre Channel Storage Server Installation and Support Guide*.

Host interface ports

The DS4500 Storage Server comes with host-side mini hubs 1 and 2 installed. Each mini hub provides host loop connectivity and self-diagnostic features. Host mini hubs connect to the controller in pairs. When fully configured, the DS4500 Storage Server can accommodate four host-side mini hubs, two per controller. Mini hubs 1 and 3 connect to the top controller (Controller A) and mini hubs 2 and 4 connect to the bottom controller (Controller B), as shown in Figure 18. To ensure redundancy, you must connect each host to both controllers through the appropriate mini hub.

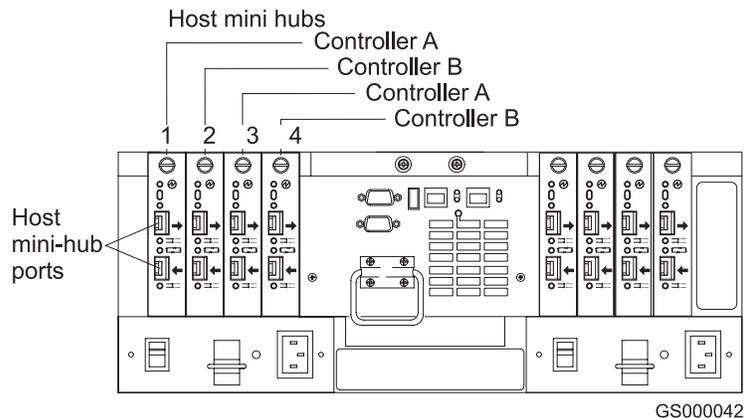


Figure 18. Host-side mini-hub interface ports

Drive interface ports

The DS4500 Storage Server comes with drive-side mini hubs 1 and 2 installed. Each drive mini hub connects to Controller A and Controller B and represents a single drive loop. The drive loops must be set up in pairs to support redundant drive loop configurations (two data paths per storage expansion enclosure). DS4500 Storage Servers use only redundant drive-loop configurations. See Figure 19 on page 14 for an illustration of the drive-side mini-hub interface ports.

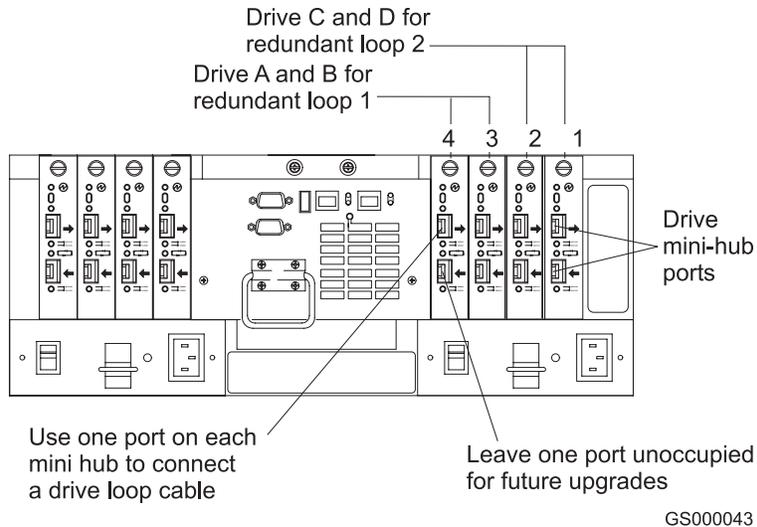


Figure 19. Drive-side mini-hub interface ports

The maximum number of storage expansion enclosures that can be connected per pair of redundant drive loops depends on the IBM DS4000 storage expansion enclosure models used. The following DS4000 storage expansion enclosure types are supported by the DS4500 Storage Server:

- FASTt EXP500
- DS4000 EXP700
- DS4000 EXP710
- DS4000 EXP100

If the drives are configured using only DS4000 EXP700, EXP710, or EXP100 storage expansion enclosures, the DS4500 Storage Server supports a maximum of 224 hard drives.

If the drives are configured using only FASTt EXP500 storage expansion enclosures, the DS4500 Storage Server supports a maximum of 220 hard drives.

Attention: In order to attach DS4000 EXP100 or DS4000 EXP710 storage expansion enclosures to a DS4500 Storage Server, the DS4500 Storage Server controller firmware must be at version 06.xx.xx.xx or higher. In addition, you must purchase the FC/SATA Enclosure Intermix premium option to combine DS4000 EXP100s with DS4000 EXP700s or DS4000 EXP710s in the same DS4500 Storage Server configuration.

For detailed information about how to cable the storage server and storage expansion enclosures, see the *IBM TotalStorage DS4500 Fibre Channel Storage Server Installation and Support Guide* and the *DS4500 Fibre Channel Cabling Instructions* that come with the storage server.

Intermixing storage expansion enclosure models

Storage expansion enclosure models can be mixed in the same redundant drive loop or the same pair of redundant drive loops. As described in the following sections, you can intermix FASTt EXP500s and DS4000 EXP700s, and you can also intermix DS4000 EXP100s, EXP710s, and EXP700s.

You *cannot* mix DS4000 EXP100s or DS4000 EXP710s with FAStT EXP500s in any DS4000 storage server configuration. If a DS4000 EXP100 or DS4000 EXP710 is attached to the DS4500 Storage Server in one drive loop, no FAStT EXP500s can be present either in the same drive loop or in the other drive loop.

Note: This restriction exists because the FAStT EXP500 storage expansion enclosure operates at 1 Gbps only, while the DS4000 EXP100 and DS4000 EXP710 storage expansion enclosures do not operate at 1 Gbps. The DS4500 Storage Server does not support mixed drive loop speeds.

Intermixing FAStT EXP500s and DS4000 EXP700s: You can intermix FAStT EXP500 and DS4000 EXP700 storage expansion enclosure models in the same redundant pair of drive loops.

Attention: If you are intermixing FAStT EXP500s and DS4000 EXP700s, it is strongly recommended that you do not cable the FAStT EXP500 and DS4000 EXP700 storage expansion enclosure models in the same redundant drive loop pair. Instead, you should cable the FAStT EXP500 storage expansion enclosures together using one pair of redundant drive loops, and you should the DS4000 EXP700 storage expansion enclosures together using the other pair of redundant drive loops.

Note: You might need to purchase two additional drive mini hubs to implement this cabling scheme.

If you are intermixing FAStT EXP500s and DS4000 EXP700s, your drive loop configuration must meet the following requirements:

- The maximum Fibre Channel transfer speed in all of the DS4000 EXP700s must be set to 1 Gbps because the maximum FC transfer speed of the IBM FAStT EXP500 storage expansion enclosures is 1 Gbps. Otherwise, a drive channel mini hub data rate mismatch error will be generated.
- The maximum Fibre Channel transfer speed in all the DS4500 Storage Server drive-side mini hubs must be set to 1 Gbps.

Attention: If you change the DS4000 EXP700 storage expansion enclosure or DS4500 Storage Server enclosure link speed setting, you must power-cycle the storage server. See “Turning off the power” on page 23 and “Turning on the power” on page 22 for the proper DS4000 configuration power-down and power-up sequences. For more information, see the *IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*.

If you intermix FAStT EXP500s and DS4000 EXP700s within a single drive loop, see Table 8 for the possible combinations of FAStT EXP500 and DS4000 EXP700 storage expansion enclosures per drive loop.

Table 8. Possible combinations of FAStT EXP500 and DS4000 EXP700 storage expansion enclosures per drive loop

Number of FAStT EXP500 units	Number of DS4000 EXP700 units	Total number of storage expansion enclosures	Total number of drives
0	8	8	112
1	7	8	108
2	6	8	104
3	6	9	114

Table 8. Possible combinations of FAStT EXP500 and DS4000 EXP700 storage expansion enclosures per drive loop (continued)

Number of FAStT EXP500 units	Number of DS4000 EXP700 units	Total number of storage expansion enclosures	Total number of drives
4	5	9	110
5	4	9	106
6	3	9	102
7	3	10	112
8	2	10	108
9	1	10	104
10	0	10	100
11	0	11	110

Important: These large configurations are for capacity purposes and might not provide the best performance.

For full details on the requirements for intermixing FAStT EXP500 and DS4000 EXP700 storage expansion enclosures, refer to the *IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide*. You can also refer to the *IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*.

Intermixing DS4000 EXP710s and DS4000 EXP700s: You can intermix DS4000 EXP710s and DS4000 EXP700s in the same drive loop with a DS4500 Storage Server, but all DS4000 EXP710s must be grouped together.

Important

The requirements for intermixing DS4000 EXP710s and EXP700s state that all DS4000 EXP710s in a redundant drive loop must be grouped together. IBM does not support intermixed drive loop configurations in which all DS4000 EXP710s are not grouped together.

Attention: The minimum DS4000 EXP700 ESM firmware requirement for intermixing DS4000 EXP710s and EXP700s is version 9326. Verify that the ESM firmware for all DS4000 EXP700s is at version 9326 or higher before intermixing DS4000 EXP700s with EXP710s.

In order to attach DS4000 EXP710 storage expansion enclosures to a DS4500 Storage Server, the DS4500 Storage Server controller firmware must be at version 06.xx.xx.xx or higher.

A fully configured DS4500 Storage Server supports a maximum of 16 IBM DS4000 EXP700 or EXP710 storage expansion enclosures (8 storage expansion enclosures per drive-loop pair), or 224 drives, using dual pairs of redundant drive loops.

For full details on the requirements for intermixing DS4000 EXP710s and EXP700s, refer to the *IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion*

Enclosures Installation, User's, and Maintenance Guide. You can also refer to the *IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide*.

Intermixing DS4000 EXP100s with DS4000 EXP710s and EXP700s: You can intermix DS4000 EXP100s SATA storage expansion enclosures with either DS4000 EXP710s, DS4000 EXP700s, or both EXP710s and EXP700s, in the same pair of redundant drive loops with a DS4500 Storage Server, but all DS4000 EXP710s must be grouped together.

Important

The requirements for intermixing DS4000 EXP100s with either DS4000 EXP710s, DS4000 EXP700s, or both EXP710s and EXP700s, state that all DS4000 EXP710s in the same pair of redundant drive loops must be grouped together. IBM does not support intermixed drive loop configurations in which all DS4000 EXP710s are not grouped together.

In order to attach DS4000 EXP100 or EXP710 storage expansion enclosures to a DS4500 Storage Server, the DS4500 Storage Server controller firmware must be at version 06.xx.xx.xx or higher. In addition, you must purchase the FC/SATA Enclosure Intermix premium option to combine EXP100s with EXP700s or EXP710s in the same DS4500 Storage Server configuration.

For more information on the cabling requirements and best practices for intermixing EXP100s with EXP700s or EXP710s in the same DS4500 Storage Server configuration, refer to 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*.

Attention: The minimum DS4000 EXP100 ESM firmware requirement for intermixing DS4000 EXP100s with DS4000 EXP710s or EXP700s is version 9554. Before intermixing DS4000 EXP100s with DS4000 EXP700s or EXP710s, you must verify that the ESM firmware for all DS4000 EXP100s is at version 9554 or higher. As discussed in “Intermixing DS4000 EXP710s and DS4000 EXP700s” on page 16, you must also verify that the ESM firmware for all DS4000 EXP710s and EXP700s is at version 9326 or higher.

A fully configured DS4500 Storage Server supports a maximum of 16 IBM DS4000 EXP700, EXP710, or EXP100 storage expansion enclosures (8 storage expansion enclosures per drive-loop pair), or 224 drives, using dual pairs of redundant drive loops.

Ethernet interface ports

There are two Ethernet interface ports, one for each controller (Controller A and Controller B). Use the Ethernet ports to directly manage storage subsystems.

Figure 20 shows the location of the interface ports.

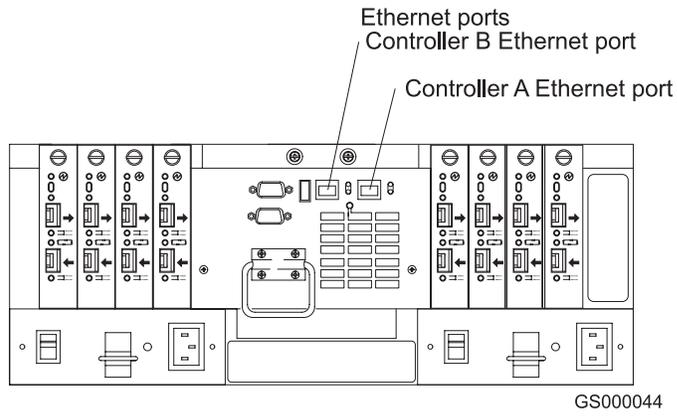


Figure 20. Ethernet interface ports

Chapter 2. Operating the DS4500 Storage Server

This chapter describes the tasks required to operate the DS4500 Storage Server.

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.
- To maintain power redundancy, plug the DS4500 storage server'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 DS4500 storage server should be plugged into the same two independent external power circuits as the DS4500. This ensures that the DS4500 storage server 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 enables the components in the storage subsystem to power on simultaneously during an unattended restoration of power.
- Before any planned system shutdown or after any system additions, removals, or modifications (including logical drive creations, storage partitioning definitions, hardware changes, and so on), save the storage subsystem profile as explained in the DS4000 Storage Manager guide for your operating system. Save the profile in a location other than the logical drives created for the DS4500 storage server.
- Ensure that your system is in an optimal state before you shut it 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 sequences listed in "Turning on the power" on page 22 and "Turning off the power" on page 23 for the proper DS4000 configuration power-down and power-up sequences. Check that each component of the subsystem 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.
- 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 DS4000 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 (such as logical drive creation or modification, or storage partitioning changes) to the DS4000 subsystem configuration.

Tasks overview

Perform the tasks shown in Table 9 on page 20 to maintain the DS4500 Storage Server after you install it.

Table 9. Tasks overview

Task	Description	See
Accessing the DS4500 Storage Server components and indicator lights	To access the controller CRUs, battery, storage server fan, and indicator lights, remove the DS4500 Storage Server bezel.	"Removing and replacing the front bezel to access the DS4000 Storage Server components"
Turning on or off the power	The DS4500 Storage Server usually runs continuously. However, you might need to turn off the power to move the DS4500 Storage Server or to perform maintenance procedures.	"Turning on the power" on page 22 and "Turning off the power" on page 23
Monitoring DS4500 Storage Server status through software	Run the storage-management software continuously. This software checks the storage subsystem for failures and displays messages that indicate the types of failures and the recovery procedures.	"Monitoring status through software" on page 25
Checking fault indicator lights for component failures	Component failures are indicated by lights on the front and back of the DS4500 Storage Server and are monitored by the storage-management software. Note: The indicator lights identify problems with the DS4500 Storage Server components, but you might need more information to thoroughly diagnose and repair the unit. Therefore, it is important to use the storage-management software to continuously monitor the status of the DS4500 Storage Server.	"Checking the indicator lights" on page 26
Restoring power after a power supply shutdown	When the DS4500 Storage Server shuts down because of a power supply overtemperature condition, take special care restarting it.	"Overtemperature condition and power supply shutdown" on page 37
Checking the battery service date	Periodically check the battery service date information. Replace the battery whenever it fails to hold a charge or every three years. Note: Using the DS4500 Storage Server in a hot environment (above 35° C or 95° F), lowers the battery life expectancy. Environmental conditions that are not in the specified range are not supported.	"Checking the battery service date" on page 38
Preparing to move the DS4500 Storage Server	You might need to move the DS4500 Storage Server to a new location or remove the chassis from its rack cabinet.	"Preparing to move the DS4500 Storage Server" on page 39

Removing and replacing the front bezel to access the DS4000 Storage Server components

To access the controller blades, battery, storage server fan, and indicator lights, you must remove the DS4500 Storage Server bezel, as shown in Figure 21 on page 21.

Attention: Pulling the cover out too far can damage the plastic hooks at the top. To avoid damaging the hooks, place the DS4500 Storage Server on a flat surface. Be sure the front of the DS4500 Storage Server extends beyond the edge approximately 5 cm (2 in.).

1. Carefully pull the bottom of the bezel out to release the pins. Then slide the bezel down as shown in Figure 21.

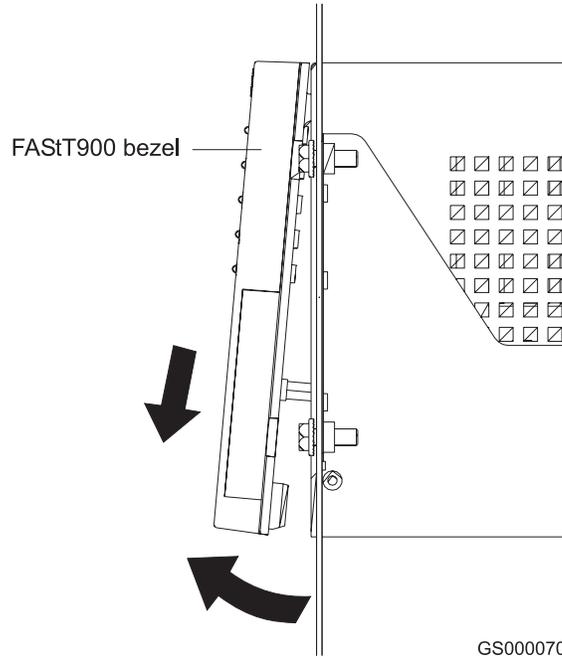


Figure 21. Removing the DS4500 Storage Server bezel

2. To replace the bezel, slip the top edge of the bezel under the lip on the chassis, then push the bottom of the bezel until the pins snap into the mounting holes, as shown in Figure 22 on page 22.

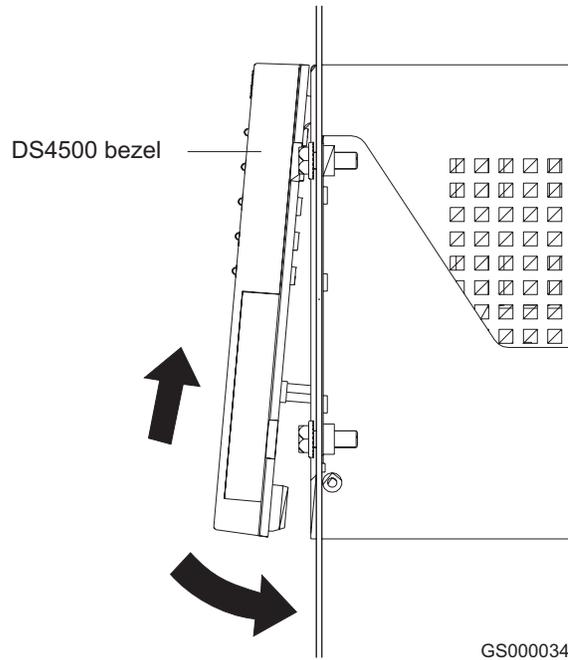


Figure 22. Replacing the DS4500 Storage Server bezel

Turning on the power

Important: You must turn on the storage expansion enclosures *before* you turn on the DS4500 Storage Server. The controllers might not recognize the correct configuration if you turn on the hard disk drives after the DS4500 Storage Server.

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

Turn on the power to each device in the following order:

- Supporting devices
- Storage expansion enclosures
- DS4500 Storage Server
- Host

If you are restoring power to the DS4500 Storage Server after an emergency shutdown or power outage, go to “Overtemperature condition and power supply shutdown” on page 37.

Use the following procedure to turn on the connected devices and the DS4500 Storage Server:

1. Turn on the power to the supporting devices (for example, Ethernet switches, Fibre Channel switches, and management stations).
2. Turn on the storage expansion enclosure. The controllers might not recognize the correct configuration if the drives are powered up after the storage server. For instructions on turning on the storage expansion enclosures, refer to the storage expansion enclosure documentation.
3. Turn on the power to the DS4500 Storage Server, as follows:

- a. Verify that all communication and power cables are plugged into the back of the DS4500 Storage Server and to a properly grounded ac electrical outlet.
- b. Turn on the power supply switches on the back of the DS4500 Storage Server (see Figure 23). You must turn on both power-supply switches to take advantage of the redundant power supplies.

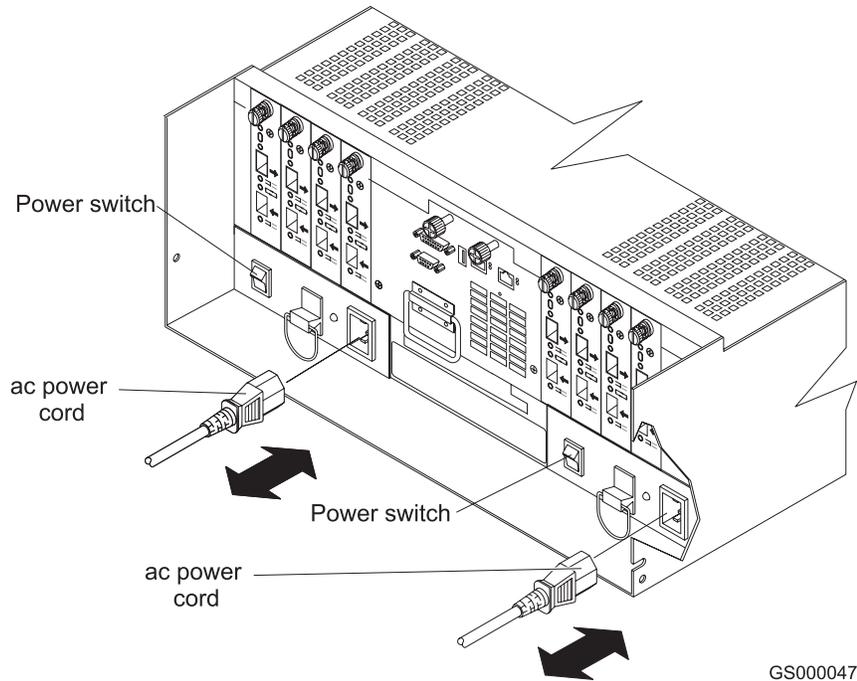


Figure 23. Connecting the power cords and power switch locations

- c. Use the storage-management software and the Fault indicator lights to check the overall status of the DS4500 Storage Server and its components. See “Checking the indicator lights” on page 26.
4. Depending on the type of operating system on the host server, perform either a server power cycle, a server restart, or a rescan for hardware on the host server.

Turning off the power

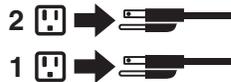
Attention: The DS4500 Storage Server is designed to run continuously, 24 hours a day. Except in an emergency, never turn off the power even if any DS4500 Storage Server fault indicator lights are lit. Use the proper troubleshooting or servicing procedure to correct the fault before you turn off the power. This measure ensures that the DS4500 Storage Server powers up correctly later. Also do not power off the storage server to reset it. Use the Reset Controller menu function in the Storage Manager Client program instead.

Statement 5:



CAUTION:

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



Use the following procedure to turn off power to the DS4500 Storage Server:

1. Make sure that all amber fault indicator lights on the DS4500 Storage Server are off. If any fault indicator lights are on, use the storage-management software to determine the status of the system components and correct any problems before you turn off the power. For more information, see “Monitoring status through software” on page 25 and “Checking the indicator lights” on page 26.
2. Perform any required procedures that are indicated by the operating system software.
3. Prepare the DS4500 Storage Server for shutdown, as follows:
 - a. Stop all I/O activity to the DS4500 Storage Server and attached storage expansion enclosures.

Note: If a parity check is in progress, it might take a long time for the drive indicator lights to stop blinking.

- b. Use the operating system software to disconnect the DS4500 Storage Server logical drives from the host before you power off the storage server.
- c. Make sure that the fast write cache indicator light on each DS4500 Storage Server front panel and all drive active indicator lights on each storage expansion enclosure front panel are off (not blinking).

Attention: To turn off all power to the storage server, 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 the DS4500 Storage Server or turn off the power to each device using the following shutdown sequence.
 - a. Turn off power to the host before you turn off the power to the storage server. If the host must stay powered on to support an existing network, refer to the operating system documentation for information about disconnecting the storage server logical drives from the host before the storage server is powered off.
 - b. Turn off power to the storage server *before* you turn off power to the storage expansion enclosures. Turn off both power supply switches on the back of the storage server. See Figure 23 on page 23.

- c. Instead of turning off the power to other supporting devices (for example, management stations, Fibre Channel switches, or Ethernet switches), disconnect the communications cables to the supporting devices.

Monitoring status through software

To monitor DS4500 Storage Server status, always run the DS4500 Storage Manager software and check it frequently. Be sure to enable the management alerts that you need. The DS4500 Storage Manager software provides the best way to diagnose and repair DS4500 Storage Server failures. This software can help you:

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

Although the DS4500 Storage Server has fault indicators, these lights are summary indicators and might not identify the specific component that has failed or needs replacing, or which type of recovery procedure you must perform. In some cases (such as loss of redundancy in DS4500 Storage Server drive loops), the fault light does not come on. Only the storage-management software can detect the failure.

Recovering from a DS4500 Storage Server failure might require you to perform procedures other than replacing the component. The DS4500 Storage Manager software gives these procedures when you are using the Recovery Guru menu.

Note: Always follow the software recovery procedures to prevent data loss.

For more information about the DS4500 Storage Manager software, refer to the Online help or publications that are appropriate for your operating system (see “About this document” on page xvii for a list of publications).

Firmware updates

In order to ensure the optimal operation of the DS4500 storage server and its attached storage expansion enclosures, the storage expansion enclosure ESM firmware, the DS4500 storage server 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.

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

Apply the necessary updates before configuring the DS4500 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 DS4500 storage server’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 indicator lights

The DS4500 Storage Server indicator lights display the status of the DS4500 Storage Server and its components. Green indicator lights mean normal operating status; amber indicator lights mean a possible failure.

It is important that you check all the indicator lights on the front and back of the DS4500 Storage Server a few minutes *after* you turn on the power. After you turn on the power, the indicator lights might blink intermittently. Wait until the DS4500 Storage Server completes its power up before checking for faults. It can take up to 15 minutes for the battery to complete its self-test and up to 24 hours to fully charge, particularly after an unexpected power loss of more than a few minutes.

The indicator lights for the components of the DS4500 Storage Server are described in the following sections.

Storage server indicator lights

The storage server has five indicator lights, as shown in Figure 24 on page 27. To view the storage server indicator lights, you do not have to remove the DS4500 Storage Server bezel.

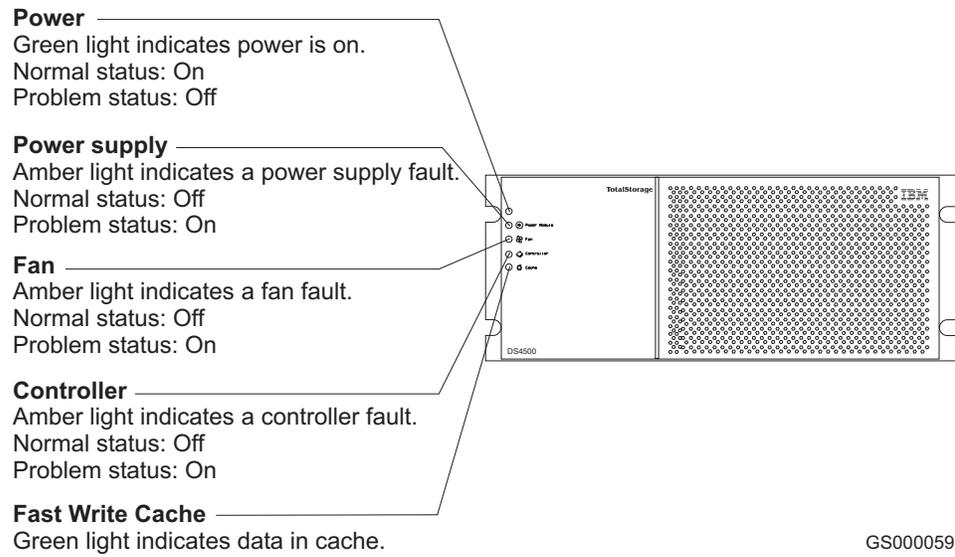


Figure 24. Storage server indicator lights

Table 10 on page 28 describes the storage server indicator lights.

Table 10. Storage server indicator lights

Indicator light	Color	Normal operation	Problem indicator	Possible conditions indicated by the problem indicator ¹
Power	Green	On	Off	<ul style="list-style-type: none"> The DS4500 Storage Server has no power. The power supply cables are loose or the switches are off. Both power supplies have failed, are missing, or are not fully seated in DS4500 Storage Server. The temperature of the DS4500 Storage Server is too high.
Power supply fault	Amber	Off	On	<ul style="list-style-type: none"> One of the redundant power supplies has failed or the power supply is turned off, disconnected, or is not fully seated in the DS4500 Storage Server. The temperature of the DS4500 Storage Server is too high. If both power supplies have failed, are turned off, or are disconnected, all of the indicator lights will not be off.
Storage server fan fault	Amber	Off	On	<ul style="list-style-type: none"> The storage server fan has failed. The fan and communications module is missing, unplugged, or has failed. The storage server fan circuitry has failed. The temperature of the DS4500 Storage Server is too high.
Controller fault	Amber	Off	On	<ul style="list-style-type: none"> The RAID controller is restarting. The RAID controller has failed. One or more controller memory modules have failed.
Cache active (Fast write cache)	Green	Steady or blinking ²	Software dependent ¹	<p>During normal operation, the indicator light is not lit in the following conditions:</p> <ul style="list-style-type: none"> The RAID controller cache is not enabled. The battery is not ready.

¹ Always use the storage-management software to identify the failure. ² The Cache active indicator light is on when there is data in the cache and blinks during a write operation.

RAID controller indicator lights

Each RAID controller has ten indicator lights: one power, one fault, and eight status lights, as shown in Figure 25 on page 29.

Note: To view the RAID controller indicator lights, remove the DS4500 Storage Server bezel, as shown in Figure 21 on page 21.

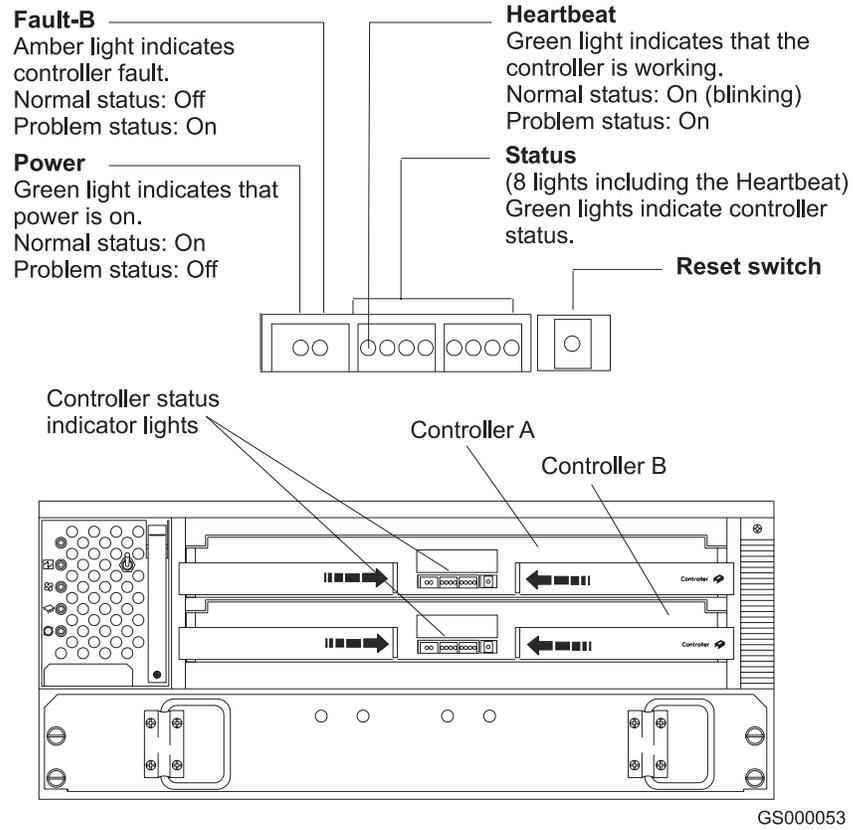


Figure 25. RAID controller indicator lights

Table 11 on page 30 describes the DS4500 RAID controller indicator lights.

Table 11. RAID controller indicator lights

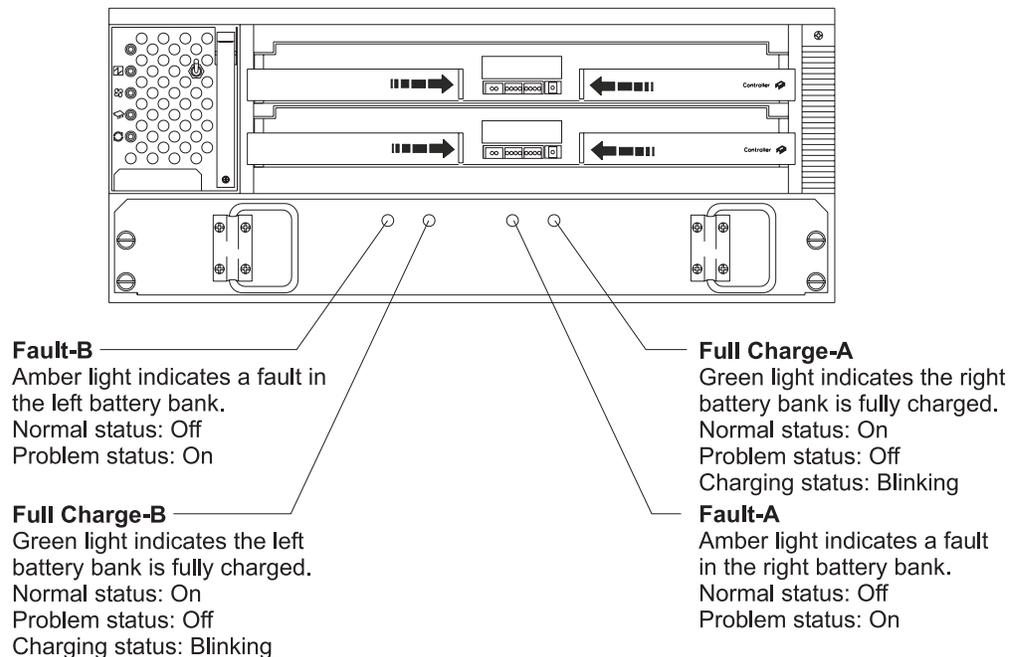
Indicator light	Color	Normal operation	Problem indicator	Possible conditions indicated by the problem indicator ¹
Power	Green	On	Off	<ul style="list-style-type: none"> There is no power to the storage subsystem. The cables are loose or the switches are off. The power supply has failed, is missing, or is not fully seated. The temperature of the DS4500 Storage Server is too high.
Fault ³	Amber	Off	On	Controller failure
Heartbeat	Green	Blinking	Not blinking	No controller activity
Status (seven ³ lights not including Heartbeat)	Green	All indicator lights are off except the heartbeat ²	Various patterns depending on the condition ²	If any status indicator lights are lit and the controller is not offline, there is a memory fault indicating that the controller CRU has failed.

¹ Always use the storage-management software to identify the failure. ² There are eight indicator lights (the Heartbeat and seven others) the seven others are lit in various patterns, depending on the controller status. ³If the controller is offline, all of the indicator lights will be lit. This does not indicate failure.

Battery indicator lights

The battery has four indicator lights, as shown in Figure 26.

Note: To view the battery indicator lights, remove the DS4500 Storage Server bezel, as shown in Figure 21 on page 21.



GS000050

Figure 26. Battery indicator lights

Table 12 on page 31 describes the battery indicator lights.

Table 12. Battery indicator lights

Indicator light	Color	Normal operation	Problem indicator	Possible conditions indicated by the problem indicator ¹
Fault-A or Fault-B	Amber	Off	On	<ul style="list-style-type: none"> The left or right battery bank has failed. The battery is either discharged or defective.
Full Charge-A or Full Charge-B	Green	On ²	Off	The left or right battery bank has failed.

¹ Always use the storage-management software to identify the failure. ² If the Full Charge-A or Full Charge-B indicator light is blinking, the battery is in the process of charging.

Fan and communications module indicator light

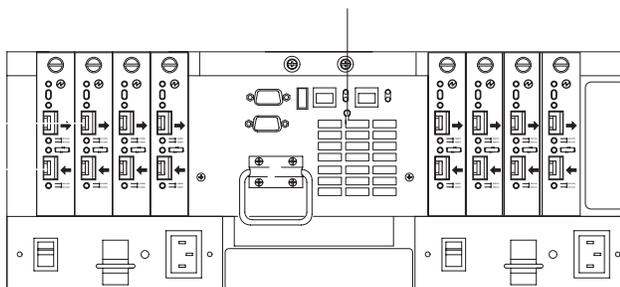
The fan and communications module has one indicator light, as shown in Figure 27.

Fault

Amber light indicates a fault in the fan and communications module.

Normal status: Off

Problem status: On



GS000064

Figure 27. Fan and communications module indicator light

Table 13 describes the fan and communications module indicator light.

Table 13. Fan and communications module indicator light

Indicator light	Color	Normal operation	Problem indicator	Possible conditions indicated by the problem indicator ¹
Fan and communications fault	Amber	Off	On	<ul style="list-style-type: none"> The fan and communications module has failed or is installed incorrectly. The temperature of the DS4500 Storage Server is too high.

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

Power supply indicator light

The power supply has one indicator light, as shown in Figure 28.

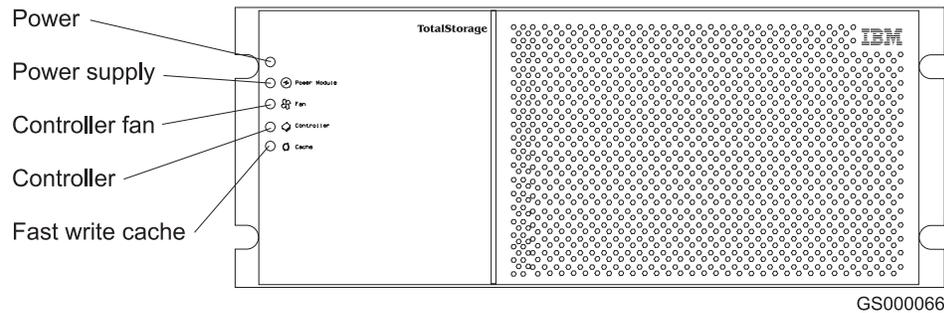


Figure 28. Power supply indicator light

Table 14 describes the power supply indicator light.

Table 14. Power supply indicator light

Indicator light	Color	Normal operation	Problem indicator	Possible conditions indicated by the problem indicator ¹
Power supply	Green	On	Off	<ul style="list-style-type: none"> The power supply has failed or is turned off The temperature of the DS4500 Storage Server is too high.

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

Mini-hub indicator lights

There are five indicator lights on each mini hub. Figure 29 shows the host-side indicator lights. The drive side indicator lights are the same; however, the possible conditions indicated by the problem indicators (described in Table 15 on page 33) might be different.

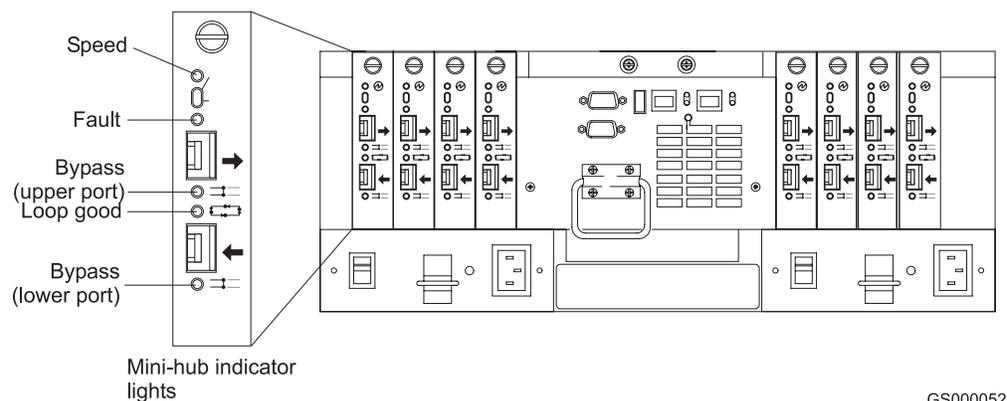


Figure 29. Mini-hub indicator lights

Table 15 on page 33 describes the indicator light status when there are Fibre Channel connections to devices between host-side and drive-side mini hubs.

Table 15. Host-side and drive-side mini-hub indicator lights

Icon	Indicator light	Color	Normal operation	Problem indicator	Possible condition indicated by the problem indicator
None	Speed	Green	On for 2 Gb Off for 1 Gb	Not applicable	Light on indicates data transfer rate of 2Gb/s. Light off indicates data transfer rate of 1Gb/s.
!	Fault	Amber	Off	On	Mini hub has failed. Note: If a host-side mini hub is not connected to a controller, this fault light is always lit.

Table 15. Host-side and drive-side mini-hub indicator lights (continued)

Icon	Indicator light	Color	Normal operation	Problem indicator	Possible condition indicated by the problem indicator
	Bypass (upper port)	Amber	Off	On	<ul style="list-style-type: none"> • Upper mini-hub port is bypassed. • Mini hub port or SFP module has failed or is loose. • Fiber-optic cables are damaged. <p>Note: When two functioning SFP modules are installed into the mini-hub ports and no Fibre Channel cables are connected to them, the bypass indicator light is lit.</p> <p>If only one functioning SFP module is installed in a host-side mini hub port and no Fibre Channel cables are connected to it, the indicator light will not be lit.</p> <p>However, the drive-side mini hub bypass indicator light will be lit when one SFP module is installed in the mini hub and the mini hub has no Fibre Channel cable connection.</p>

Table 15. Host-side and drive-side mini-hub indicator lights (continued)

Icon	Indicator light	Color	Normal operation	Problem indicator	Possible condition indicated by the problem indicator
	Loop good	Green	On	Off	<ul style="list-style-type: none"> • The loop is not operational, so no devices are connected. • Mini hub has failed or a faulty device is connected to the mini hub. • If no SFP module is installed, the indicator will be lit. • If one functioning SFP module is installed in the host-side mini hub port and no Fibre Channel cable is connected to it, the loop good indicator light will not be lit. If one functioning SFP module is installed in the drive-side mini hub port and no Fibre Channel cable is connected to it, the loop good indicator light will be lit. • Storage expansion enclosure has failed (drive-side mini hub only).

Table 15. Host-side and drive-side mini-hub indicator lights (continued)

Icon	Indicator light	Color	Normal operation	Problem indicator	Possible condition indicated by the problem indicator
	Bypass (lower port)	Amber	Off	On	<ul style="list-style-type: none"> • Lower mini-hub port is bypassed; no devices are connected. • Mini-hub port or SFP module has failed or is loose. • Fiber-optic cables are damaged. <p>Note: When two functioning SFP modules are installed into the mini hub port and no Fibre Channel cables are connected to them, the bypass indicator light is lit.</p> <p>If only one functioning SFP module is installed in a host-side mini hub port and no Fibre Channel cables are connected to it, the indicator light is not lit.</p> <p>However, the drive-side mini hub bypass indicator light will be lit when one functioning SFP module is installed in the mini hub port and the mini-hub has no Fibre Channel cables connected to it.</p>

Overtemperature condition and power supply shutdown

If the fan and communications module fails or is unable to maintain an internal temperature below 70° C (158° F), one or both of the power supplies in the DS4500 Storage Server might shut down (see Figure 30). If both power supplies shut down, the DS4500 Storage Server is not operational.

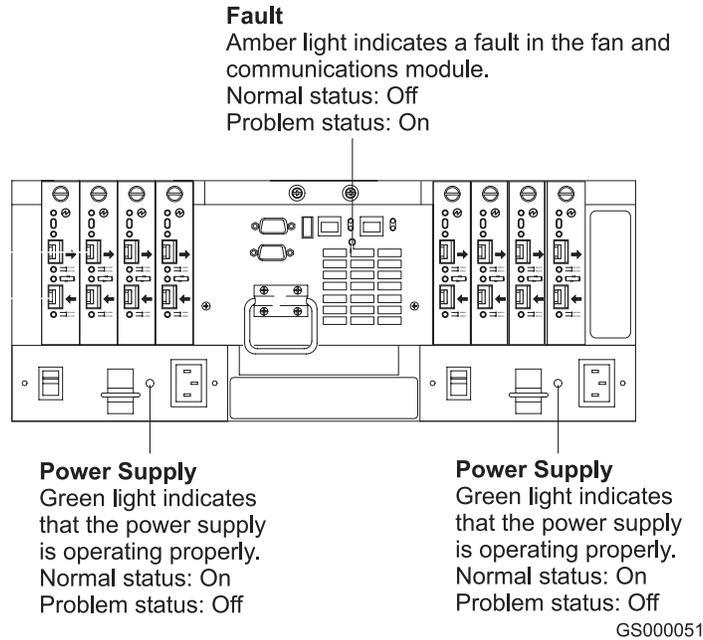


Figure 30. Fan and communications and power supply fault indicators

The storage-management software causes the fan and communications module fault indicator and storage server fan indicator to light before the temperature has risen sufficiently to shut down the power supplies. The storage server fan indicator light, shown in Figure 31, is lit when the DS4500 Storage Server temperature exceeds 45° C (113° F). The DS4500 Storage Server shuts down if the temperature rises to 70° C (158° F). If both power supplies shut down, the fault indicator cannot light.

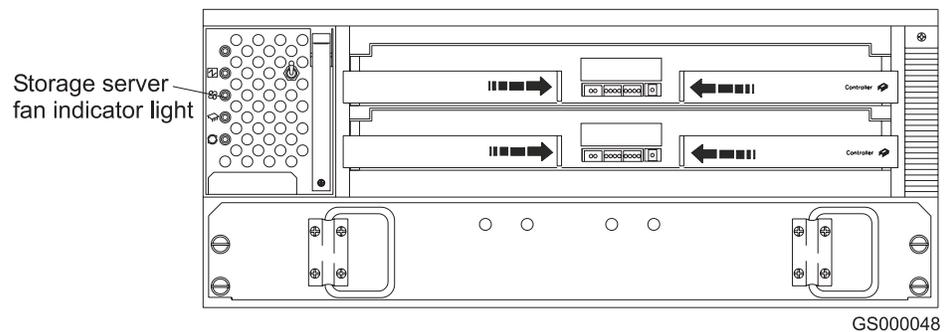


Figure 31. Storage server fan indicator

Turning on the power after an overtemperature shutdown

If your DS4500 Storage Server shuts down unexpectedly and you received a "Maximum temperature exceeded " alert from the storage server before it shutdown, take the following precautions to cool it before you power on the unit:

1. Turn off the power switches to allow the DS4500 Storage Server to cool.
2. When the room temperature is below the upper operating temperature of 35° C (95° F), turn on the power switches.
3. Check the DS4500 Storage Server for faults or damage. Use the storage-management software to check the overall status of the DS4500 Storage Server and its components. Correct any problems indicated.

Turning on the power after an emergency shutdown

Use this procedure to regain normal system operation after a power failure or emergency shutdown:

1. Check all components and cables for damage. If there is no visible damage, continue with Step 2; otherwise, service the system.
2. Make sure the power cords are plugged in.
3. Make sure that the circuit breaker, storage expansion enclosures, and storage server power switches are in the off position.
4. Turn on the circuit breakers in the rack cabinet, and turn on the power switches on all storage expansion enclosures attached to the DS4500 Storage Server.

Important: You must turn on the storage expansion enclosures *before* you turn on the DS4500 Storage Server. The controllers might not recognize the correct configuration if the attached drives are powered up after the DS4500 Storage Server. For instructions on how to power up the storage expansion enclosures, refer to the storage expansion enclosure documentation.

5. Turn on both power switches on the back of the DS4500 Storage Server. For the location of the power switches, see Figure 23 on page 23.
6. Check the status of the DS4500 Storage Server and other devices. Make sure all fault indicator lights are off on the front and back of the DS4500 Storage Server. For more information, see "Checking the indicator lights" on page 26.
7. When all the devices are powered up, check the overall system status by using the storage-management software.

Checking the battery service date

Note: Replace the battery whenever it fails to hold a charge or every three years. Operating the DS4500 Storage Server in a hot environment (above 35° C or 95° F) lowers the battery life expectancy.

To check the battery service date, perform the following steps:

1. Remove the DS4500 Storage Server bezel, as shown in Figure 21 on page 21.

2. Check the Battery Support Information label, as shown in Figure 32.

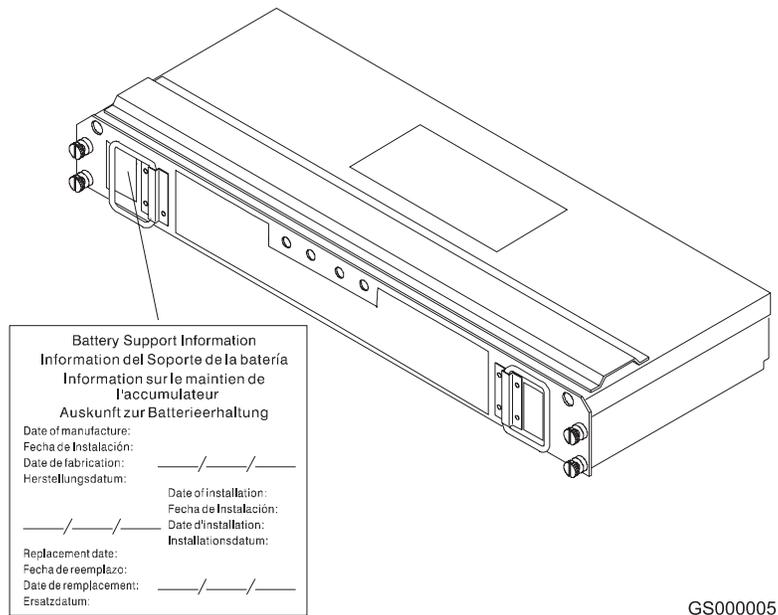


Figure 32. Checking the battery service date

The Battery Support Information label on the front of the battery has three dates:

- **Date of Manufacture** - Date the battery was built at the factory
 - **Date of Installation** - Date the battery was installed in the DS4500 Storage Server
 - **Replacement Date** - Battery replacement date (see the note at the beginning of this section)
3. Perform one of the following tasks:
 - If it is time to replace the battery, install a new battery using the procedure described in “Replacing a failed battery” on page 47.
 - If it is not time to replace the battery, replace the DS4500 Storage Server bezel, as shown in Figure 22 on page 22.

Preparing to move the DS4500 Storage Server

Remove each component CRU before you move the DS4500 Storage Server to a new location or before you remove the chassis from its rack cabinet. This precaution helps safeguard the equipment and ensures a smoother transition to the new environment.

If you are moving the DS4500 Storage Server a short distance, and you have sufficient assistance or equipment, you might be able to move the DS4500 Storage Server without removing each component CRU. If you do not have sufficient assistance or equipment, use the procedure in “Moving or relocating the DS4500 Storage Server” on page 40 to safely move the equipment to its new location.

If you are moving the DS4500 Storage Server a significant distance, be sure to pack it in its original shipping container.

Moving or relocating the DS4500 Storage Server

Use the following procedure to remove all component CRUs before you move or relocate the DS4500 Storage Server.

1. Prepare the DS4500 Storage Server for shutdown. Refer to “Turning off the power” on page 23.
2. Label the host Fibre Channel and interface cables and disconnect them.

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 bend the cables to a radius of less than 38 mm (1.5 in.).

3. Disconnect all remaining cables from the DS4500 Storage Server and label them so that you can correctly reconnect them later.

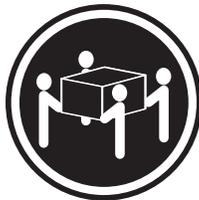
Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see “Handling static-sensitive devices” on page 43.

4. Remove all CRUs from the DS4500 Storage Server. For information about removing and replacing CRUs, see Chapter 3, “Replacing the DS4500 Storage Server components,” on page 43.
5. Remove the two screws from the inside rear of the DS4500 Storage Server; then, remove the two screws from the inside front of the DS4500 Storage Server. Save the screws for later. For detailed information, see the *Rack Mounting Instructions* that come with the storage server.

Attention: Do not remove the black hex head screws. These secure the rails that support your DS4500 Storage Server.

Statement 4:



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

CAUTION: Use safe practices when lifting.

6. Slide the DS4500 Storage Server out of the rack cabinet and set it on a level, dry surface.
7. Perform one of the following tasks:
 - If you are shipping the DS4500 Storage Server to another location, replace all CRUs in the DS4500 Storage Server. Carefully pack the unit in its original shipping container. You are finished with this procedure.
 - If you are moving the DS4500 Storage Server to another rack cabinet, remove the support rails and power cords from the old rack cabinet and install them in the new one.

8. To install the DS4500 Storage Server into a rack cabinet in the new location, perform the following steps:
 - a. Slide the DS4500 Storage Server into the rack cabinet.
 - b. Insert and tighten two of the screws that you removed in Step 5 on the inside front of the DS4500 Storage Server.
 - c. Insert and tighten the remaining two screws that you removed in Step 5 on the inside rear of the DS4500 Storage Server.
9. Replace all CRUs in the DS4500 Storage Server.
10. Connect the interface cables and host Fibre Channel cables that you labeled in Step 3 on page 40.
11. Connect the remaining cables to the DS4500 Storage Server.
12. Turn on power to the DS4500 Storage Server. Use the procedure in “Turning on the power” on page 22.
13. Replace the DS4500 Storage Server bezel.

Chapter 3. Replacing the DS4500 Storage Server components

The DS4500 Storage Server contains two RAID controllers, a cooling system that contain four fans, mini hubs, SFP modules, and a power system. This chapter includes detailed instructions on how to replace these components.

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, 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 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.

DS4500 Storage Server controller

The DS4500 Storage Server supports RAID technology. The DS4500 Storage Server contains two RAID controllers.

Each controller comes in a removable, portable unit, called a controller CRU, as shown in Figure 34 on page 45. Each controller CRU slides into one of two controller slots on the front of the DS4500 Storage Server and attaches to hosts through Fibre Channel connections. Two handles lock the controller in place. Each controller slot has a controller slot designation that identifies the physical location of the controller in the chassis: controller slot A (top) or controller slot B (bottom). Each controller CRU has ten indicator lights: one power, one fault, and eight status indicator lights, as shown in Figure 33 on page 44.

Attention: If you are removing both controllers (controller A and controller B) from the DS4500 Storage Server, label controllers A and B with the white tape dots that are included in the rack mounting assembly kit. To prevent data loss, the controllers must be installed into their original location.

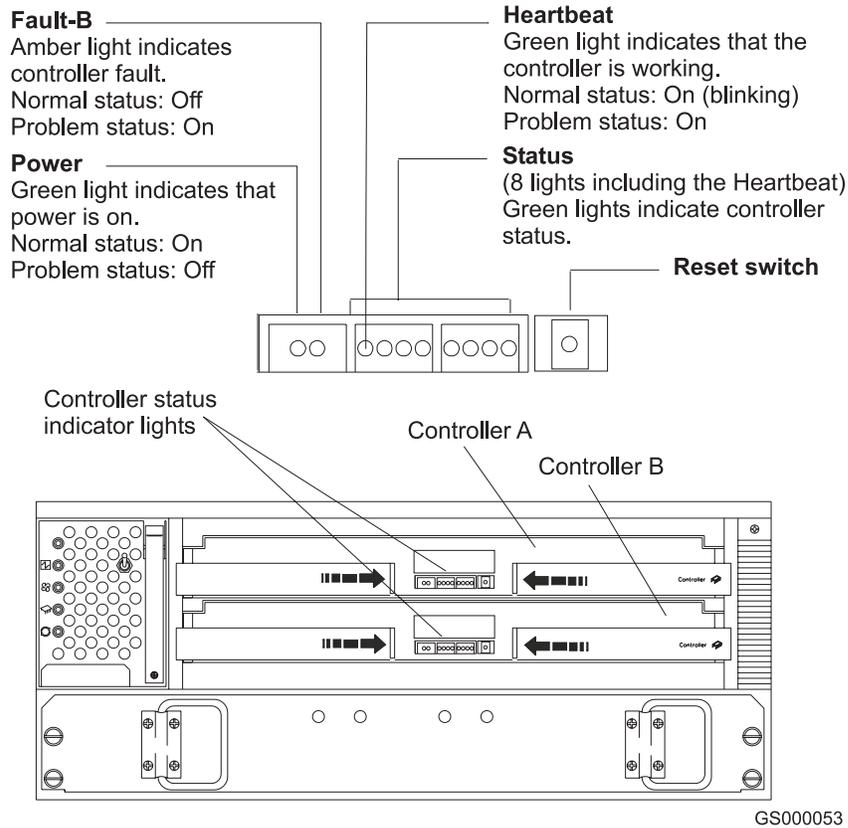


Figure 33. Controller status indicator lights

Servicing notes

Consider the following factors when servicing the controllers in the DS4500 Storage Server:

- The DS4500 Storage Server supports two controller CRUs, which attach to hosts through Fibre Channel connections.
- You can hot swap or replace a failed controller while the DS4500 Storage Server is in operation as long as the host has a Fibre Channel connection to the functioning controller and is in a “passive” or “offline” status in the storage-management software.
- If cache mirroring is enabled in redundant controllers and one controller fails, the second controller assumes processing functions without data loss. However, some or all data might be lost if cache mirroring is disabled and a failure occurs before data is written from cache memory to disk.
- If you replace the controller CRU and still experience problems, the DS4500 Storage Server might have other defective components or connections. Check the storage-management software for indications of other component failures.
- When a controller CRU fails, the fault light on the affected controller is lit. For more information about indicator lights, see “RAID controller indicator lights” on page 28.

- The two controllers are automatically synchronized when you replace a failed controller. The storage-management software automatically synchronizes the firmware between the existing controller and the new controller.

Replacing a failed controller

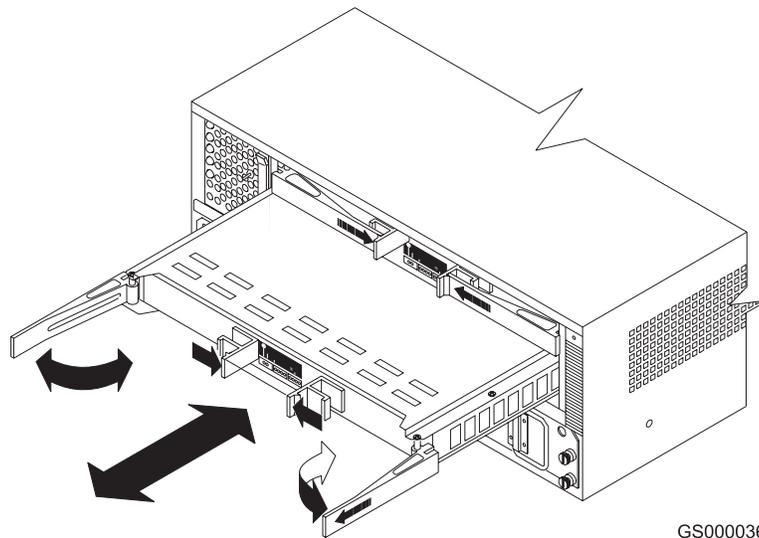
When instructed by the storage-management software, replace a controller CRU by using the following procedure.

Attention: After replacing a controller, always use the storage-management software to verify the firmware levels.

1. Remove the DS4500 Storage Server bezel, as shown in Figure 21 on page 21.

Attention: Removing a controller that is operating normally (not failed) can result in data loss. Only remove a controller that:

- Has a fault indicator light that is lit
 - Is marked as “Failed” (offline) through the storage-management software
2. Using Figure 34 as a guide, remove the controller that has failed.
 - a. Using your thumbs, squeeze the two center tabs and pull both controller handles outward with your fingers.
 - b. Using both handles, pull out on the controller to remove it.



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Figure 34. Removing and replacing a failed controller CRU

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 43.

3. Unpack the new controller. Using the proper handling precautions, remove the new controller from the packing material.

Check the shipping invoice and the controller to make sure that it has the same memory size as the controller that you just removed.

4. Using Figure 34 as a guide, install the new controller as follows:
 - a. Using your thumbs, squeeze the two center tabs and pull both controller handles outward with your fingers.
 - b. Using the handles, slide the controller into the slot until the back edge of both handles hooks onto the frame.

- c. Close both handles and snap into place.
5. Using Figure 35 as a guide, check the controller indicator lights.

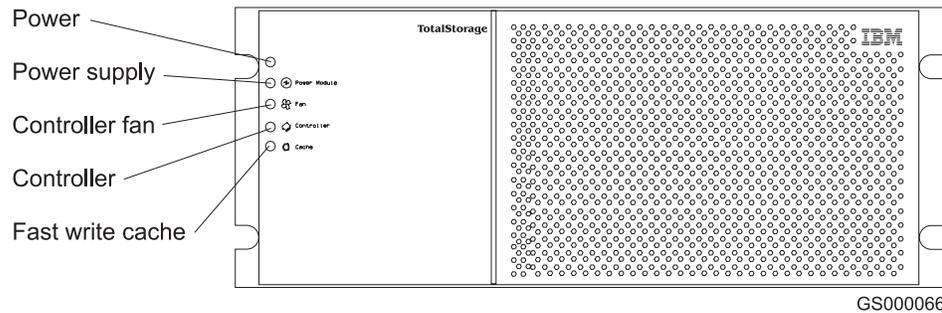


Figure 35. Indicator lights on the DS4500 Storage Server bezel

- If the green power indicator light is on and the amber fault indicator light is off, go to Step 8.
 - If the green power indicator light remains off or the fault indicator light is on after a few seconds, make sure that the controller CRU is locked into place. If the fault indicator light remains on, go to Step 6.
6. Use the storage-management software to check the status of both controllers. If applicable, perform the recovery procedures required by the software. If this corrects the fault and the DS4500 Storage Server is operating without error, go to Step 8. If not, go to Step 7.
 7. Reinsert the controller CRU. Then, if there are no error messages or controller faults, go to Step 8. If there is still a problem, call for service.
 8. Replace the DS4500 Storage Server bezel, as shown in Figure 22 on page 22.

Battery

The battery CRU contains rechargeable batteries and a battery-charger board. The battery CRU plugs into the front of the DS4500 Storage Server (see Figure 36 on page 48) where it provides backup power to the cache memory in both controllers. During a power outage, a properly charged battery CRU maintains electrical current to the controllers for up to five days with 1 Gb cache memory installed. All data stored in memory is preserved as long as the batteries can sustain power to the cache memory. However, the battery does not provide power to the rest of the system during a power outage. Therefore, the system is not able to write data to hard disk drives without a backup power source.

Servicing notes

Consider the following factors when you service the battery in the DS4500 Storage Server:

- The battery has a three-year life expectancy. Replace the battery every three years or whenever it fails to hold a charge. Operating the DS4500 Storage Server in an unsupported environment (above 35° C or 95° F) lowers the life expectancy of the battery.
- The service label on the battery provides a blank line for recording the date on which the battery was last serviced (see Figure 37 on page 49). Check this label to determine when to replace the battery. For information about using the software to track battery age, refer to the IBM DS4000 Storage Manager online help.

- When a battery fails, the fault light on the battery is lit. For more information about indicator lights, see “Battery indicator lights” on page 30.
- If you replace the battery and still experience battery problems (for example, loss of battery power to the controllers or batteries not charging properly), the DS4500 Storage Server might have defective components or connections. Check the storage-management software for indications of other component failures.

Replacing a failed battery

When instructed by the storage-management software, replace the battery.

Attention: Because the battery CRU is a sealed unit, you must replace the entire CRU (not just the batteries) in order to keep the battery backup system in working order. Opening the battery CRU voids your warranty.

1. Use the storage-management software to disable caching. Caching is disabled when the Cache active (Fast write cache) indicator light is off. Data in cache is unprotected if a power outage occurs while the battery CRU is out of operation.

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 43.

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.

2. Remove the DS4500 Storage Server bezel, as shown in Figure 21 on page 21.

Attention: Be careful when you remove the battery. The battery weighs approximately 6.4 kg (14 lb).

3. Using Figure 36 on page 48 as a guide, remove the battery.
 - a. Loosen the four captive screws on the battery. If necessary, use a flat blade screwdriver to loosen the screws.
 - b. Using both pull handles, slide out the battery about 5 cm (2 in.).
 - c. Using both hands, grasp the sides of the battery and pull out.

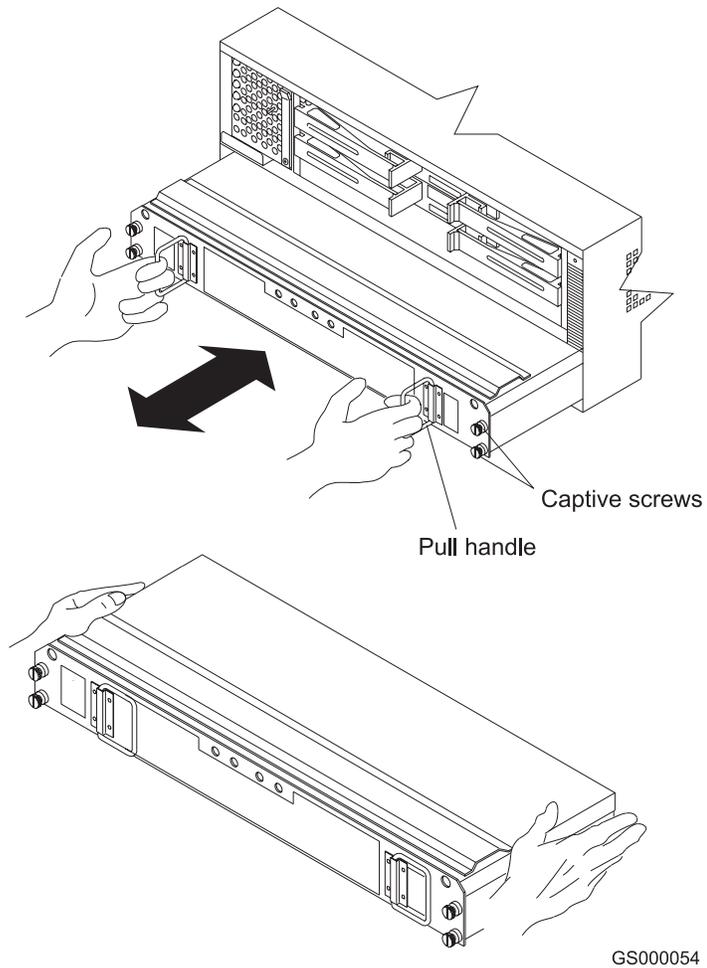
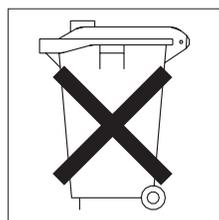


Figure 36. Removing and installing a battery



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 or contact your IBM representative. For information on disposal of sealed lead acid batteries outside the United States, go to <http://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.

4. Prepare the new battery. Unpack the battery CRU. Save the packing material for shipping the used battery CRU to a disposal facility.
5. Find the “Battery Support Information” label on the front of the new battery CRU, as shown in Figure 37.

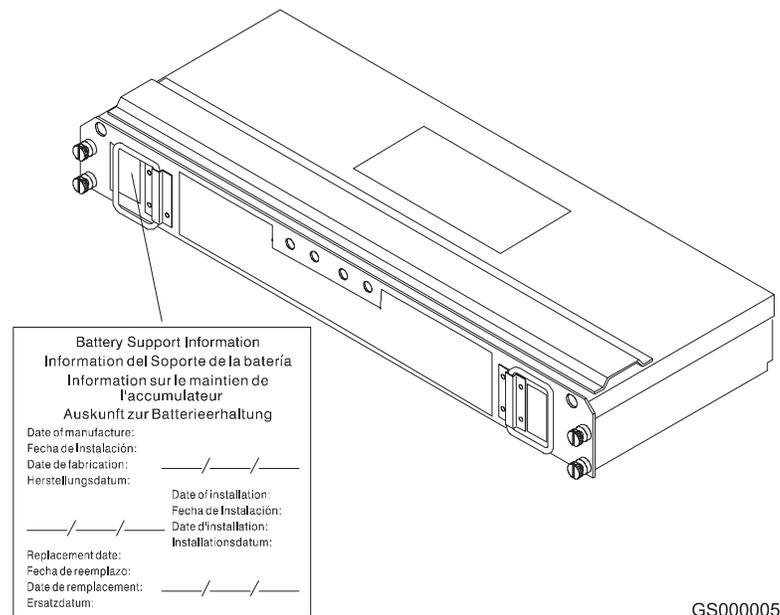


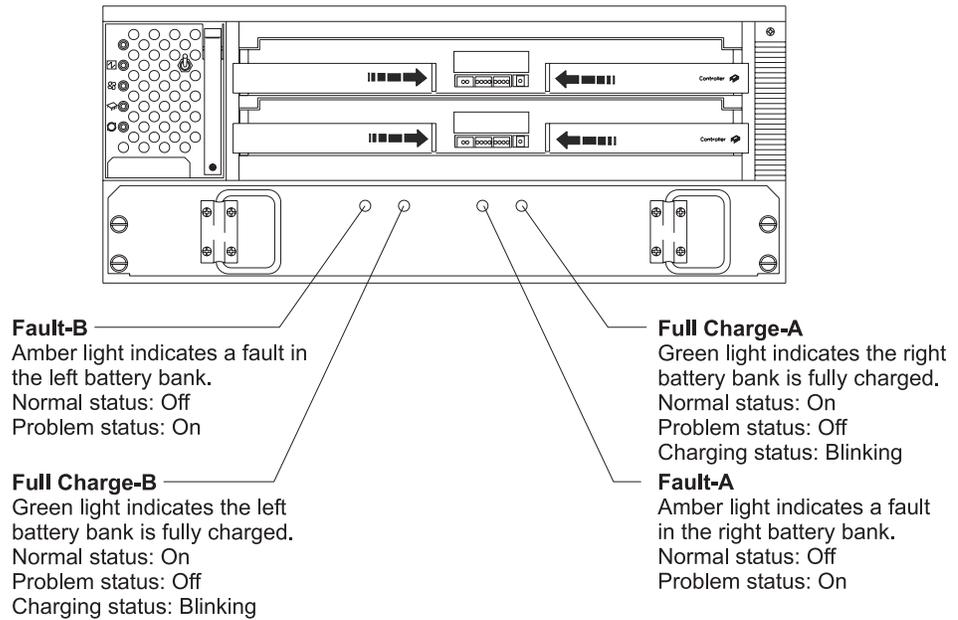
Figure 37. Recording the battery support information

Fill in the following information:

- Date of Installation - Record today's date on the blank line
 - Replacement Date - Record the expiration date (three years from today's date) on the blank line
6. Install the new battery.
 - a. Using both hands, slide the battery about 5 cm (2 in.) into the slot.
 - b. Using the pull handles, slowly push the battery completely into the slot.
 - c. Tighten the four captive screws.
 7. Replace the DS4500 Storage Server bezel, as shown in Figure 22 on page 22.
 8. Run the system for at least 24 hours to properly charge the batteries. The battery might take up to 15 minutes to complete its self-test and up to 24 hours

to fully charge, even after a power loss of only a few minutes. When properly charged, both full-charge indicator lights on the front of the battery are lit.

9. Check the battery indicator lights, as shown in Figure 38.



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Figure 38. Battery CRU indicator lights

Note: If the Full Charge-A and the Full Charge-B indicator lights are blinking, the battery is in the process of charging.

10. After your battery has completed the self test, reset the battery installation date using the storage-management software. The software continues to issue battery-related errors if the installation date is not reset.

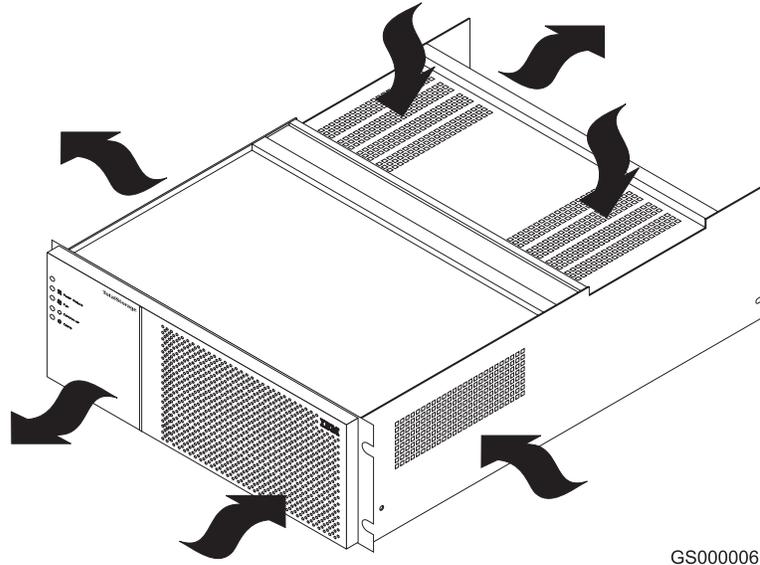
Storage server fan

The storage server fan is a single, removable unit that contains two cooling fans and temperature monitoring circuitry. The storage server fan plugs directly into a slot on the front of the DS4500 Storage Server, to the left of the controllers (see Figure 40 on page 52). Five indicator lights provide overall system status information (see Figure 41 on page 53). The dual fans in the storage server fan unit provide a redundant cooling system to both controller CRUs. If one fan fails, the other continues to operate, providing sufficient air circulation to prevent the controllers from overheating until you can replace the entire storage server fan.

To prevent cooling problems, the DS4500 Storage Server must have proper air circulation throughout the chassis. Cooling problems include any malfunctions or obstructions that impede air flow and cause one or more components in the DS4500 Storage Server to overheat. Make sure that the ambient air temperature around the DS4500 Storage Server is within the environmental requirements. To boost air circulation, the DS4500 Storage Server chassis has air vents along its top and sides. These vents serve as air intake and exhaust passages. Always keep vents clean and free of obstructions (Refer to the *IBM DS4500 Fibre Channel Storage Server Installation and Support Guide* for operating specifications).

Figure 39 shows the DS4500 Storage Server air flow. Make sure your installation site allows adequate ventilation to the DS4500 Storage Server during operation.

Note: Allow at least 60 cm (2 ft) of clearance in front of and behind the DS4500 Storage Server for proper ventilation.



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Figure 39. DS4500 Storage Server airflow

Servicing notes

Consider the following factors when you service the storage server fan:

- The storage server fan and the fan and communications module cooling system failing simultaneously in the storage server is unlikely. Such a failure will cause either one or both controllers to overheat. Under these circumstances, the amber controller light on the front panel might be lit. If this occurs, shut down the DS4500 Storage Server immediately and let the unit cool to room temperature and then replace the storage server fan.
- You can hot swap, or replace, the storage server fan, as long as you complete the exchange within 15 minutes. The time limit applies to the total time that the fan is out of the chassis. The time begins when you remove the failed storage server fan and ends when you install the new one. This does not include the time it takes to perform the entire procedure (for example, checking the indicator lights).
- When a storage server fan fails, the fault light on the storage server fan is lit. For more information about indicator lights, see “Storage server indicator lights” on page 26.
- If you replace the storage server fan and still experience problems, the DS4500 Storage Server might have defective components or connections. Check the storage-management software for indications of other component failures.
- The storage server fan indicator light is also used to indicate a fan and communications module failure. Be sure to check the storage server fan and fan and communications module before you call for service.

Replacing a failed storage server fan

When instructed by the storage-management software, replace the storage server fan.

1. Remove the DS4500 Storage Server bezel, as shown in Figure 21 on page 21.
Attention: To prevent damage to the DS4500 Storage Server components, do not operate the DS4500 Storage Server without adequate ventilation to the controllers. If it will take longer than 15 minutes to replace the storage server fan, you must shut down the DS4500 Storage Server to prevent it from overheating. The time limit applies to the total time that the fan is out of the chassis. For more information, see “Turning off the power” on page 23.
2. Remove the failed storage server fan, as shown in Figure 40.
 - a. Lift up the lever on the storage server fan.
 - b. Pull firmly on the bottom lip to remove the fan.

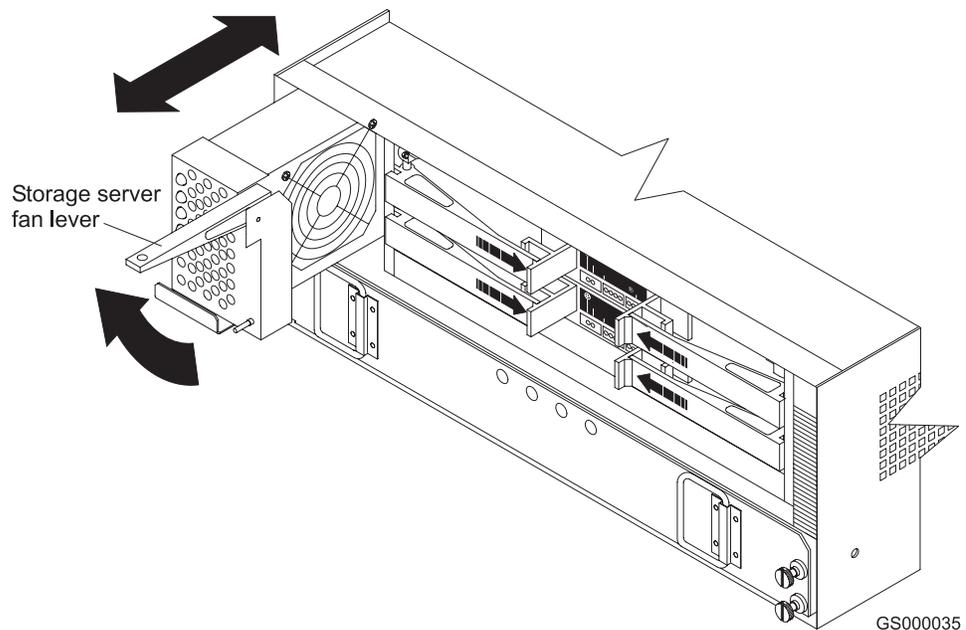


Figure 40. Removing and installing the storage server fan

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 43.

3. Unpack the new storage server fan.
4. Install the new storage server fan.
 - a. Slide the new storage server fan all the way into the slot.
 - b. Press down on the lever and snap the lever into place.

- Using Figure 41 as a guide, check the storage server indicator lights on the fan.

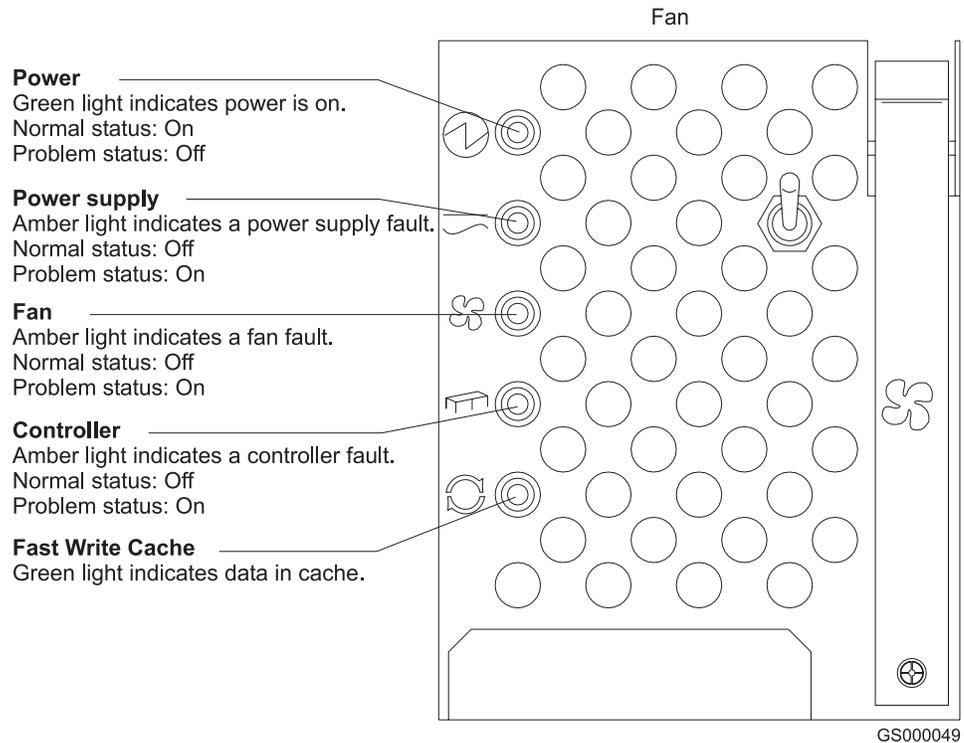


Figure 41. Storage server indicator lights

- When the storage server fan is operating properly, the green power indicator is lit and the amber fan indicator is off.
 - If the amber fan indicator is lit or the green power indicator remains off, make sure that the storage server fan is seated securely in the slot and that the lever is snapped into place. Check the storage server fan or the fan and communications module status.
 - If the storage server fan indicator remains on, it might indicate a problem with the new storage server fan or the fan and communications module (both components share the same indicator light). Replace the storage server fan with a spare, if available. Otherwise, turn off the DS4500 Storage Server to prevent it from overheating until you can replace the fan.
- Replace the DS4500 Storage Server bezel, as shown in Figure 22 on page 22.

Fan and communications module

The fan and communications module is a single, removable unit that contains two cooling fans and two Ethernet ports. This module plugs into a slot at the center back of the DS4500 Storage Server, just above the power supplies (see Figure 43 on page 55). It has two captive screws and a rectangular handle for securing and removing the fan and communications module. The module contains dual fans that provide a redundant cooling system to both power supplies. If one fan within the module fails, the other continues to operate. A single fan provides sufficient air circulation to prevent the power supplies from overheating until you can replace the entire fan and communications module.

Servicing notes

Consider the following factors when you service the fan and communications module:

- The fan and communications module contains two Ethernet connections used for direct network-management.
- You can hot swap the fan and communications module as long as you complete the exchange within 15 minutes from when you remove the failed unit until you install the new one.
- It is unlikely that the storage server fan and the fan and communications module cooling system will fail simultaneously. Such a failure will cause one or both power supplies to overheat. In these circumstances, the amber power supply indicator light on the bezel is lit and the overheated power supply automatically shuts down (the green power indicator light on the power supply turns off). Once the ambient air temperature cools below 70° C (158° F), the power supply automatically turns on. Replace the failed fan and communications module. Then check the power supply indicator lights (fault indicator light on the front and power indicator light on the back). If the power supply fault indicator light remains on, replace the power supply. For more information about indicator lights, see “Fan and communications module indicator light” on page 31 and Figure 28 on page 32.
- If you replace the fan and communications module and still experience problems, the DS4500 Storage Server might have defective components or connections. Check the storage-management software for indications of other component failures.

Replacing a failed fan and communications module

When instructed by the storage-management or diagnostic software, replace the fan and communications module.

Attention: To prevent damage to the DS4500 Storage Server circuitry, do not operate the DS4500 Storage Server without adequate ventilation to the power supplies and mini hubs. If it will take longer than 15 minutes to replace the fan and communications module, you must shut down the DS4500 Storage Server to prevent it from overheating. The time limit applies only to the total time that the fan and communications module is out of the chassis. The time begins when you remove the failed module and ends when you install the new one. This does not include the time it takes you to perform this entire procedure (for example, checking the indicator lights).

1. Disconnect all Ethernet interface cables from the failed fan and communications module. The locations of the ports are shown in the following figure.

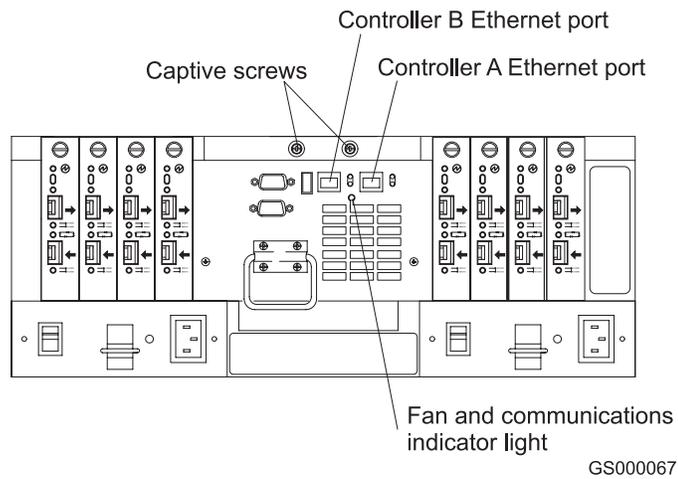


Figure 42. Fan and communications module ports and indicator light

2. Use Figure 43 as a guide and perform the following steps to remove the failed fan and communications module from the DS4500 Storage Server.

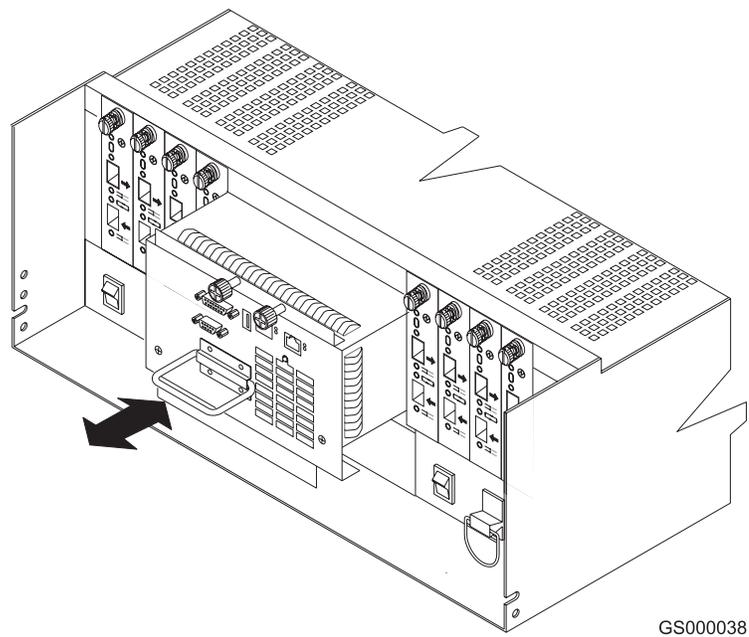


Figure 43. Removing and installing a fan and communications module

- a. Using a flat-blade screwdriver, loosen the two captive screws on the fan and communications module.
- b. Use the pull handle to slide the module out of the slot a few inches.
- c. Grasp the sides of the module with both hands and remove it from the DS4500 Storage Server.

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 43.

3. Unpack the new fan and communications module.
4. Install the new fan and communications module.
 - a. Push the new fan and communications module all the way into its chassis slot.
 - b. Use a flat-blade screwdriver to tighten the two captive screws on the new module, securing it into place.
5. Check the fan and communications indicator light. See Figure 42 on page 55 for the location of the fan and communications indicator light.
 - If the amber fault indicator light is on, make sure that the fan and communications module is inserted all the way into the chassis and secured in place.
 - If the fault indicator light remains on, one or both fans inside the fan and communications module might be malfunctioning. Replace the failed fan and communications module with a spare, if available. Otherwise, shut down the DS4500 Storage Server until you can replace the failed fan and communications module with a new one.
6. Reconnect the interface cables that you disconnected in Step 1 on page 55 to the new fan and communications module.

Power supply

The DS4500 Storage Server power system consists of two power supplies. The power supplies slide into either of the two slots on the back of the DS4500 Storage Server. The power supplies provide power to the internal components by converting incoming ac voltage to dc voltage. The power supplies are interchangeable and redundant. Each power supply uses one power cord. You can plug both power cords into a common power source or plug each cord into a separate circuit for power redundancy. One power supply can maintain electrical power to the DS4500 Storage Server if the other power supply is turned off or malfunctions.

Servicing notes

Consider the following factors when you service the power supplies:

- Each power supply has a built-in sensor that detects the following conditions:
 - Overvoltage
 - Overcurrent
 - Overtemperature

If any of these conditions occur, one or both power supplies enter shutdown mode. All power remains off until one of the following events occurs:

- You cycle the power switches (turn off the power switches, wait at least 30 seconds, then turn on the power switches). For more information, see “Overtemperature condition and power supply shutdown” on page 37.
 - The power supplies automatically resume operation when the ambient air temperature cools to below 70° C (158° F). When the power supplies automatically resume operation, the DS4500 Storage Server also resumes operation.
- You can hot swap (replace) a power supply because the two power supplies provide redundancy.

- Both power supplies have built-in temperature sensors designed to prevent the power supplies from overheating. If a temperature sensor detects an ambient air temperature greater than 70° C (158° F), the “overheated” power supply automatically shuts down. The second power supply remains on as long as its temperature remains below 70° C (158° F). If the second power supply overheats, it turns off all power to the DS4500 Storage Server.

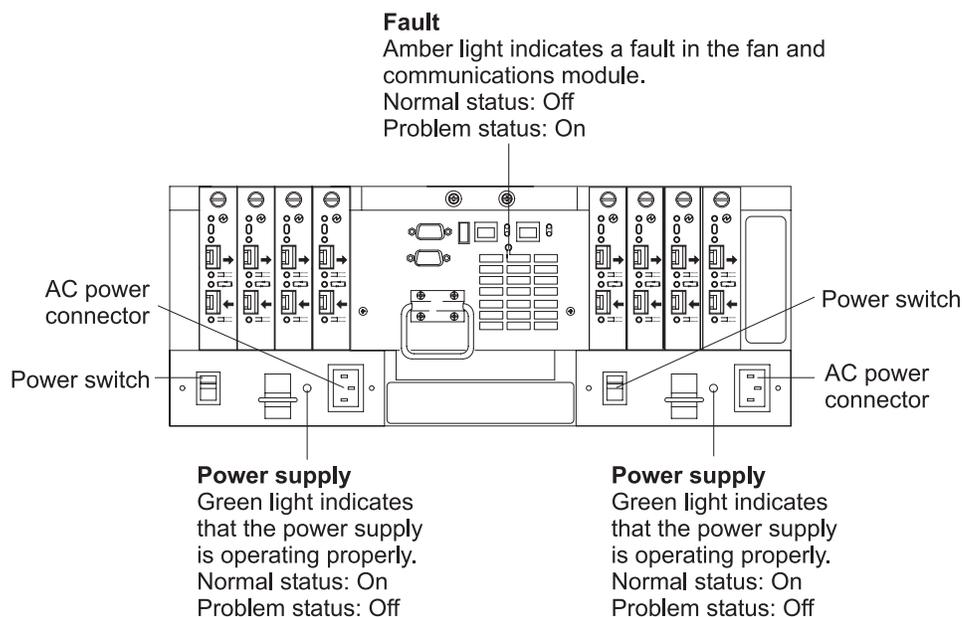
Note: There is a serious problem if the air temperature inside the rack cabinet is hot enough to cause the power supplies to shut down.

- The DS4500 Storage Server is capable of power-up recovery without operator intervention. Once the air temperature cools to below 70° C (158° F), the power supplies automatically restart. An automatic restart resets the controllers, attempts to restart the hard disk drives, which has no effect on the hard disk drives if they are already running, and returns the DS4500 Storage Server to normal operation.
- When a power supply fails, the green power indicator light on the power supply goes off and the amber power supply fault light is lit on the front of the DS4500 Storage Server. For more information, see “Power supply indicator light” on page 32 and “Storage server indicator lights” on page 26.
- If you replace the power supply CRU and still experience problems, the DS4500 Storage Server might have defective components or connections. Check the storage-management software for indications of other component failures.

Replacing a failed power supply

When instructed by the storage-management software, replace a power supply.

1. Check the power supply indicator light on the back of the DS4500 Storage Server, as shown in Figure 44. Be sure that the green power indicator light on the failed power supply is off.



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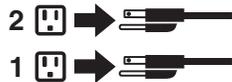
Figure 44. Power supply switch, ac power connectors, and indicator lights

Statement 5:



CAUTION:

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



2. Turn off the power switch and unplug the power cord from the failed power supply (see Figure 44 on page 57).

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.

3. Using Figure 45 on page 59 as a guide, remove the failed power supply. Lift up and pull out on the pull handle to release the power supply. Then slide the unit out.

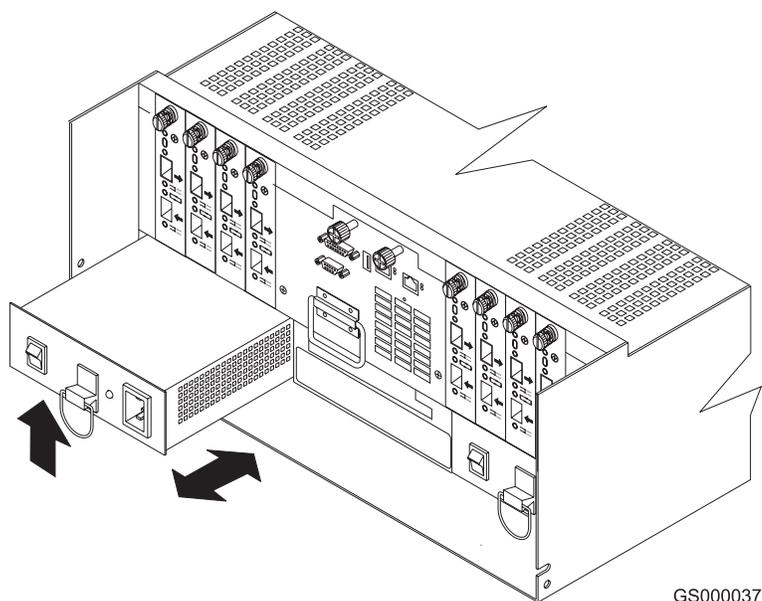


Figure 45. Removing and installing a power supply CRU

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 43.

4. Unpack the new power supply.
5. Install the new power supply, as shown in Figure 45. Using the pull handle, push the power supply into the slot until it locks into place.
6. Plug in the power cord and turn on the power supply switch.
7. Check the new power supply and other DS4500 Storage Server indicator lights for faults. For more information, see “Checking the indicator lights” on page 26.

Small Form-Factor Pluggable (SFP) modules

Small Form-Factor Pluggable (SFP) modules are used to connect mini-hub ports to attached nodes. An SFP module slides into a mini-hub port on the back of the DS4500 Storage Server and then a host or drive-interface cable connects into the SFP module. For more information, see “Fibre Channel connections” on page 4 and “Mini hubs” on page 63.

Servicing notes

Consider the following factors when you service SFP modules:

- 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 mini-hub 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 storage server 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 mini-hub 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 mini hub.
- Four indicator lights on a mini hub provide status information. If an SFP module fails, the corresponding SFP port bypass indicator will be lit on the mini hub. For more information, see “Mini-hub indicator lights” on page 32.
- If you replace the SFP module and still experience problems, the DS4500 Storage Server might have defective components or connections. Check the storage-management software for indications of other component failures.
- Do not mix long-wave SFPs and short-wave SFPs on a single storage server. Use either long-wave SFPs or short-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.

Attention: In addition, do not use long-wave SFPs or GBICs in any of the FC ports in the FC drive loops. (Long-wave SFPs and GBICs are not supported for use in the drive ports of storage expansion enclosures. Long-wave SFPs and GBICs are only supported in the host ports of the DS4000 storage server).

Replacing a failed SFP module

When instructed by the storage-management software, complete the following steps to replace an SFP module from the mini hub.

Statement 3:



CAUTION:

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

- 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 precautions. 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: To avoid damage to the cable or 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 that has failed. For more information, see “Handling fiber-optic cables” on page 5 and “Removing an LC-LC Fibre Channel cable from an SFP module” on page 8.
2. Replace the protective caps on the LC-LC Fibre Channel cables.

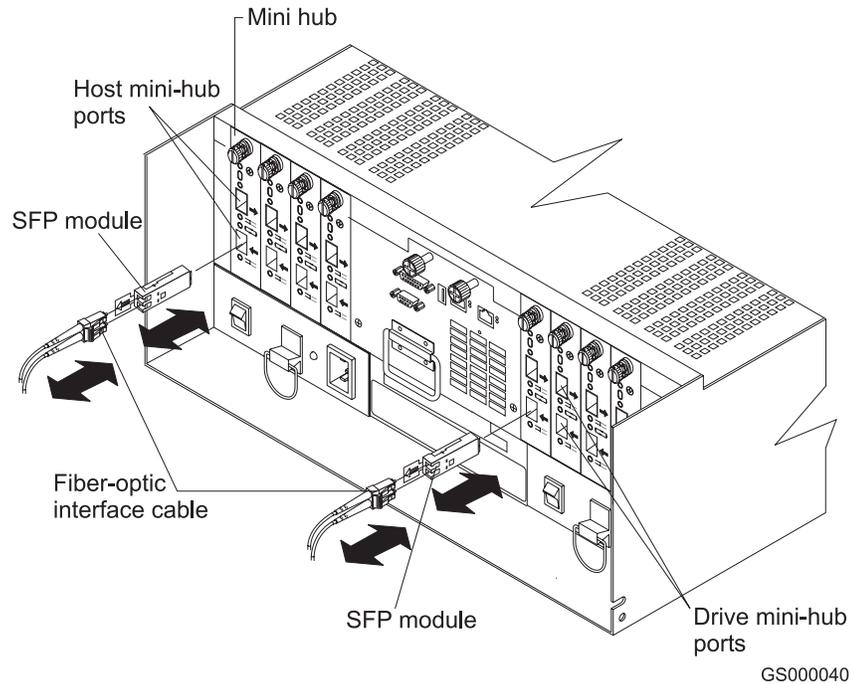


Figure 46. Replacing a failed SFP module

3. 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 47.

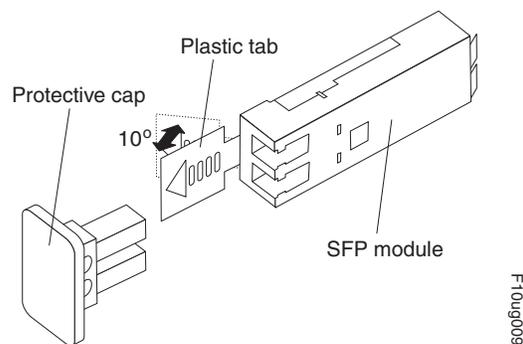


Figure 47. Unlocking the SFP module latch - plastic variety

- For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 48 on page 62.

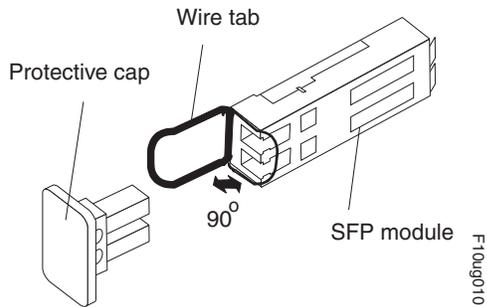


Figure 48. Unlocking the SFP module latch - wire variety

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 43.

4. 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.
5. Replace the protective cap on the SFP module.
6. Unpack the new SFP module.
7. Remove the protective cap from the SFP module, as shown in Figure 49.

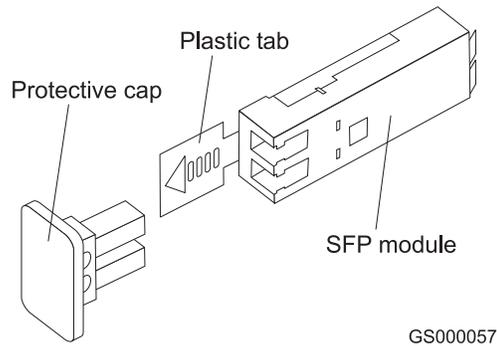


Figure 49. Small Form-Factor Pluggable (SFP) Module

8. Insert the SFP module into the mini-hub port until it clicks into place.

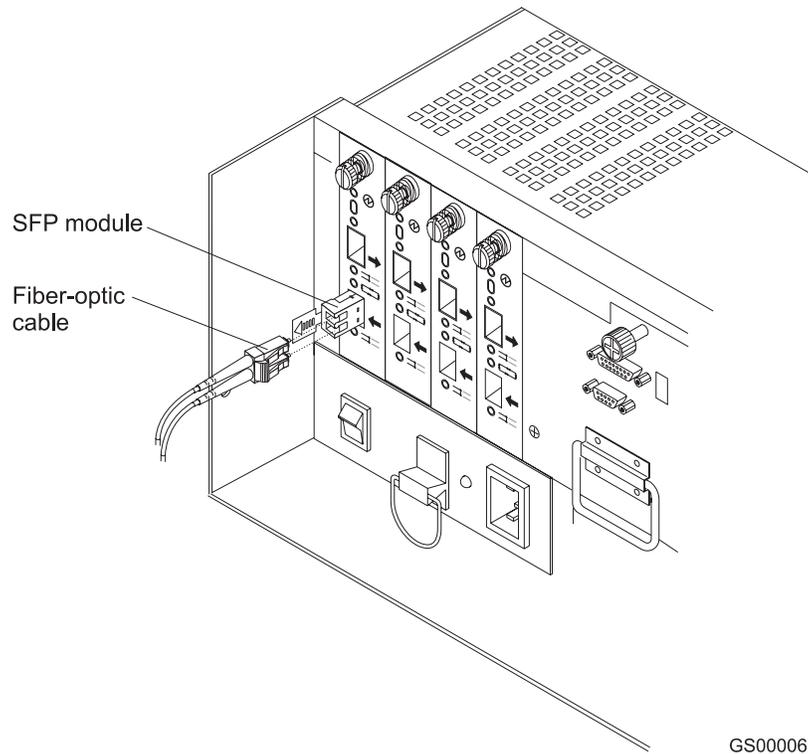


Figure 50. Installing an SFP module in a mini hub

9. Reconnect the fiber-optic cables that you removed in Step 1 on page 61.
10. Check the indicator lights on the mini hub.

When the mini hub is operating properly, the green loop good light is lit and the fault light is not lit. If the mini-hub port is in normal operation, the amber port bypass light is not lit. If a problem is indicated, use the storage-management software to check the DS4500 Storage Server status. For more information, see “Mini-hub indicator lights” on page 32.

Mini hubs

The mini hubs are located on the back of the DS4500 Storage Server (see Figure 52 on page 65). A mini hub is a single, removable unit that provides the Fibre Channel interface between a DS4500 Storage Server and hosts or drives. The back of the DS4500 Storage Server can accommodate eight mini hubs: up to four host-side and up to four drive-side mini hubs. Each mini hub has two ports. An SFP module is installed in a mini-hub port; then, a fiber-optic interface cable is connected into the SFP module. For more information, see “Fibre Channel connections” on page 4 and “Small Form-Factor Pluggable (SFP) modules” on page 59.

Servicing notes

Consider the following factors when you service mini hubs:

- You can hot swap (replace) a failed mini hub while the DS4500 Storage Server is in operation.

- Four indicator lights provide status information. If a mini hub fails, the interface fault and the bypass indicator lights on the mini hub are lit and the loop good indicator light is off. For more information about indicator lights, see “Mini-hub indicator lights” on page 32.
- If you replace the mini hub and the SFP modules in them and still experience problems, the DS4500 Storage Server might have defective components or connections. Check the storage-management software for indications of other component failures.

For more information, see “Fibre Channel connections” on page 4 and “Types of interface ports” on page 12.

Replacing a failed mini hub

When instructed by the storage-management software, replace a mini hub. Use the following procedure to replace either a failed host-side or drive-side mini hub.

Attention: To prevent possible data loss, do not remove cables from a mini hub that has not failed.

Note: You *must* remove the fiber-optic cable from the SFP module before you can remove the SFP module from the mini-hub port.

1. On the mini hub that has failed, remove the fiber-optic cables from the SFP modules, as shown in Figure 51.

For proper handling of fiber-optic cables, see “Handling fiber-optic cables” on page 5.

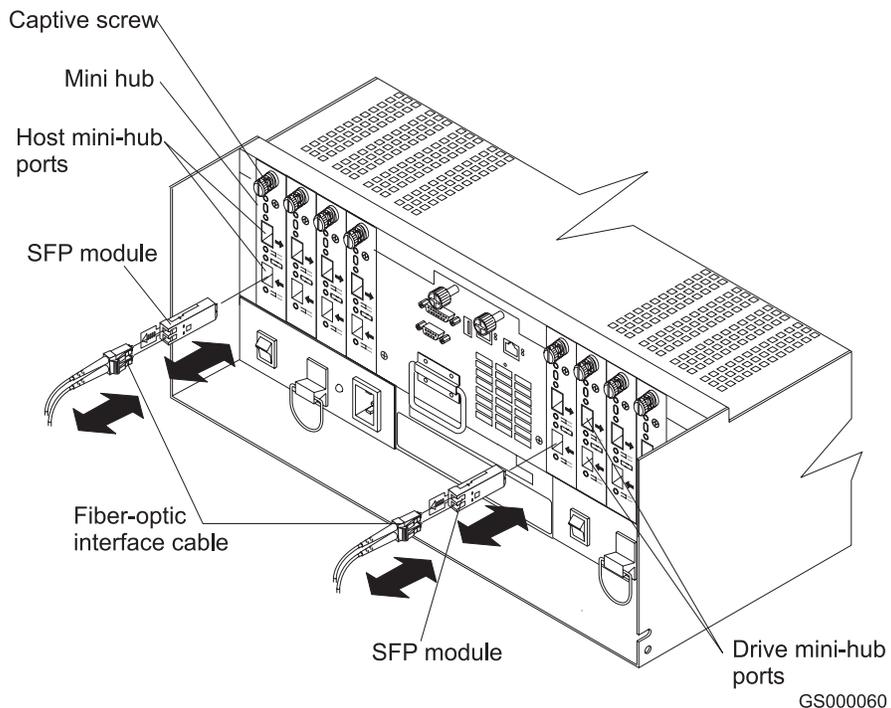
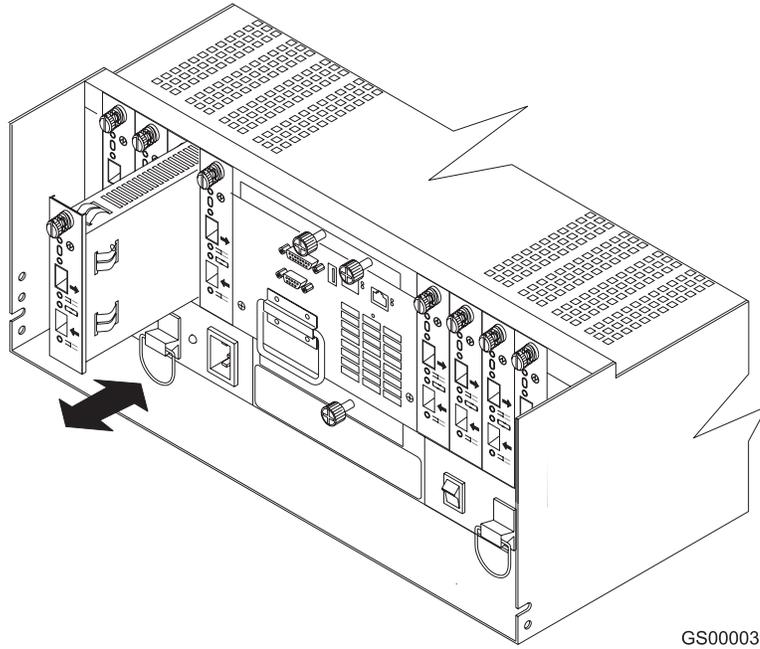


Figure 51. Removing the fiber-optic cable from the SFP module

2. Replace the protective caps on the cables.
3. Remove the SFP modules from the mini hub as follows:

- a. Unlock the SFP module latch by pulling the plastic tab outward 10° and slide the SFP module out of the mini-hub port.
- b. Replace the protective cap on the SFP module.
- c. Place the SFP modules into their static-protective packages.
4. Loosen the captive screw on the mini hub. Then grasp the screw and remove the mini hub from the chassis, as shown in Figure 52.



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Figure 52. Removing and installing a mini hub

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 43.

5. Unpack the new mini hub and slide it into the appropriate slot. Then tighten the captive screw.
6. Install the SFP modules that you removed in Step 4 on page 62 as follows:
 - a. Remove the SFP modules from their static-protective packages.
 - b. Remove the protective caps from the SFP modules.
 - c. Slide the SFP modules into the mini-hub ports.
7. Replace the fiber-optic cables that you removed in Step 1 on page 64.
8. Check the indicator lights on the mini hub.

When the mini hub is operating properly, the green loop good light is lit and the fault light is off. If the mini-hub port is active, the amber port bypass light is not lit. For more information see “Mini-hub indicator lights” on page 32. If a problem is indicated, use the storage-management software to check the DS4500 Storage Server status.

Appendix. 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.

Table 16 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 16. 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.
Alt+ underlined letter	Access menu items, buttons, and other interface components by using the keys associated with the underlined letters. 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. For other interface components, use the Alt + underlined letter combination.
Ctrl+F1	Display or conceal a tool tip when keyboard focus is on the toolbar.
Spacebar	Select an item or activate a hyperlink.

Table 16. DS4000 Storage Manager alternate keyboard operations (continued)

Short cut	Action
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 1000000 bytes, and GB stands for approximately 1000000000 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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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. 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 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.

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

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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, China (Macau S.A.R.), Czech Republic, Egypt, Finland, France, French Guiana, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Ivory Coast, Jordan, Lebanon, Luxembourg, 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

IBM power cord part number	Used in these countries and regions
14F0033	Antigua, Bahrain, Brunei, Channel Islands, China (Hong Kong S.A.R.), Cyprus, Dubai, Fiji, Ghana, 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.

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 data also.

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.

Index

A

- about this document xvii
- accessing components 20
- Australia and New Zealand
 - Class A notice 72
 - electronic emission Class A notice 72

B

- battery 3
 - indicator lights 30
 - fault A 31
 - fault B 31
 - full charge A 31
 - full charge B 31
 - information label 38
 - recycling properly 49
 - replacing 47
 - service date 38
 - servicing notes 46
- best practices 19
- bypass
 - lower port 36
 - upper port 34

C

- cabling instructions xviii
- Canada
 - Class A notice 72
 - electronic emission Class A notice 72
- checking battery service date 38
- Class A electronic emission notice 71
 - Australia and New Zealand 72
 - industry Canada 72
- comments, how to send xxviii
- complete SM SW installation xviii
- components of DS4500 Storage Server
 - back view 3
 - front view 2
- concepts guide xviii
- Concepts Guide xxiii
- configure storage hardware xviii
- configure storage subsystems on host xviii
- connect power xviii
- controller, overview 43
- cooling system 43
- Copy Services Guide xxiii

D

- determine management method xviii
- document organization xxv
- documentation
 - DS4000 Storage Manager xxiii
 - related xxiv
- drive interface ports 13

- DS4000 Storage Manager
 - related documents xxiv
- DS4000 Storage Manager 9
 - user tasks xxiii
- DS4000/FAStT product renaming xvii
- DS4100 Storage Server library xxii
- DS4300 Fibre Channel Storage Server library xxi
- DS4400 Storage Server library xx
- DS4500 Fibre Channel Storage Server library xix
- DS4500 Storage Manager software
 - monitoring with 25
- DS4500 Storage Server
 - components
 - back view 3
 - front view 2
 - components, replacing 43
 - Fibre Channel connections 4
 - moving the 40
 - preparing to move 39
 - RAID controller 43
 - replacing components 43
 - turning power off 23
 - turning power on 22

E

- electrical emission statement
 - Japan 73
 - Taiwan 72
- electronic emission
 - Class A notice 71
 - Australia and New Zealand 72
 - industry Canada 72
 - notices 71
 - Australia and New Zealand 72
 - industry Canada 72
- electrostatic discharge, preventing 43
- emergency shutdown, turning on the power after 38
- emission compliance statement
 - Australia and New Zealand Class A 72
 - Industry Canada Class A 72
- emission statement
 - European Union EMC Directive conformance 72
 - Japanese Voluntary Control Council for Interference (VCCI) statement 73
 - Taiwan electrical emission statement 72
 - United Kingdom telecommunications safety requirement 72
- Ethernet interface ports 17
- European Union EMC Directive conformance statement 72

F

- fan and communications module 4
 - overview 53
 - replacing 54

- fan and communications module *(continued)*
 - servicing notes 54
- fan, storage server
 - overview 50
 - replacing 52
 - servicing notes 51
- FASTT/DS4000 product renaming xvii
- fault 33
- FC cabling instructions xviii
- FC HW maintenance and problem determination guide xviii
- FC planning and integration user's guide and service information xviii
- FC storage server installation guide xviii
- FCC Class A notice 71
- fiber-optic cable
 - handling 5
 - LC-LC connecting 6
 - LC-LC removing 8
 - LC-LC using 5
 - LC-SC connecting 10
 - LC-SC removing 11
 - LC-SC using 9
- Fibre Channel
 - cable
 - connecting LC-LC 6
 - connecting LC-SC 10
 - removing LC-LC 8
 - removing LC-SC 11
 - using LC-LC 5
 - using LC-SC 9
 - overview 1
- Fibre Channel connections 4
- fire suppression xxviii
- front bezel
 - removing 20
 - replacing 21

G
glossary 75

H
hardware installation process xviii
hardware maintenance and problem determination xviii
hardware service and support xxviii
HBA installation and user's guide xviii
host bus adapter installation and user's guide xviii
host interface ports 13

I
IBM DS4500 Storage Server

- operating 19

 important notes 70
 indicator lights

- battery 30
- checking 26
- controller fault 28
- fan and communications fault 31

indicator lights *(continued)*

- fan and communications module 31
- fan and communications module fault 37
- fast write cache 28
- mini hub 32
- power 28
- power supply 32
- power supply fault 28
- RAID controller 28
- storage server fan fault 28

 industry Australia and New Zealand Class A emission compliance statement 72
 industry Canada Class A emission compliance statement 72
 install and verify SM SW on host and workstation xviii
 install network hardware xviii
 install storage expansion enclosure xviii
 install storage server/RAID enclosures in rack xviii
 installation and support OS guides xviii
 installation guide, storage server xviii
 installation planning xviii
 installation process xviii
 interface port

- drive 13
- Ethernet 17
- host 13

J
Japanese Voluntary Control Council for Interference (VCCI) statement 73

L
LC-LC Fibre Channel cable, removing 8
 LC-SC Fibre Channel cable

- connecting 10
- removing 11

 loop good 35

M
make FC connections xviii
migration guide xviii
mini hub indicator light

- drive side 36
- host side 33, 34, 35, 36
- overview 32

 mini hubs 43

- drive side 3
- host side 3
- overview 63
- replacing 64
- servicing notes 63

N
notes

- important 70
- servicing 44, 46, 51, 54, 56, 59, 63

- notices 69
 - Australia and New Zealand Class A emission compliance statement 72
 - electronic emission 71
 - Australia and New Zealand 72
 - industry Canada 72
 - European Union EMC Directive conformance statement 72
 - FCC, Class A 71
 - industry Canada Class A emission compliance statement 72
 - Japanese Voluntary Control Council for Interference (VCCI) statement 73
 - Taiwan electrical emission statement 72
- trademarks 69
- United Kingdom telecommunications safety requirement 72
- used in this document xxvi
- notices, safety xi

O

- online help xviii
- overtemperature condition 37
- overtemperature shutdown, turning on the power after 38
- overview
 - Fibre Channel 1
 - tasks 19

P

- ports
 - drive interface 13
 - Ethernet interface 17
 - host interface 13
 - interface 12
- power
 - turning off 23
 - turning on 22
- power cords 73
- power supply 3
 - indicator lights 32
 - overview 56
 - replacing 57
 - servicing notes 56
 - shutdown 37
- power system 43
- power-off sequence 23
- power-on sequence 22
- powering off the storage server 23
- prepare for SM SW installation xviii
- prepare network connection xviii

R

- RAID controller
 - description 3
 - indicator lights 28
 - fault 30
 - heartbeat 30

- RAID controller (*continued*)
 - indicator lights (*continued*)
 - power 30
 - status 30
 - replacing a failed controller 45
- RAID controller enclosure unit installation guide xviii
- recycling the cache battery 49
- renaming xvii

S

- safety notices xi
- service notes 44
- set link speed xviii
- SFP module
 - overview 59
 - removing protective cap 62
 - replacing 60
 - servicing notes 59
- shutdown
 - emergency 38
 - overtemperature 38
 - power supply 37
- shutdown sequence 23
- SM concepts guide xviii
- SM installation and support guide for Linux xviii
- SM installation and support guide for Novell NetWare xviii
- SM installation and support guide for Windows 2000 xviii
- SM installation and support guide for Windows NT xviii
- software installation process xviii
- software service and support xxvii
- speed 33, 36
- start server xviii
- startup sequence 22
- statements in this document xxvi
- static-sensitive devices, handling 43
- storage expansion enclosure
 - turning off 23
 - turning on before storage server 22
- storage expansion enclosure installation guide xviii
- storage expansion enclosures
 - compatibility 14
 - intermixing 14
- storage server fan 3
 - overview 50
 - replacing 52
 - servicing notes 51
- storage server indicator lights 26
- storage server installation guide xviii

T

- Taiwan electrical emission statement 72
- telecommunications safety requirement, United Kingdom 72
- trademarks 69
- turning on the power
 - after an emergency shutdown 38
 - after an overtemperature shutdown 38

turning power off 23
turning power on 22

U

United Kingdom, telecommunications safety
requirement 72

United States

electronic emission Class A notice 71
FCC Class A notice 71

user tasks

DS4000 Storage Manager xxiii
DS4100 Storage Server xxii
DS4300 Fibre Channel Storage Server xxi
DS4400 Fibre Channel Storage Server xx
DS4500 Fibre Channel Storage Server xix
related documents xxiv

V

verify server operation w/ LEDs xviii

views

back 3
front 2

W

web sites, related xxvii

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