IBM TotalStorage FAStT600
Fibre Channel Storage Server

IBM

Installation and User's Guide

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Fibre Channel Storage Server

Installation and User's Guide

> **Note:**
> Before using this information and the product it supports, be sure to read the general information in "Notices" on page 89.

Safety

Before installing this product, read the Safety information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الآمنية

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

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

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si přečtěte příručku bezpečnostních instrukcí.

Læs sikkerhedsforskrifterne, før du installerer dette produkt.

Lees voordat u dit product installeert eerst de veiligheidsvoorschriften.

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

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

Vor der Installation dieses Produkts die Sicherheitshinweise lesen.

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

לפני שתתקינו מוצר זה, קראו את הוראות הבטיחות.

A termék telepítése előtt olvassa el a Biztonsági előírásokat!

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

製品の設置の前に、安全情報をお読みください。

본 제품을 설치하기 전에 안전 정보를 읽으십시오.

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

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

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

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

Перед установкой продукта прочтите инструкции по
технике безопасности.

Pred inštaláciou tohto zariadenia si pečítaje Bezpečnostné predpisy.

Pred namestitvijo tega proizvoda preberite Varnostne informacije.

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

Läs säkerhetsinformationen innan du installerar den här produkten.

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

Statement 3

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

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

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

Class 1 laser statement

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

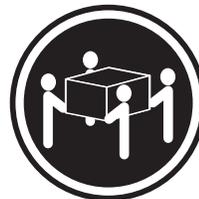IEC 825-1:1993 CENELEC EN 60 825

Statement 4
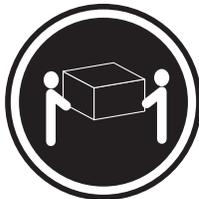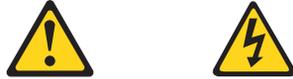

≥18 kg (37 lbs)   ≥32 kg (70.5 lbs)   ≥55 kg (121.2 lbs)
CAUTION:
Use safe practices when lifting.

Statement 5

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

Statement 8:

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

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

Contents

Figures

Tables

About this document

This document provides instructions on how to install the IBM® TotalStorage™ FAStT600 Storage Server.

Who should read this document

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

How this document is organized

Chapter 1, "Introduction," on page 1 describes the storage server and includes an overview of the storage server features and components.

Chapter 2, "Installing and configuring the storage server," on page 11 contains information about installing the storage subsystem configuration and gives Fibre Channel loop configuration examples.

Chapter 3, "Cabling the storage server," on page 27 contains information about cabling the storage server to other devices.

Chapter 4, "Operating the storage server," on page 37 describes the tasks that are required to operate the storage server, including the proper sequences for powering the storage subsystem on and off.

Chapter 5, "Installing and replacing components," on page 49 contains step-by-step instructions for installing and removing the storage server components.

Chapter 6, "Solving problems," on page 83 contains symptoms of storage server problems and possible solutions.

"Records," on page 87 provides a form on which you can record and update important information about the storage server, including serial number and device records. When you add components to the storage server, be sure to update the information in this appendix.

FAStT installation process overview

The following flow chart gives an overview of the FAStT hardware and the FAStT 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.

Install Process

- Plan Installation
- Install Storage Server/RAID Controller Enclosure(s) in Rack
- Install Storage Expansion Unit(s)
- Make FC Connections
- Set Link Speed (1 Gb only)
- Determine Management Method — Out-of-Band / In-Band
- Install Network Hardware; Prepare Network Connection

* For pSeries Server and 6227 or 6228 HBA use only

Documentation

- FC Planning and Integration: User's Guide and Svc Info
- FAStT Storage Manager Concepts Guide
- FAStT Storage Svr Installation Guide
- FAStT RAID Controller Enclosure Unit Install and User's Guide
- FAStT Storage Exp Units Install and User's Guides
- FAStT and HBA Install and User's Guides
- FAStT Fibre Channel Storage Server Installation Guides
- Fibre Channel Cabling Instructions

- Connect Power and Start Server
- Verify Server operation w/ LEDs
- Prepare for Installation of SM Software
- Install and Verify SM SW on Host and Workstation
- Complete SM SW Installation
- Configure Storage Hardware
- Configure Storage Subsystems on Host

- FAStT Storage Server Installation Guides
- Fibre Channel Hardware Maintenance and Problem Determination Guide
- FAStT Storage Manager Installation and Support OS Guides
- FAStT Storage Manager Copy Services User's Guide
- Online Help

Figure 1. Installation process flow by current publications

FAStT documentation

The following tables present an overview of the FAStT Storage Manager and the FAStT600 Fibre Channel 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. Click on active links in the tables to access those documents currently available on the Internet. You can access documentation for the other FAStT products at the following Web site:

ssddom02.storage.ibm.com/techsup/webnav.nsf/support/fastt/

FAStT600 Fibre Channel Storage Server library

Table 1 associates each document in the FAStT600 Fibre Channel Storage Server library with its related common user tasks.

Table 1. TotalStorage FAStT600 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage FAStT600 Fibre Channel Storage Server Installation and User's Guide, GC26-7531	✔	✔		✔		
IBM TotalStorage FAStT Fibre Channel Hardware Maintenance Manual and Problem Determination Guide, GC26-7528						✔
IBM TotalStorage FAStT FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7532		✔			✔	
IBM TotalStorage FAStT600 Rack Mounting Instructions, 24P8125	✔	✔				
IBM TotalStorage FAStT600 Cabling Instructions, 24P8126	✔	✔				

FAStT Storage Manager Version 8.3 and 8.4 library

Table 2 on page xviii and Table 3 on page xix associate each document in the FAStT Storage Manager library with its related common user tasks.

Table 2. TotalStorage FAStT Storage Manager Version 8.3 titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage FAStT Storage Manager 8.3 Installation and Support Guide for Windows® NT and Windows 2000, GC26-7522	X		✔	✔		
IBM TotalStorage FAStT Storage Manager 8.3 Installation and Support Guide for Linux, GC26-7519	✔		✔	✔		
IBM TotalStorage FAStT Storage Manager 8.3 Installation and Support Guide for Novell NetWare, GC26-7520	✔		✔	✔		
IBM TotalStorage FAStT Storage Manager 8.3 Installation and Support Guide for UNIX and AIX Environments, GC26-7521	✔		✔	✔		
IBM FAStT Remote Mirror Option Installation and User's Guide, 48P9821	✔		✔	✔	✔	

Table 2. TotalStorage FAStT Storage Manager Version 8.3 titles by user tasks (continued)

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM FAStT Storage Manager Script Commands (see product CD)				✔		
IBM FAStT Storage Manager Version 7.10 Concepts Guide, 25P1661	✔	✔	✔	✔	✔	✔

Table 3. TotalStorage FAStT Storage Manager Version 8.4 titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage FAStT600 Turbo Option and Storage Manager 8.4 Library Guide and Common Index, GC26-7600-00	✔	✔	✔	✔	✔	✔
IBM TotalStorage FAStT Storage Manager 8.4 Installation and Support Guide for Intel-based Operating System Environments, GC26-7589	✔		✔	✔		
IBM TotalStorage FAStT Storage Manager 8.4 Installation and Support Guide for AIX®, UNIX, and Solaris, GC26-7593	✔		✔	✔		
IBM TotalStorage FAStT Copy Services User's Guide, GC26-7561	✔		✔	✔	✔	
IBM FAStT Storage Manager Script Commands (see product CD)				✔		

Table 3. TotalStorage FAStT Storage Manager Version 8.4 titles by user tasks (continued)

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage FAStT Storage Manager 8.4 Concepts Guide, GC26-7560	✔	✔	✔	✔	✔	✔

FAStT-related documents

Table 4 associates each of the following documents related to FAStT operations with its related common user tasks.

Table 4. TotalStorage FAStT related document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
IBM Safety Information, P48P9741					✔	
IBM Netfinity® Fibre Channel Cabling Instructions, 19K0906		✔				
IBM Fibre Channel SAN Configuration Setup Guide, 25P2509	✔		✔	✔	✔	

Notices used in this document

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

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

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/storage/techsup.htm
- 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 FAStT information, go to the following Web site:

  www.ibm.com/storage/techsup.htm

  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.ibmlink.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.ibm.com/pc/intellistation/

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

  www.storage.ibm.com/disk/fastt/pdf/0217-03.pdf

Software service and support

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

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

For more information about the IBM Support Line and other IBM services, go to the following Web sites:
- www.ibm.com/services/
- www.ibm.com/planetwide/

Hardware service and support

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

www.ibm.com/planetwide/

In the U.S. and Canada, hardware service and support is available 24 hours a day, 7 days a week. In the U.K., these services are available Monday through Friday, from 9 a.m. to 6 p.m.

Fire suppression systems

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

Table 7 on page 9 lists the environmental specifications for the FAStT600.

How to send your comments

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

  Submit your comments electronically to:

  starpubs@us.ibm.com

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

- Mail or fax

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

  International Business Machines Corporation
  RCF Processing Department
  Dept. M86/Bldg. 050-3
  5600 Cottle Road
  San Jose, CA 95193-0001
  U.S.A

  When you send information to IBM, you grant IBM a nonexclusive right to use or distribute the information in any way it believes appropriate without incurring any obligation to you.

Chapter 1. Introduction

IBM FAStT (Fibre Array Storage Technology) solutions support the large and growing data storage requirements of business-critical applications. These scalable IBM FAStT solutions offer you data access and protection to meet your existing enterprise storage requirements and prepare for the future.

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

Fibre channel technology supports applications that require large amounts of disk storage that is shared by two or more servers. With fibre channel, you can see a higher throughput rate over longer distances than is possible with small computer system interface (SCSI) or with serial storage architecture (SSA) technology.

The IBM TotalStorage FAStT600 Storage Server (Machine Type 1722, Models 60U and 60X) comes with two RAID controllers, two power supplies, and two cooling units and provides dual, redundant controllers, redundant cooling, redundant power, and battery backup of the RAID controller cache. The FAStT600 Storage Server is designed to provide maximum host and driveside redundancy. Each RAID controller supports direct attachment of one host that contains one or two host adapters.

The standard FAStT600 supports up to a maximum of three expansion units. In order to support up to seven EXP700s, the FAStT600 Turbo option must be purchased. The Turbo option consists of the following items:

- Two 1 GB cache RAID controllers
- Storage Manager and firmware at 8.4 level
- License for connecting up to seven EXP700s

FAStT600 supports up to fourteen internal disk drive modules, supporting over 2 TBs of storage capacity when using 146 GB drives. Additional storage can be added to the FAStT600 with up to seven FAStT EXP700s using optional EXP700 attachment features as shown in Table 5.

Table 5. Additional storage features available for the FAStT600 Storage Server

Expansion Units	Number of Drives	Feature Number	Part No.
Two EXP700s	15 to 42 drives	7360	24P8066
First additional EXP700	15 to 28 drives	7361	24P8169
Second additional EXP700	29 to 42 drives, can be purchased only after Feature number 7361	7362	24P8151
Third additional EXP700	43 to 56 drives, can be purchased only after Feature number 7362	7363	24P8183
Three EXP700s	15 to 56 drives	7368	24P8180

Table 5. Additional storage features available for the FAStT600 Storage Server (continued)

Expansion Units	Number of Drives	Feature Number	Part No.
Seven EXP700s Also include 1GB cache controller upgrade and Storage Manager 8.4 client and controller firmware.	15 to 112 drives	2000 (for the 1722–60U) or 2010 (for the 1722–60X)	24P8215 (for the 1722–60U) 24P8216 (for the 1722–60X)

By using these features and the 14 internal disk drive modules, you can attach up to 112 disk drives to the FAStT600 with individual drive module capacities that range from 36.4 GB to 146.8 GB.

Features at a glance

Table 6 summarizes the features of the storage server. For a list of the operating specifications, such as weight, height, and heat output, see Table 7 on page 9.

Table 6. Features at a glance

General	User interface / Disk drive storage / Attached Expansion Units	RAID controllers

General
• Modular components:
  – High-capacity disk drives
  – RAID controllers
  – Power supplies
  – Cooling fans
• Technology:
  – Support for disk arrays
  – Support for clustering
  – Fibre Channel host interface
  – Redundant data storage, cooling system, power system, and RAID controllers
  – Hot-swap technology for drives, power supplies, fans, and RAID controllers
	• User interface:
	  – Built-in power, activity, and fault Light Emitting Diodes (LEDs)
	  – Identification labeling on customer replaceable units (CRUs), rear LEDs, switches, and connectors
	  – Easy-to-replace drives, power supplies, RAID controllers, and fans
	
	Disk drive storage
	  2Gb Fibre Channel enclosure
	  Maximum drives per storage server: 14
	
	Attached Expansion Units
	  Attachment of drive expansion units (EXP700s) requires one or more EXP700 Attachment option (or feature) upgrades for the FAStT600
	  2 Gb connection only
		RAID controllers
		• Technology and interfaces:
		  – Fibre channel: 40-pin FC disk drives
		  – Fibre Channel interface: six small form-factor pluggable (SFP) modules for incoming and outgoing FC cables (three SFPs on each RAID controller)
		  – Two 2Gb Fibre Channel host side connections per controller

Clustering support

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

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

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

Inventory checklist

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

Hardware

IBM FAStT600 Storage Server comes with the following components:
- Two RAID controllers
- Two fan units
- Two power supplies
- Two power cords
- 14 filler panels
- Rack-mounting hardware kit (1)
  - Two rails (right and left assembly)
  - Ten M6 screws
  - Ten M6 cage nuts
  - Ten M6 clip nuts

Software and documentation
- IBM FAStT Storage Manager software according to the following options:
  - For the FAStT600 standard option, IBM FAStT Storage Manager Version 8.3 CD including client and firmware, and online help and publications in Adobe Acrobat Portable Document Format (PDF)
  - If the FAStT 600 is shipped from the factory with the Turbo Option controllers preinstalled in the storage subsystem, IBM FAStT Storage Manager Version 8.4 CD including client and firmware, and online help and publications in Adobe Acrobat Portable Document Format (PDF)

For a list of available IBM FAStT publications, see "FAStT documentation" on page xvi.
  - Rack Mounting Assembly kit, including:
    - Rack mounting installation instructions
    - Rack mounting template (for aligning the rails properly)
    - White tape dots for marking the holes in the rack
  - Fibre Channel cabling instructions

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

If you have not already done so, record your storage server serial number in the table in "Records," on page 87.

Handling static-sensitive devices

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

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

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

Best practices guidelines

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

- Back up the data on your storage drives periodically.
- To maintain power redundancy, plug the FAStT600 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 FAStT drive enclosures attached to the FAStT600 Storage Server should be plugged into the same two independent external power circuits as the FAStT600 Storage Server. This ensures that the FAStT600 Storage Server and all its attached drive 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. See Figure 32 on page 34 for an example of redundant power connections.
- Before any planned system shutdown or after any system changes (additions, removals, or modifications), save controller subsystem profiles as explained in the storage manager guide for your operating system.
- Ensure that your system is in an optimal state before 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 power-up sequence listed in "Turning on the storage server" on page 38. 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.
- The storage subsystem supports simultaneous power-up to the system components; however, you should always follow the power-up sequence listed in "Turning on the storage server" on page 38 during any attended power-up procedure.
- A storage system in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, call IBM support if any of the following conditions occur:

– The storage subsystem logical drives and arrays are not displayed in the Storage Manager graphical user interface (GUI).
– The storage subsystem logical drives and arrays do not come online.
– The storage subsystem logical drives and arrays seem to be degraded.

Storage server components

The following sections show the components of the storage server.

The hot-swap features of the storage server enable you to remove and replace hard disk drives, power supplies, RAID controllers, and fans without turning off the storage server. Therefore, you can maintain the availability of your system while you remove, install, or replace a hot-swap device.

Front view

Figure 2 shows the components and controls on the front of the storage server.
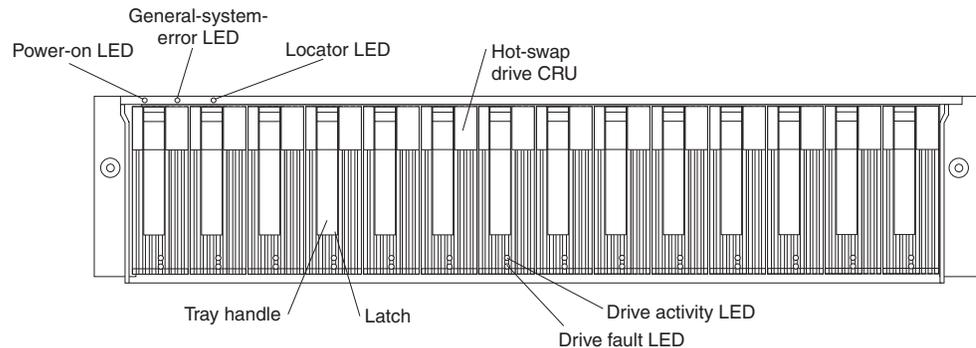
Figure 2. Front controls and components

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

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

    Note: If the General-system-error LED is on continuously (not flashing), there is a problem with the storage server. Use the storage-management software to diagnose and repair the problem. For more information, see "Checking the LEDs" on page 42.

Locator LED
    When on, this blue light indicates that the storage-management software is locating the server.

Hot-swap drive CRU
    You can install up to 14 hot-swap drive customer replaceable units (CRUs) in the storage server. Each drive CRU consists of a hard disk drive and tray.

Filler panel

The storage server comes without drives installed and contains filler panels in the unused drive bays. Before installing new drives, you must remove the filler panels and save them. Each of the 14 bays must always contain either a filler panel or a drive CRU to ensure proper cooling, air ventilation, and EMI compliance.

Drive activity LED

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

Drive fault LED

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

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

Tray handle

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

For information on how to install and replace drive CRUs, see "Working with hot-swap drives" on page 59. For more information about the LEDs, see "Checking the LEDs" on page 42.

Back view

Figure 3 shows the components at the back of the storage server.
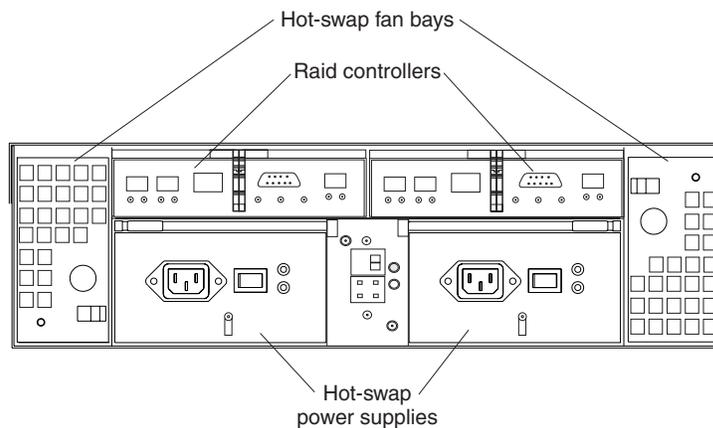
Figure 3. Back view of FAStT600 storage server

RAID controller

Each RAID controller contains three ports for Small Form-Factor Pluggable (SFP) modules that connect to the Fibre Channel cables. Two SFPs can connect to two host systems. The third SFP is used to connect additional expansion units to the storage server.

Each RAID controller also contains a battery to maintain cache data in the event of a power failure. For more information, see "Cache memory and RAID controller battery" on page 46.

Hot-swap fans

The storage server has two interchangeable hot-swap and redundant fan CRUs. Each fan CRU contains two fans. If one fan CRU fails, the second fan CRU continues to operate. You must install both fan CRUs to maintain proper cooling within the storage server, even if one fan CRU is not operational.

Hot-swap power supplies

The storage server comes with two hot-swap power supplies. You must install both power supplies to maintain proper cooling.

Interface ports and switches

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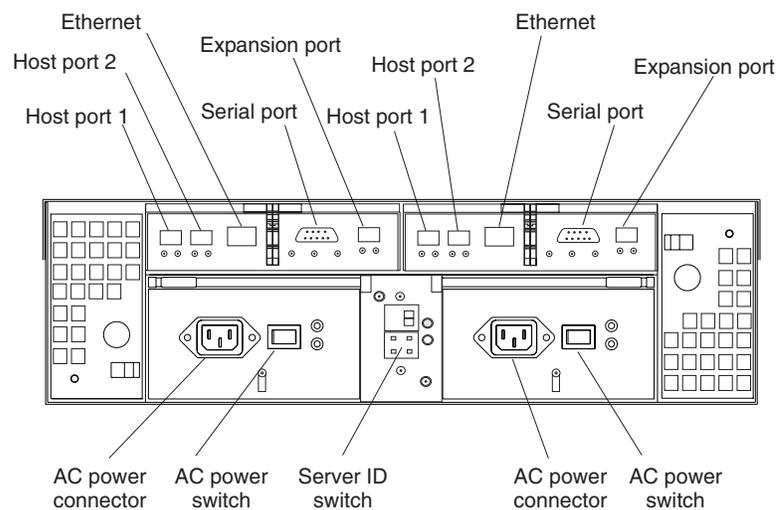
Figure 4. Interface ports and switches

RAID controller

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

Host ports

The host ports are used to connect a Fibre Channel cable from the host systems. You first insert an SFP into the port and then connect a Fibre Channel cable. The two host ports in each controller are independent. They are not connected in the controller module as they would be in a hub configuration.

Ethernet port

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

Expansion port

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

Note: You must purchase options to enable the attachment of additional FAStT EXP700 Expansion Units. See Table 5 on page 1 for more information.

Serial port

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

Server ID switch

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

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

Operating specifications

The following table summarizes the operating specifications of the storage server.

Table 7. FAStT600 storage server operating specifications

Size (with front panel and without mounting rails)	Environment	Acoustical noise emissions values

• Depth: 59.7 cm (23.6 in)
• Height: 13.2 cm (5.2 in)
• Width: 48 cm (18.9 in)
 	
Heat output
• 390 watts (1330 BTU/hr)
 	
Weight
• Standard storage server as shipped: 39.10 kg (86.2 lb)
• Unit weight: 31.48 kg (69.4 lb)
 	
Electrical input
• Sine-wave input (50 to 60 Hz) is required
• Input voltage:
  – Low range:
    - Minimum: 90 V ac
    - Maximum: 136 V ac
  – High range:
    - Minimum: 198 V ac
    - Maximum: 264 V ac
  – Input kilovolt-amperes (kVA) approximately:
    - Minimum configuration: 0.06 kVA
    - Maximum configuration: 0.37 kVA
	• Air temperature:
	  – Storage server on:
	    10° to 35°C
	    (50° to 95°F)
	    Altitude: 0 to 914 m (3000 ft.)
	  – Storage server on:
	    10° to 32°C
	    (50° to 90°F)
	    Altitude: 914 m (3000 ft.) to 2133 m (7000 ft.)
	• Humidity:
	  – 8% to 80%
		For open bay (0 drives installed) and typical system configurations (14 hard disk drives installed).
		• Sound power (idling):
		  – 6.3 bels (open bay)
		  – 6.5 bels (typical)
		• Sound power (operating):
		  – 6.3 bels (open bay)
		  – 6.8 bels (typical)
		• Sound pressure (idling):
		  – 47 dBA (open bay)
		  – 49 dBA (typical)
		• Sound pressure (operating):
		  – 47 dBA (open bay)
		  – 53 dBA (typical)
		
		These levels are measured in controlled acoustical environments according to ISO 7779 and are reported in accordance with ISO 9296. The declared sound power levels indicate an upper limit, below which a large portion of machines operate. Sound pressure levels in your location might exceed the average 1-meter values stated because of room reflections and other nearby noise.

Heat output, airflow, and cooling

The maximum heat output of the FAStT600 is 390 watts (1330 BTU/hr). Each FAStT600 (machine type 1722) and drive expansion (EXP700) rack-mounted unit requires an airflow of 2.5 m³ per minute (87 ft³ per minute). The input air temperature to all racks is recommended to be in the range 10°C through 35°C (50°F through 95°F), with a recommended operating temperature of 22°C (72°F).

When racks that contain many 1722 units are to be installed together, the following requirements must be met to ensure that the 1722 units are adequately cooled:

- Air enters at the front of the rack and leaves at the back. To prevent the air that is leaving the rack from entering the intake of another piece of equipment, racks must be positioned in alternate rows, back-to-back and front-to-front. This arrangement is known as "Cold Aisle / Hot Aisle" and is shown in Figure 5 on page 10.

- Where racks are in rows, each rack must touch the rack that is next to it to reduce the amount of hot air that can flow around from the back of the rack into the intakes of the 1722 units that are in that rack. You should use Suite Attach Kits to completely seal any gaps that remain between the racks. For details of Suite Attach Kits, contact your marketing representative.

- Where racks are in rows front-to-front or back-to-back, a gap of at least 1220 mm (48 in.) must separate the rows across the cold aisle.

- To ensure correct airflow in each rack, the rack filler plates must be installed in unused positions. Also, all the gaps in the front of the racks must be sealed, including the gaps between the 1722 units.
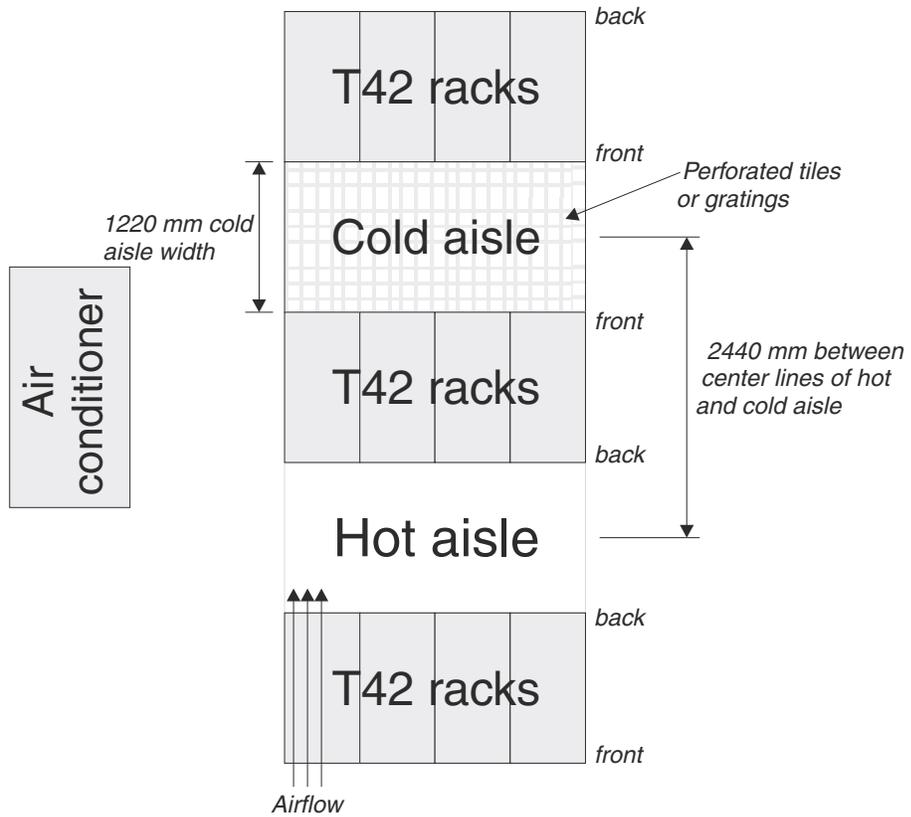
Figure 5. Example of Cold Aisle/Hot Aisle rack configuration

Chapter 2. Installing and configuring the storage server

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

Getting started

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

1. Prepare the site to meet all area, environmental, power, and site requirements. For more information, see "Operating specifications" on page 9.
2. Move the storage server and its rack cabinet to the site.
3. Remove the storage server from its shipping container and check the contents (for a list of items, see "Inventory checklist" on page 3.) If any items are missing, contact your IBM reseller before you proceed.
4. Assemble the tools and equipment that you will need for installation. These might include:
   - Power cords (come with the storage server)
   - Screwdrivers (various sizes)
   - Antistatic protection (such as a grounding wrist strap)
   - SFPs
   - Fibre Channel and Ethernet interface cables and cable straps
   - Rack-mounting hardware (comes with the storage server)
   - Storage-management software to configure the storage subsystems (comes with the storage server on the *IBM TotalStorage FAStT Storage Manager 8.3* installation CD.)

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

After you install the storage server in the rack and configure the storage server, go to Chapter 3, "Cabling the storage server," on page 27.

Rack mounting template and instructions

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

FRONT
Rack Mounting
Template

Bezel
(**Front Left**)

Bezel
(**Front Right**)

Rail assembly
(**Front Left**)

Rail assembly
(**Front Right**)
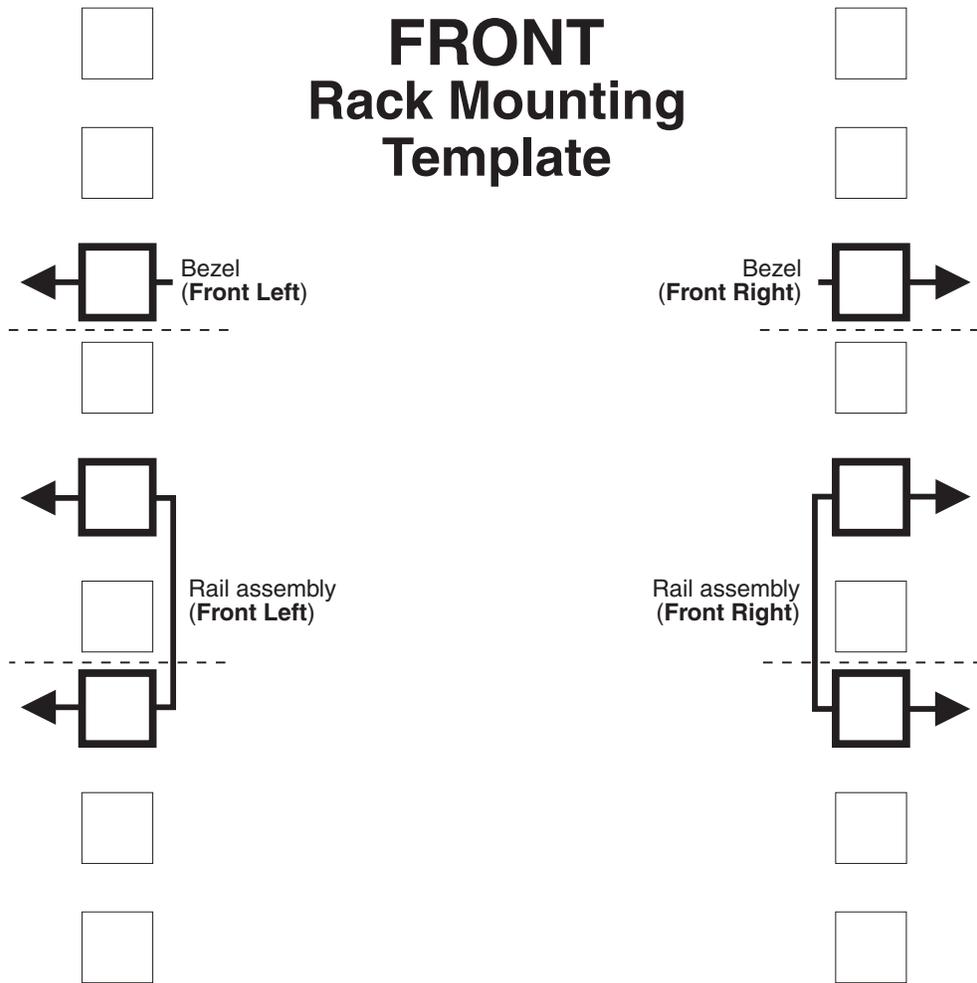
Figure 6. Front rack mounting template

REAR
Rack Mounting
Template

Rail assembly
(**Rear Left**)

Rail assembly
(**Rear Right**)

IBM®

P/N 06P4631
Printed in the U.S.A.
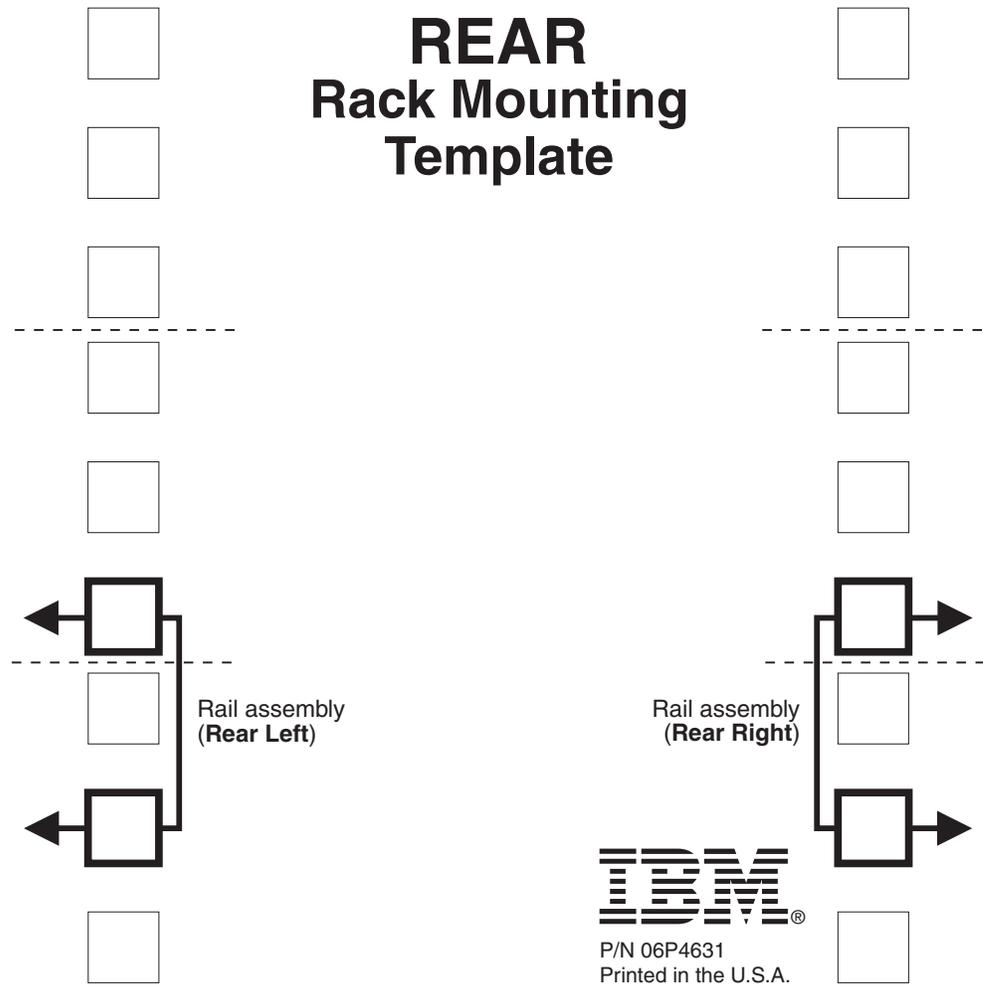
Figure 7. Rear rack mounting template

Installing the storage server in a rack

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

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

Statement 4:

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

CAUTION:
Use safe practices when lifting.

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

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

Note:

See the storage server documentation for handling guidelines before you remove any ESD-sensitive devices.

Perform the following steps to install the storage server in a rack. The first four steps for the installation procedure involve removing some components from the storage server in order to reduce the weight of the storage server for easier installation.

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

   If you have a second RAID controller, repeat this step for the second controller.
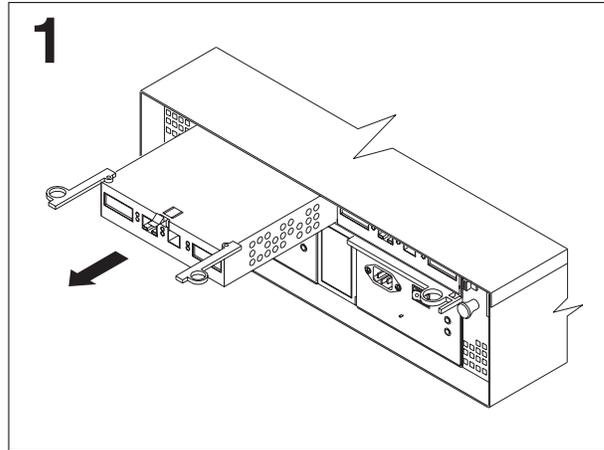
Figure 8. RAID controller removal

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

   Repeat this step for the other fan and set both fans aside for later installation.
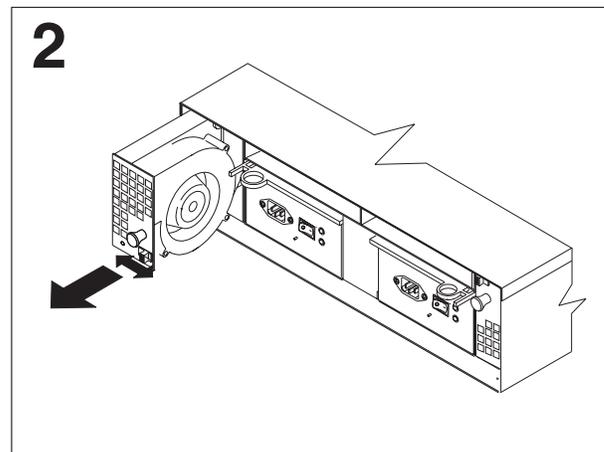
Figure 9. Hot-swap fan removal

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

   Repeat this step for the other power supply; then set both power supplies aside for later installation.
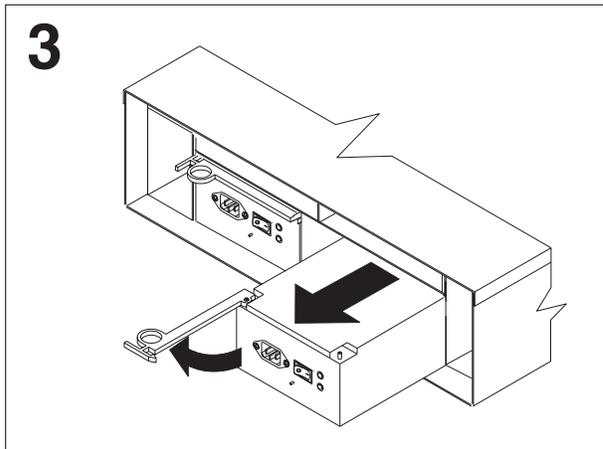
Figure 10. Power supply removal

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

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

    Repeat this step for all hard disk drives.
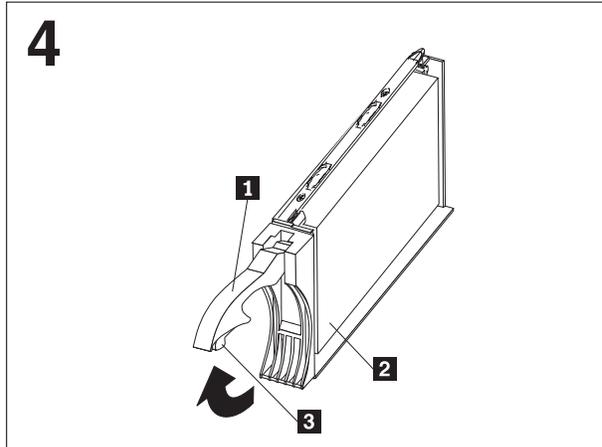
Figure 11. Hard disk drive removal

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

    Note: Use the cage-nut-insertion tool or a flat-blade screwdriver to install cage nuts.
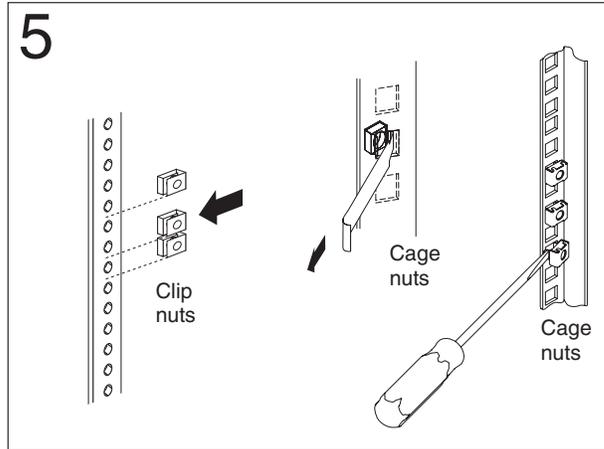
Figure 12. Rack nut installation

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

   Extend the rear of the rail outside of the rear rack-mounting-flange; then install and tighten two M6 screws **4** . Tighten the front screws **1** and repeat this step for the other rail.
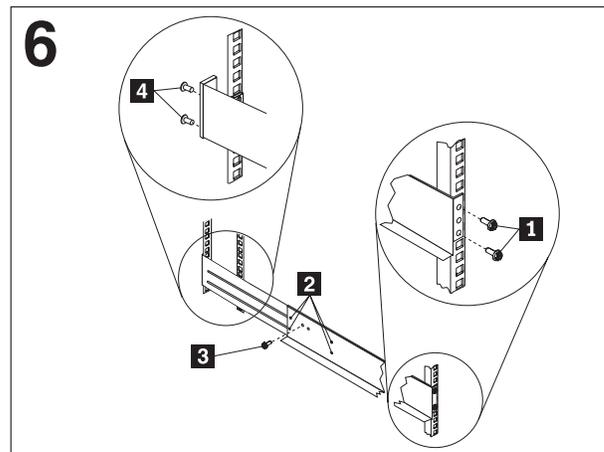
Figure 13. Rail extension

7. Tighten the rail adjustment screws **1** on both rails.
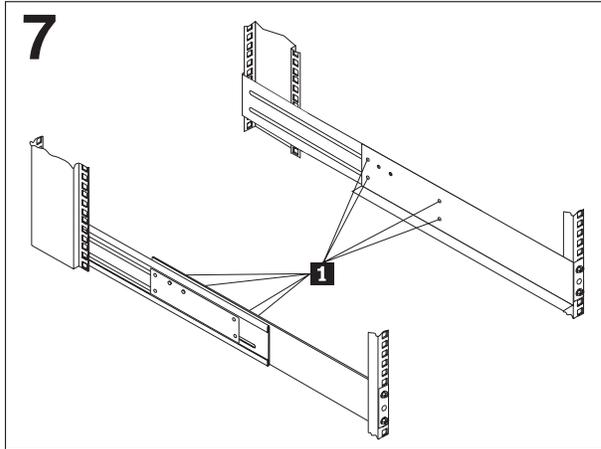
Figure 14. Rail adjustment screws

8. Remove the white screws and nuts **1** from the storage server bezel; then slide the storage server into the rack. Align the bezel locator pins and attach the bezel with two M6 screws **2** ; then install and tighten the 6-32 in. screws **3** .
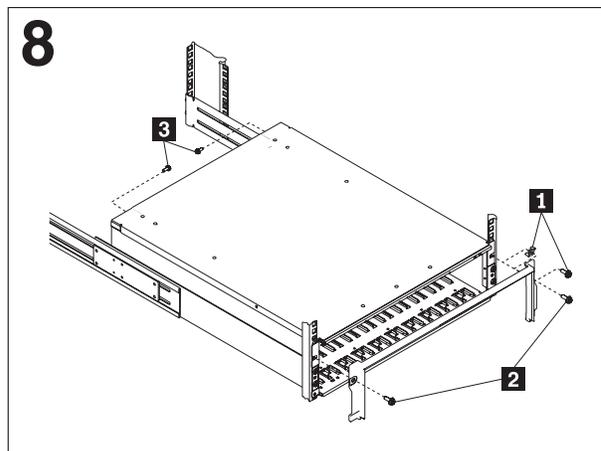
Figure 15. Server installation

9. Reverse step 1 through step 4 to reinstall the components that you removed. See your storage server documentation to complete your installation. Store this information with the storage server documentation for future use.

Setting server ID settings

The FAStT600 comes with a server ID switch that is used to identify the FAStT600 on a Fibre Channel loop. The server ID switch is located on the back of the unit, as shown in Figure 16 on page 19.
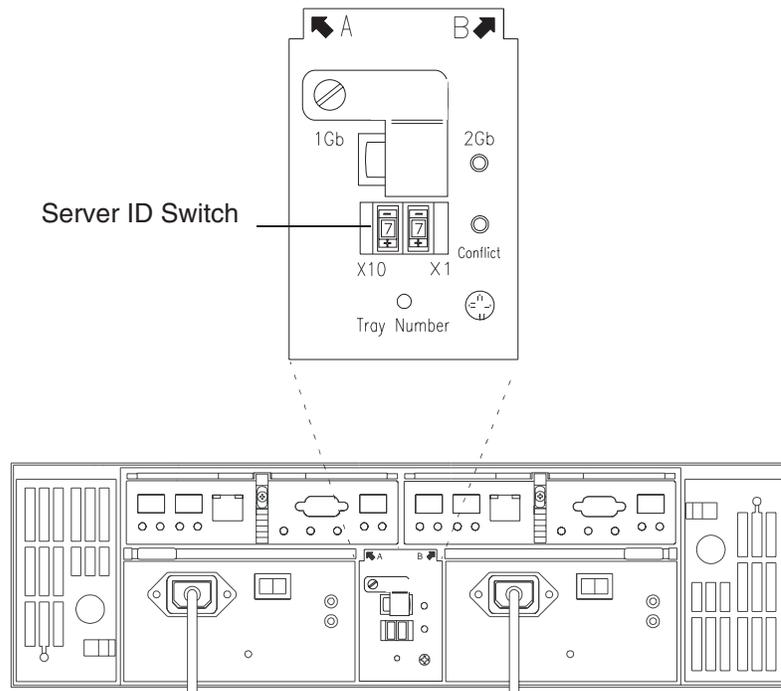
Figure 16. Setting the Server ID

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

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

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

Configuring the storage subsystem

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

Storage subsystem management methods

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

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

Host-agent management method

This method requires host-agent software that you install on the host server. The
host-agent software allows the FAStT storage manager client program to manage
the FAStT storage subsystem using the same Fibre Channel connections between
the host server and the storage subsystem. You must install at least one
management station and a software agent host. The management station can be
the host or a workstation on the Ethernet network. A management station will have
the client software installed. Figure 17 shows the host-agent management method.
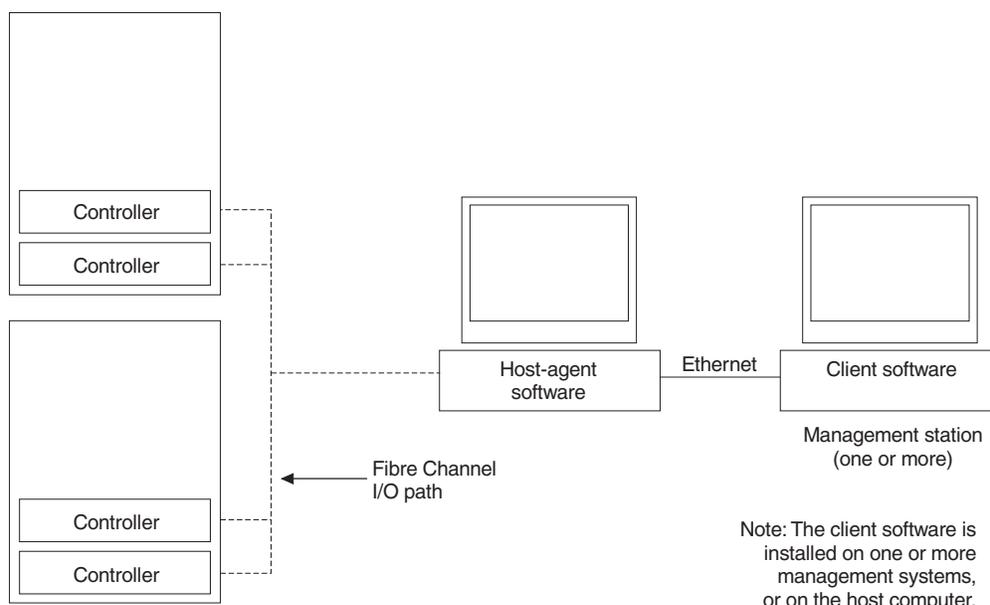
Figure 17. Host-agent managed storage subsystems

Direct-management method

This method uses Ethernet connections from a management station to each controller. You must install at least one management station. The management station can be the host or a workstation on the Ethernet network. A management station will have the client software installed. Attach Ethernet cables to each management station (one pair per storage server). You will connect the cables to each controller later when you install the storage server. Figure 18 shows the direct management method.
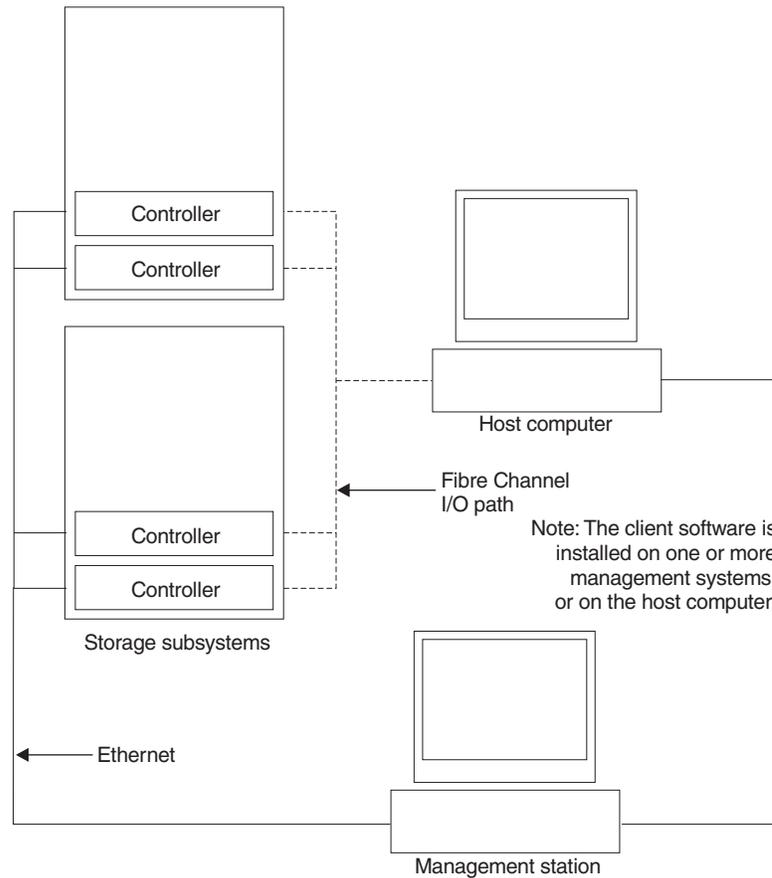
Figure 18. Direct-managed storage subsystems

Fibre Channel connections

The storage server Fibre Channel consists of a host Fibre Channel loop and a drive Fibre Channel loop. The host Fibre Channel loop provides the fibre path for host attachment. It can consist of Fibre Channel cables, SFPs, host bus adapters, Fibre Channel switches, and RAID controllers. The drive Fibre Channel loop provides the fibre path to the hard disk drives (HDDs). The drive Fibre Channel loop consists of Fibre Channel HDDs and optional drive expansion units, Fibre Channel cables, and SFPs.

The FAStT600 Storage Server supports redundant disk-drive-loop configurations. Each RAID controller has three SFP ports. These SFP ports are labeled ″Host 1″, ″Host 2″, and ″Expansion″. You can build a redundant drive loop by connecting one or more expansion units to the redundant RAID controllers. Then, use dual

fiber-optic cables to connect one expansion unit to another in a daisy-chain. For more information about adding expansion units, see "Connecting additional expansion units" on page 34.

Fibre Channel loop configurations

You must determine how the host systems will connect to the storage server. You can connect up to two host systems directly to the storage server, or you can connect more than two hosts to the Fibre Channel storage server through switches. The illustrations in the following sections show common host system configurations.

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

Redundant host and drive loops
This section provides the following examples of FAStT600 host Fibre Channel configurations:

- Redundant host and drive Fibre Channel loop configurations, as shown in Figure 19 on page 23
- Single SAN fabric zone configuration, as shown in Figure 20 on page 24
- Dual SAN fabric zone configuration, with an additional FAStT600 storage server and an EXP attached, as showing inFigure 21 on page 24
- Two clusters, as shown in Figure 22 on page 25

Note: These configurations have host and drive path failover protection and are recommended for high availability.
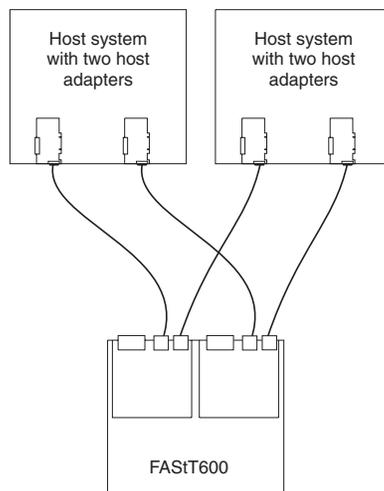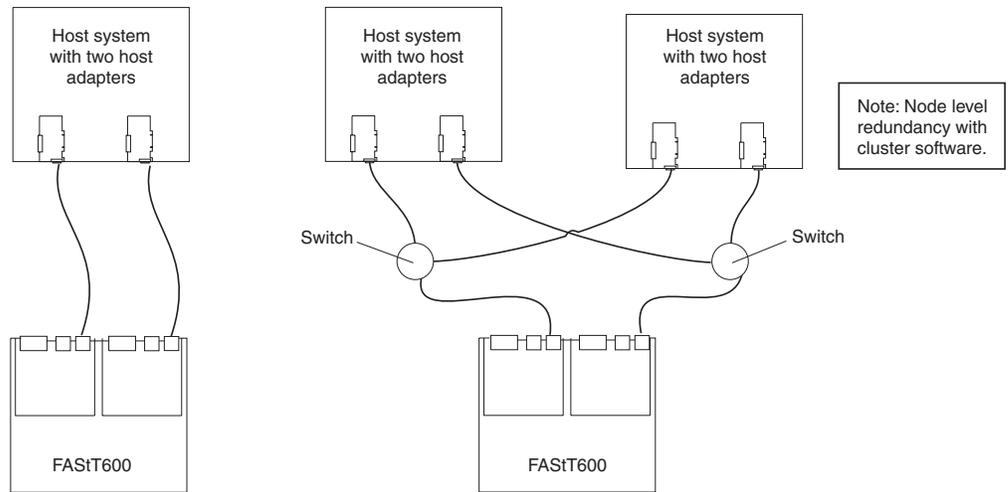
Figure 19. Redundant host and drive Fibre Channel loop configurations
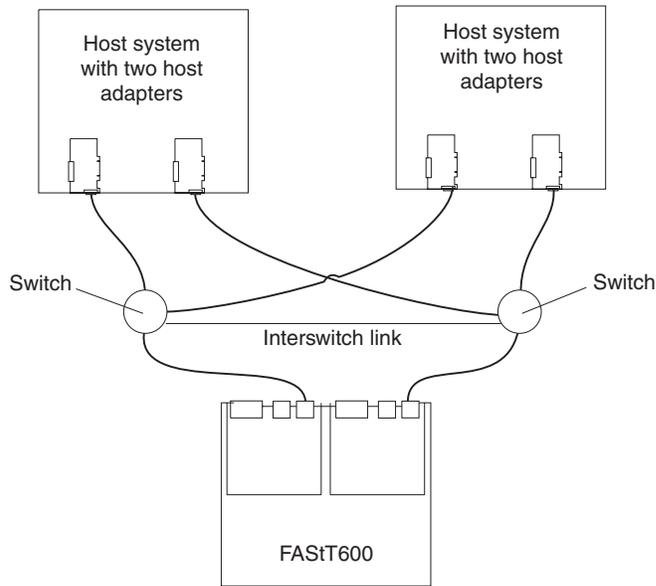
Figure 20. Single SAN fabric zone configuration
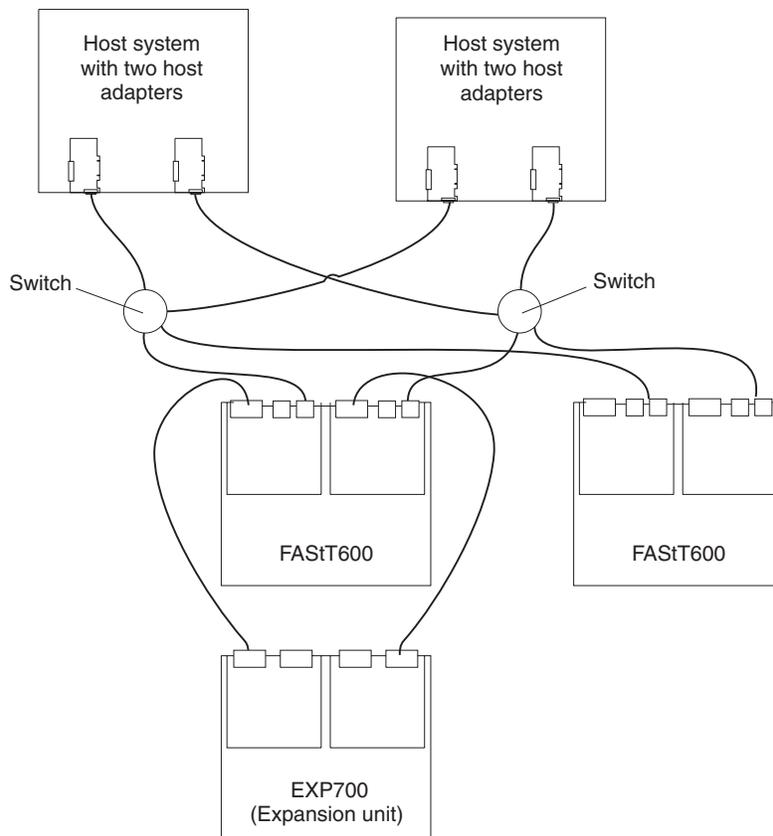
Figure 21. Dual SAN fabric zone configuration
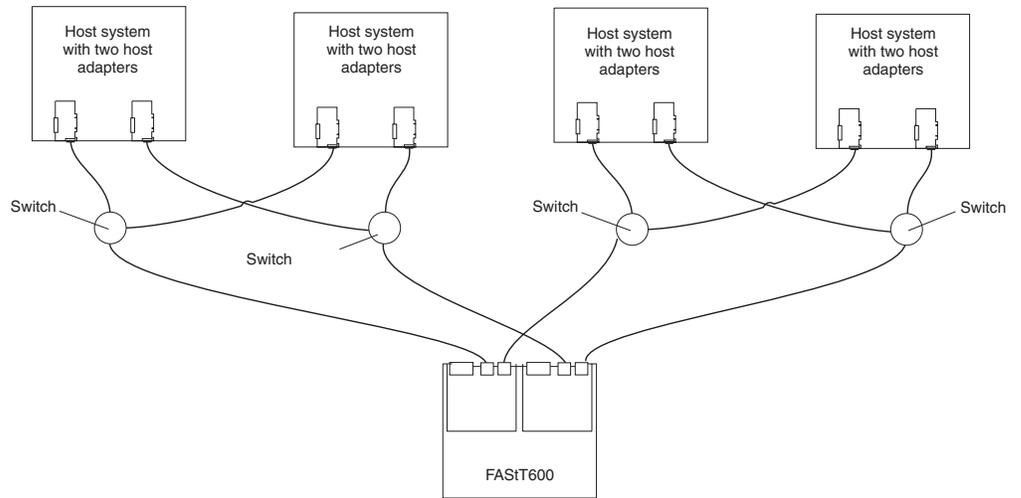
Figure 22. Two clusters configuration

Installing the storage subsystem configuration

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

Notes:

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

   www.ibm.com/support/

Attach fiber-optic interface cables to each host adapter. You will connect the other end of the cables to the controller later in the installation process. For more information about handling fiber-optic cables, see "Installing fiber-optic cables" on page 30.

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

Chapter 3. Cabling the storage server

This chapter provides Fibre Channel and power cabling information for the storage server.

After you attach the storage server power cables, use the instructions that are provided in "Turning the storage server on and off" on page 37 for the initial startup of the storage server.

Working with SFPs and fiber-optic cables

Each RAID controller has two host ports and one expansion port. You use a small-form factor pluggable transceiver (SFP) to connect each host port and expansion port to hosts and expansion units. The SFP is inserted into the port, and then a fiber-optic cable is inserted into the SFP. The other end of the fiber-optic cable connects to an external device. SFPs are laser products.

Statement 3

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

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

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

Handling fiber-optic cables

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

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

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

27

- Do not overtighten the cable straps or bend the cables to a radius of less than 38 mm (1.5 in.).
- Do not put excess weight on the cable at the connection point. Be sure that the cable is well supported.

Installing SFP modules

The FAStT600 Storage Server host ports require SFP modules. SFP modules are used to convert electrical signals to optical signals that are required for Fibre Channel transmission to and from RAID controllers. The FAStT600 Storage Server supports two types of SFP modules: one with a plastic latch and one with a wire latch. After you install the SFP modules, you use fiber-optic cables to connect the FAStT600 Storage Server to other Fibre Channel devices.

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

- The SFP module housing has an integral guide key designed to prevent you from inserting the SFP module improperly.
- Use minimal pressure when you insert the SFP module into a port. Forcing the SFP module into a port could cause damage to the SFP module or the port.
- You can insert or remove the SFP module while the port is powered on.
- The operational loop performance is not affected when you install or remove an SFP module.
- You must insert the SFP module into a port before you connect the fiber-optic cable.
- You must remove the fiber-optic cable from the SFP module before you remove the SFP module from the port. See "Removing SFP modules" on page 30 for more information.

To install an SFP module, complete the following steps.

Statement 3:

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

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

DANGER

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

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

1. Remove the SFP module from its static-protective package.
2. Remove the protective cap from the SFP module, as shown in Figure 23. Save the protective cap for future use.
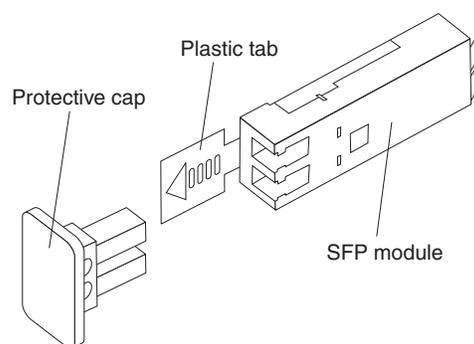
Figure 23. Small Form-Factor Pluggable (SFP) Module

3. Remove the protective cap from the host port. Save the protective cap for future use.
4. Insert the SFP module into the host port until it clicks into place. See Figure 24.
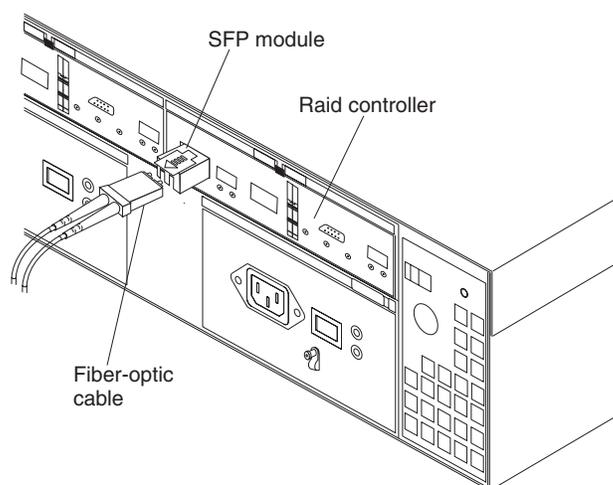
Figure 24. Installing an SFP module into the host port

5. Connect a Fibre Channel cable.

Removing SFP modules

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

Attention: To avoid damage to the cable or to the SFP module, make sure you unplug the LC-LC Fibre Channel cable *before* you remove the SFP module.

1. Remove the LC-LC Fibre Channel cable from the SFP module. For more information, see "Handling fiber-optic cables" on page 27.
2. 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 25.
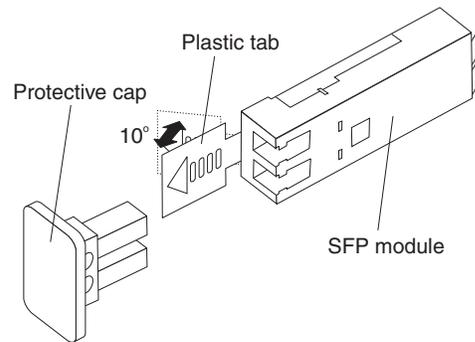
Figure 25. Unlocking the SFP module latch - plastic variety

   - For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 26.
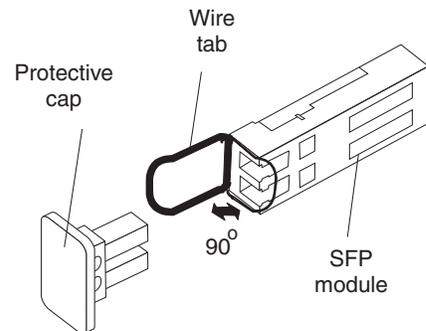
Figure 26. Unlocking the SFP module latch - wire variety

3. 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.
4. Replace the protective cap on the SFP module.
5. Place the SFP module into a static-protective package.
6. Replace the protective cap on the port.

Installing fiber-optic cables

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

1. Remove the protective cap from the fiber-optic cable. See Figure 27.
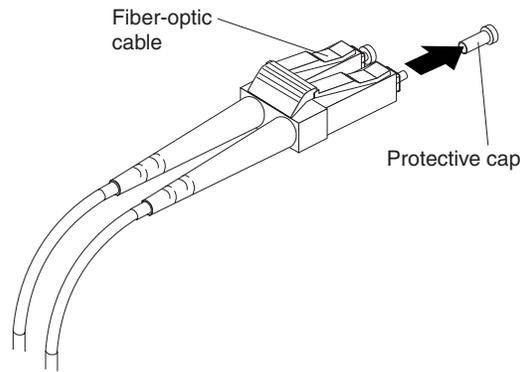
Figure 27. Removing caps from fiber-optic cables

2. Connect the fiber-optic cable to the installed SFP, as shown in Figure 28.
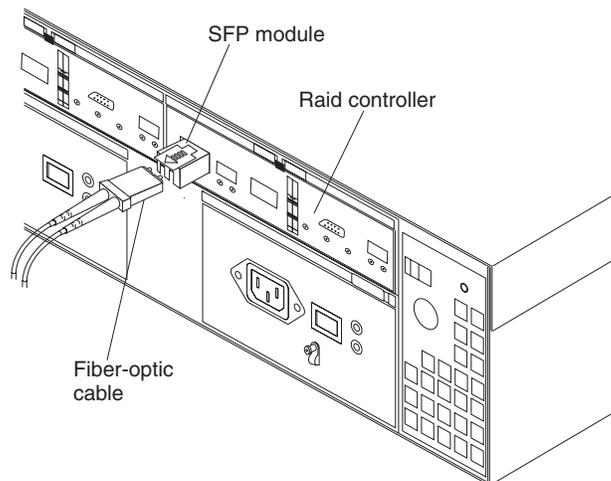
Figure 28. Connecting cables to the installed SFP

3. Check the LEDs on the RAID controller. When the RAID controller is operating properly, the amber Fault LED is off. For information about the status of the RAID controller LEDs, see Table 9 on page 44.

4. To remove the fiber-optic cables, gently pull the fiber-optic cable from the SFP; then replace the protective caps.

Connecting hosts to the RAID controllers

To connect a host adapter to the RAID controller, perform the following steps:

1. Install an SFP in a host port on the RAID controller.

2. Connect the host-system cables to the RAID controller or to switches. Figure 29 on page 32 shows the location on the RAID controllers where the host-system cables connect.

Controller A   Controller B

Host A: Host Adapter 1   Host A: Host Adapter 2
(or from managed hub   (or from managed hub
or switch)   or switch)
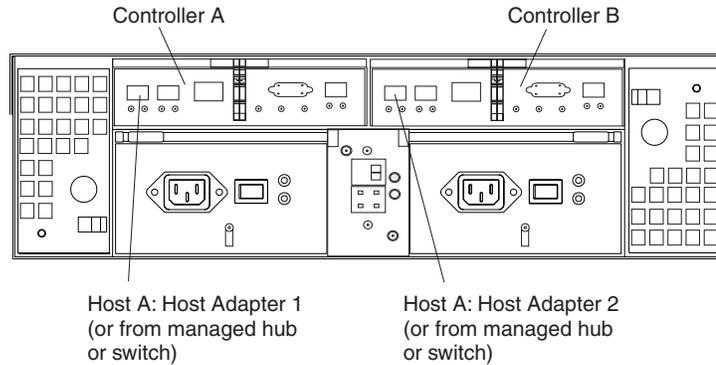
Figure 29. Location of host cables

For examples of redundant, partially-redundant, and non-redundant host and drive loop configurations, see "Fibre Channel loop configurations" on page 22.

Connecting secondary interface cables

Use the Ethernet interface ports on the back of the storage server to connect the controllers for direct management of the storage subsystems (see 21). Connect a pair of Ethernet cables from the storage-management station to the Ethernet ports for Controller A (located on the left) and Controller B (located on the right) on the back of the storage server. Figure 30 shows the location of the ports.

Controller A   Controller A   Controller B   Controller B
Ethernet port   Serial port   Ethernet port   Serial port
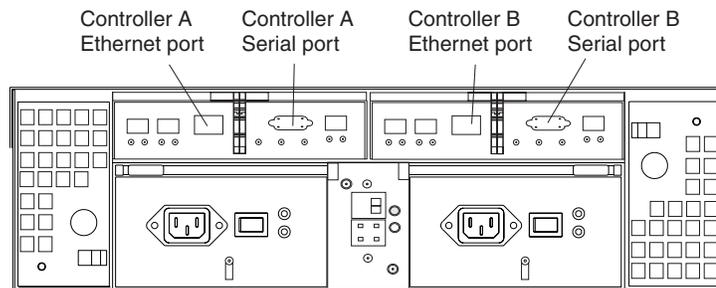
Figure 30. Ethernet and serial port locations

Note: The serial interface ports are intended to be used by service technicians to perform diagnostic operations on the storage server.

Power cabling

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

If you have not already done so, attach the power cords by using Figure 31 on page 33for the location of the component parts.
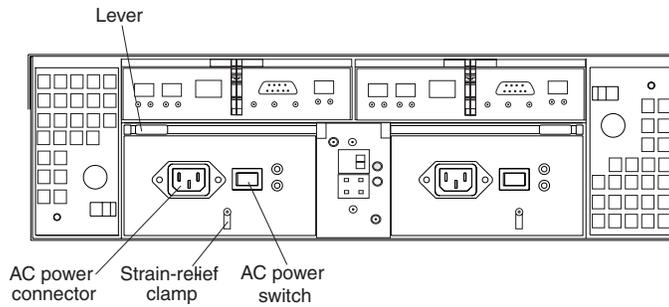
Figure 31. Power cord locations

Perform the following to cable the power cords:

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

Note: To maintain power redundancy, plug the FAStT600 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 FAStT drive enclosures attached to the FAStT600 Storage Server should be plugged into the same two independent external power circuits as the FAStT600 Storage Server. See Figure 32 on page 34 for an example of redundant power cabling.
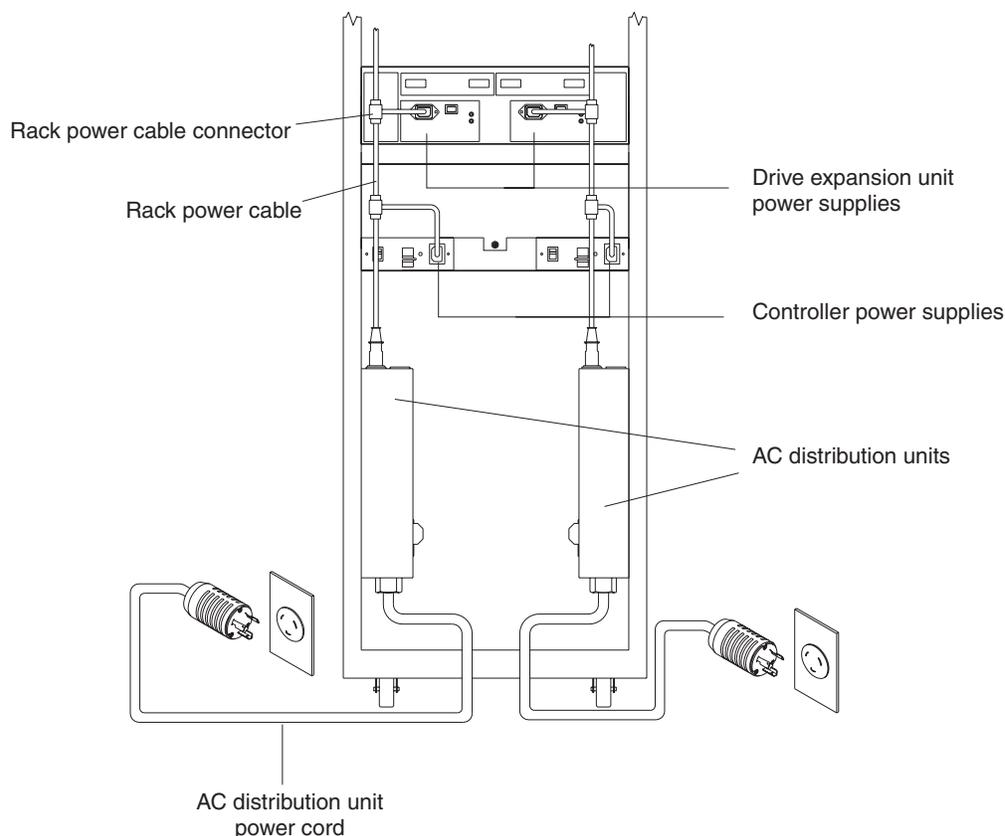
Figure 32. Redundant AC power connections to controllers and drive expansion units

For details about power requirements, see "Operating specifications" on page 9.

5. Go to "Turning the storage server on and off" on page 37 for the initial startup of the storage server.

Installing the storage-management software

Install the storage-management software by using the procedures in the software installation and support guide for your operating system. Use that document and the online help to configure the logical drives, partitions, and so on for the RAID controllers. Use your operating system documentation to make the new logical drives accessible to the operating system.

Note: Make sure that you start the storage-management software to continuously monitor the status of the storage server. For information about the importance of this information, see "Monitoring status through software" on page 42.

Connecting additional expansion units

After you install the storage server, you can connect additional expansion units. You can do this at any time after you install the storage server, even while it is turned on and processing data. You can even install one expansion unit now and an additional expansion unit later.

Note: You must purchase an option to connect additional drive expansion enclosures to the FAStT600 storage server. Contact your IBM resellers or marketing representatives for more information.

Attention: You can add only *new* expansion units to the storage server. This means that there must be no existing configuration information on the expansion unit that you want to install. If the expansion unit that you want to install currently contains logical drives or configured hot spares, and you want them to be part of the FAStT600 storage server, you must contact IBM for information. Improper drive migration might cause loss of configuration and other storage server problems.

To connect a single additional expansion unit to the storage server, perform the following steps:

Note: The following procedure is for ″cold-case″ (the FAStT600 storage server is powered down when expansion units are connected).

1. Follow the instructions in your expansion unit installation manual to set up and mount the new expansion unit.
2. Use the following procedure and Figure 33 to connect a single expansion unit to the storage server:
   a. Use a fiber-optic cable to connect to the FC-Expansion Units port on the left RAID controller in the storage server to the In port on the left ESM board of the expansion unit.
   b. Use a second fiber-optic cable to connect the FC-Expansion Units port on the right RAID controller in the storage server to the Out port on the right ESM board of the expansion unit.
   c. Ensure that the enclosure ID switch is set to a value different from one set for the FAStT600 server and other drive expansion enclosures in the loop. Also, ensure that the link speeds of the expansion units are set to 2 Gb.
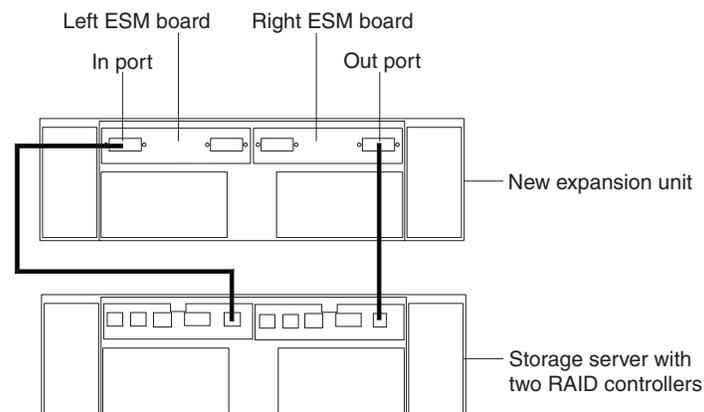
Figure 33. Adding an expansion unit

3. Remove the blank filler trays and insert drive trays. Connect power to the drive expansion unit first, then connect power to the FAStT600 storage server. After the storage server is powered-on, the storage server locates the new drives.
4. Use the storage-management software to check the status of the new drives, correct any errors found, and configure the new drives.

Use the following procedure and Figure 34 on page 36 to connect a second expansion unit to the storage server after previously adding the first expansion unit:

1. Ensure that the enclosure ID switch is set to a value different from one set for the FAStT600 server and other drive expansion enclosures in the loop. Also, ensure that the link speeds of the expansion units are set to 2 Gb.

2. Disconnect cable **1** from its current connection and connect it to the In port on the left ESM board on the new expansion unit.

3. Connect cable **2** to the In port you disconnected in step 1 and the Out port on the left ESM board on the new expansion unit.

4. Connect a third cable **3** to the In port on the right ESM board on the first expansion unit and the Out port on the right ESM board on the new expansion unit.

Left ESM board   Right ESM board

In port   Out port   Out port

1

2

3   New cables

New expansion unit

First expansion unit

Storage server
with two RAID controllers
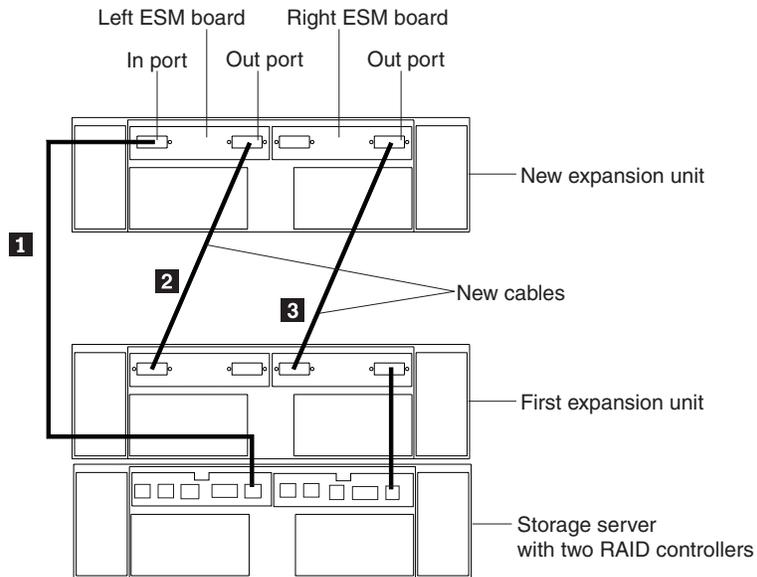
Figure 34. Adding a second expansion unit

5. Remove the blank filler trays and insert drive trays. Connect power to the drive expansion units first, then connect power to the FAStT600 storage server. After the storage server is powered-on, the storage server locates the new drives.

6. Use the storage-management software to check the status of the new drives, correct any errors found, and configure the new drives.

For more detailed information about how to cable the storage server and expansion units, see the *IBM FAStT600 Fibre Channel Cabling Instructions* that come with the storage server.

Chapter 4. Operating the storage server

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 FAStT600 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 FAStT drive enclosures attached to the FAStT600 Storage Server should be plugged into the same two independent external power circuits as the FAStT600 Storage Server. This ensures that the FAStT600 Storage Server and all its attached drive enclosures will have power if only one power circuit is available. In addition, having all the right or all the left power supplies plug into the same power circuit will enable the components in the storage subsystem to power on simultaneously during an unattended restoration of power. See Figure 32 on page 34 for an example of redundant power connections.
- Before any planned system shutdown or after any system changes (additions, removals, or modifications), save controller subsystem profiles as explained in the Storage Manager guide for your operating system.
- Ensure that your system is in an optimal state before 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 power-up sequence listed in "Turning on the storage server" on page 38. You should check that each component of the subsystem is powered-on in the proper order during this entire power-up procedure to ensure that the controller will optimally access all of your storage subsystems.
- The storage subsystem supports simultaneous power-up to the system components; however, you should always follow the power-up sequence listed in "Turning on the storage server" on page 38 during any attended power-up procedure.
- A storage system in an optimal state should recover automatically from an unexpected shutdown and unattended simultaneous restoration of power to system components. After power is restored, call IBM support if any of the following conditions occur:
  - The storage subsystem logical drives and arrays are not displayed in the Storage Manager graphical user interface (GUI).
  - The storage subsystem logical drives and arrays do not come online.
  - The storage subsystem logical drives and arrays seem to be degraded.

Turning the storage server on and off

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

If you are turning on the storage server after an emergency shutdown or power outage, see "Restoring power after an emergency shutdown" on page 41.

Turning on the storage server

Important: You must turn on the drive enclosures and verify that the drive enclosures' FC connections are optimal by checking the indicator lights *before* you turn on the FAStT600 Storage Server. The controllers might not recognize the correct configuration if the hard disk drives are powered up after the FAStT600 Storage Server. For instructions on how to power up the drive enclosures, refer to the drive enclosure documentation.

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

Perform the following steps to turn on the power for the initial startup of the storage server:
1. Verify that:
   a. All communication and power cables are plugged into the back of the storage server and a properly grounded ac electrical outlet.
   b. All hard disk drives are locked securely in place. For more information, see "Installing hot-swap drives" on page 60.

      Note: At least one drive must be present before you start the FAStT600.

      Attention: If you are restarting the system after a normal shutdown, wait at least 10 seconds before you turn on the power by using the power-on sequence in step 2.
2. Check the system documentation for the hardware devices that you intend to power up, and then determine the proper startup sequence. Use the following power-on sequence, where applicable:
   a. Turn on the power to the supporting devices (for example, Ethernet switches and management stations) before the storage server.

      Attention: If you will be directly managing the storage array, you must set up the Dynamic Host Configuration Protocol (DHCP) or BOOT-P server before you turn on the power. Setting up the server allows the controllers to obtain the corresponding IP address when you turn on the power to the array module. For more information, see the software installation guide for your operating system.
   b. You must turn on the expansion units before the storage server. The controllers might not recognize the correct configuration if the drives are powered up after the storage server. For instructions on how to power up the expansion units, see the expansion-unit documentation.
   c. Turn on the power to the storage server; then restart or turn on the power to the host.

      Note: Depending on your operating system, you might not have to restart the host. For more information, see the software installation guide for your operating system.
3. Turn on the power to each device, based on the power-on sequence in step 2. To turn on power to the storage server, turn on the power-supply switches on the back of the storage server. You must turn on both power-supply switches to take advantage of the redundant power supplies.
4. Use the storage-management software and the Fault LEDs to check the overall status of the storage server and its components. All LEDs should be green on

the front of the storage server. If they are not, use the storage-management software to diagnose the problem (see "Monitoring status through software" on page 42).

Note: The green drive active LED and amber drive fault LED below the drive CRUs might flash intermittently as the drives spin-up. Wait until the storage server is finished powering up before checking the LEDs on the front of the storage server. For more information, see "Checking the LEDs" on page 42.

Turning off the storage server

Attention: Except in an emergency, never turn off the power if any storage server Fault LEDs are on. Correct the fault before you turn off the power. Use the storage-management software and the Fault LEDs to check the overall status of the storage server and its components. All LEDs should be green on the front of the storage server. If they are not, use the storage-management software to diagnose the problem (see "Monitoring status through software" on page 42). This ensures that the storage server will power up correctly later. For more information, see "Troubleshooting" on page 84.

The storage server is designed to run continuously, 24 hours a day. After you turn on the storage server, do not turn it off. Turn off the power only when:
- Instructions in a hardware or software procedure require you to turn off the power.
- A service technician tells you to turn off the power.
- A power outage or emergency situation occurs (see "Performing an emergency shutdown" on page 41).

Statement 5

CAUTION:
The power control button on the device and the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.
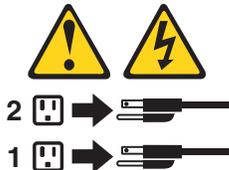
Perform the following steps to turn off the power:
1. Before proceeding, use the storage-management software to determine the status of the system components and special instructions. The operating system software might require you to perform other procedures before you turn off the power.
2. Use the storage-management software to check the status of the storage server. Correct problems that are reported before you turn off the power.
3. Stop all I/O activity to the storage server and attached expansion units. Make sure that:

- All of the green Drive active LEDs on the front of the storage server (and on all attached expansion units) are not flashing.
- The green Cache active LEDs on the back of the storage server are off.

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 5 for the proper shutdown sequence.

4. If applicable, use the operating system software to disconnect the storage server logical drives from the host before the storage server is powered off.

5. Turn off the power to each device based on the following shutdown sequence:

    a. Turn off power to the host before the storage server. If the host must stay powered on to support an existing network, see 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 expansion units. Turn off both power supply switches on the back of the storage server.

    c. Turn off power to other supporting devices (for example, management stations, fibre-channel switches, or Ethernet switches).

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

6. After you perform the necessary maintenance procedures, turn on the power using the procedure in "Turning on the storage server" on page 38.

Restoring power after an unexpected shutdown

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

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

- The internal temperature of the storage server exceeds the maximum operating temperature (an over-temperature condition).

    If both fan CRUs fail or are unable to maintain an internal temperature below 70°C (158°F), one or both of the power supplies in the storage server will shut down. If both power supplies shut down, the unit is inoperable.

    The storage-management software warns you if the temperature of the unit is rising before it has risen sufficiently to shut down the power supplies. The first warning comes when the storage server internal temperature exceeds 45°C (113°F). The storage server shuts down if the temperature rises to 70°C (158°F).

- There is a general power failure or a loss of power to the unit.

- You are forced to shut down the storage server without performing the normal shutdown procedures (listed in "Turning off the storage server" on page 39) because of an emergency situation.

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

If the storage server shuts down unexpectedly, go to "Restoring power after an over-temperature shutdown" on page 41. Otherwise, go to "Restoring power after an emergency shutdown" on page 41.

Note: Unattended restoration of power is supported; however, if power restoration is attended, you should follow the best practices guidelines and the power restoration sequence in "Turning on the storage server" on page 38.

Performing an emergency shutdown

Attention: Emergency situations might include fire, flood, extreme weather conditions, or other hazardous circumstances. If a power outage or emergency situation occurs, always turn off all power switches on all computing equipment. This will help safeguard your equipment from potential damage due to electrical surges when power is restored. If the storage server loses power unexpectedly, it might be due to a hardware failure in the power system or midplane (see "Troubleshooting" on page 84).

Use this procedure to shut down the storage server during an emergency:

1. If you have time, stop all I/O activity to the storage server by shutting down the host or disconnecting the storage server logical drives through the host.

2. Check the LEDs (front and back). Make note of any Fault LEDs that are on so you can correct the problem when you turn on the power again.

3. Turn off all power-supply switches; then unplug the power cords from the storage server.

Restoring power after an emergency shutdown

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

1. After the emergency situation is over or power is restored, check the storage server for damage. If there is no visible damage, continue with step 2; otherwise, have your system serviced.

2. After you have checked for damage, ensure that the power-supply switches are off; then plug in the storage-server power cords.

3. Complete step 2 on page 38 to determine the proper power-on sequence for your system.

4. Complete steps 3 and 4 on page 38 to turn on power to the devices in your system and to check the status of the storage server.

Restoring power after an over-temperature shutdown

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

1. Make sure that the power-supply switches on the back of the storage server are turned off.

2. Do whatever is necessary to cool the unit (replace the fans, use external fans to cool the room, and so on).

3. Check all components and cables for visible damage. *Do not start the storage server if you find evidence of damage.*

4. Complete step 2 on page 38 to determine the proper power-on sequence for your system.

5. When the internal temperature of the storage server is below 35°C (95°F), complete steps 3 and 4 on page 38 to turn on power to the devices in your system and to check the status of the storage server.

Monitoring status through software

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

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

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

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

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

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

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

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

Checking the LEDs

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

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

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

- Figure 35 on page 43
- Table 8 on page 43

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

- Figure 37 on page 45
- Table 9 on page 44
- Table 10 on page 46
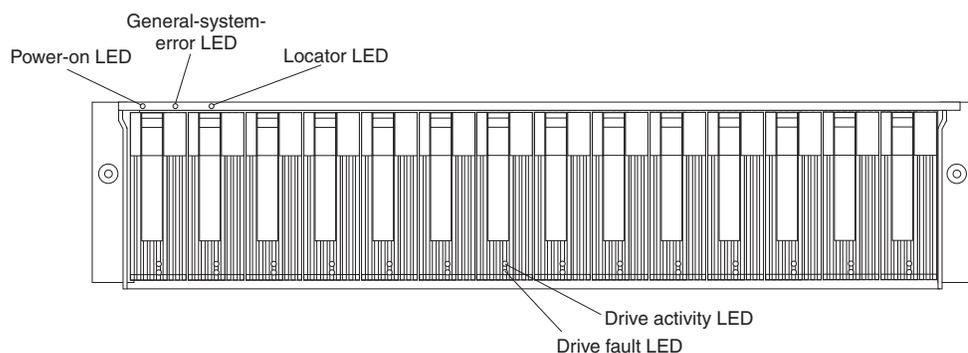
Figure 35. Storage server LEDs (front)

Table 8. Storage server LEDs (front)

LED	Color	Operating states[1]
Drive active	Green	• **On** - Normal operation. • **Flashing** - The drive is reading or writing data. • **Flashing every 5 seconds** - The drive has not spun up or the drive is bad. • **Off** - One of the following situations has occurred: – The storage server has no power. – The drive is not properly seated in the storage server.
Drive fault	Amber	• **Off** - Normal operation. • **Flashing** - The storage-management software is locating a drive, logical drive, or storage subsystem. • **On** - The drive has failed, or a user failed the drive.
Power	Green	• **On** - Normal operation. • **Off** - One of the following situations has occurred: – The storage server has no power. – Both power supplies have failed. – There is an over-temperature condition.
General system error	Amber	• **Off** - Normal operation. • **On** - A storage server component has failed[2].
Locator	Blue	• **On** - When on, this blue LED indicates that the user had initiated a storage-management software function to locate the storage server. • **Off** - Normal operation.

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

[2] Not all component failures turn on this LED. For more information, see "Monitoring status through software" on page 42.
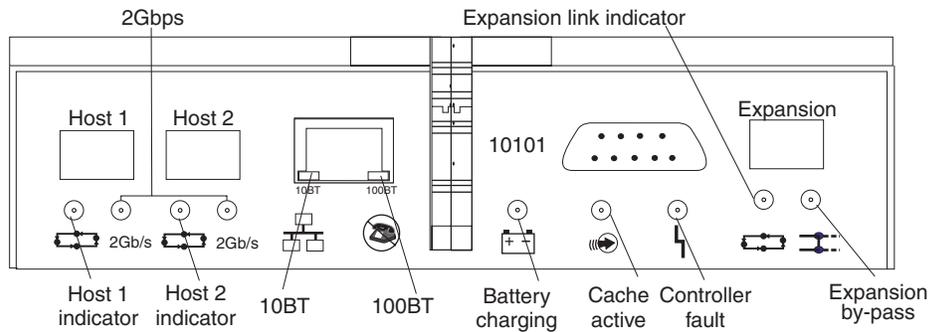
Figure 36. RAID controller LEDs

Table 9. RAID controller LEDs

Icon	LED	Color	Operating states[1]
	Fault	Amber	• **Off** - Normal operation. • **On** - One of the following situations has occurred: – The RAID controller has failed. – The RAID controller was placed offline – The controller battery had failed (in conjunction with the battery LED in off state).
	Host loop	Green	• **On** - Normal operation. • **Off** - One of the following situations has occurred: – The host loop is down, not turned on, or not connected. – A SFP has failed, or the host port is not occupied. – The RAID controller circuitry has failed, or the RAID controller has no power.
	Cache active	Green	• **On** - There is data in the RAID controller cache. • **Off** - One of the following situations has occurred: – There is no data in cache. – There are no cache options selected for this array. – The cache memory has failed, or the battery has failed.
	Battery	Green	• **On** - Normal operation. • **Flashing** - The battery is recharging or performing a self-test. • **Off** - The battery or battery charger has failed.

Table 9. RAID controller LEDs (continued)

Icon	LED	Color	Operating states[1]
⊐▪·····	Expansion port bypass	Amber	• **Off** - Normal operation. • **On** - One of the following situations has occurred: – An SFP module is inserted in the drive loop port and the fibre-channel cable is not attached to it. – The fibre-channel cable is not attached to an expansion unit. – The attached expansion unit is not turned on. – An SFP has failed, a fibre-channel cable has failed, or an SFP has failed on the attached expansion unit.
▭·▪·	Expansion loop	Green	• **On** - Normal operation. • **Off** - The RAID controller circuitry has failed, or the RAID controller has no power.
2Gbps	2Gbps	Green	• **On** - Normal operation (host connection is at 2Gbps). • **Off** - Host connection is at 1Gbps (which is not supported for controller firmware 05.33.xx.xx.
10BT	10BT	Green	• **If the Ethernet connection is 10BASE-T:** The 10BT LED is on, 100BT LED flashes faintly. • **If the Ethernet connection is 100BASE-T:** 10BT LED is off, 100BT LED is on. • **If there is no Ethernet connection** - Both LEDs are off.
100BT	100BT		
[1] Always use the storage-management software to identify the failure.			

Figure 37. Fan and power supply LEDs

Table 10. Fan LED

LED	Color	Operating states[1]
Fault	Amber	• **Off** - Normal operation. • **On** - The fan CRU has failed.
[1] Always use the storage-management software to identify the failure.		

Table 11. Power supply LEDs

LED	Color	Operating states[1]
Fault	Amber	• **Off** - Normal operation. • **On** - One of the following situations has occurred: – The power supply has failed. – An over-temperature condition has occurred.
Power	Green	• **On** - Normal operation. • **Off** - One of the following situations has occurred: – The power supply is disconnected. – The power supply is seated incorrectly. – The storage server has no power. – The power supply is turned off.
[1] Always use the storage-management software to identify the failure.		

Cache memory and RAID controller battery

Each RAID controller in the FAStT600 storage server standard model contains 256 MB of cache data. The controllers in the FAStT600 with the Turbo Option contain 1 GB of cache data. Each controller also contains a rechargeable battery that maintains data in the cache in the event of a power failure. The following sections describe these features and their associated LEDs.

Cache memory

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

See the storage-management software documentation for information on setting cache memory options.

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

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

Note: Always use the storage-management software to check your cache memory settings before assuming a hardware failure.

Figure 38 shows the location of the Cache active LED on the front of the RAID controller.
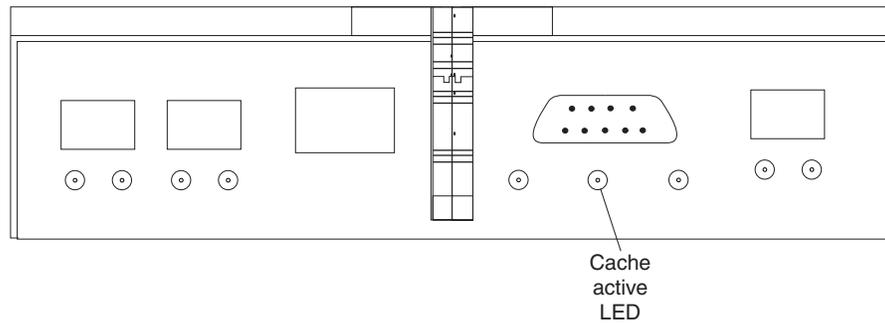
Figure 38. Cache active LED

RAID controller cache battery

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

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

Each RAID controller has a green Battery LED on the back that indicates the battery status, as follows:
- The LED is on and remains steady when the battery is fully charged.
- The LED flashes when the battery is charging or performing a self-test.
- The LED is off if the battery or the battery charger has failed.

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

Data caching starts after the battery completes the startup tests.

Figure 39 shows the location of the Battery LED on the front of the RAID controller.
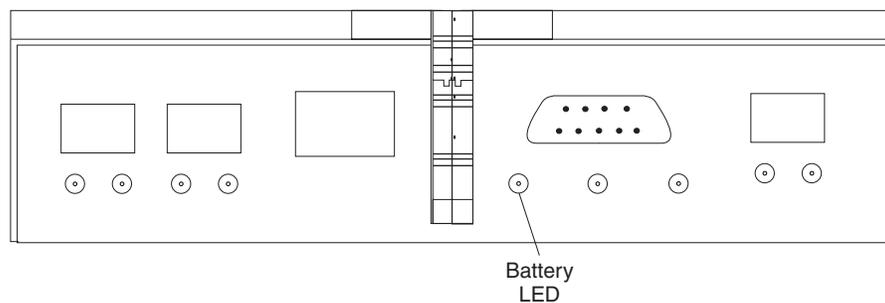
Battery
LED

Figure 39. Battery LED

Chapter 5. Installing and replacing components

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

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

www.ibm.com/storage/techsup.htm

Handling static-sensitive devices

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

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

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

Upgrading your RAID controllers

If you have purchased the FAStT600 Turbo option, you must replace your existing 256MB cache controllers to 1 GB cache controllers shipped as part of the option. You should perform this upgrade with the power on as a hot-swap. It is also possible to perform this procedure as a cold-swap.

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

Hot-swap RAID controller upgrade procedure

Important:

- You must upgrade the Storage Manager 8.4 client software in the management workstation or in the host server connected to the FAStT600 that will be upgraded before you replace the old controller with the new controller.

- This procedure must be done when the FAStT600 system is at a low I/O state. It is preferred that no I/Os are made to the FAStT600 server while the storage server is being upgraded.

- The upgrade should be preformed when the system is in an optimal state. If it is not, fix the problem before attempting the upgrade. Use the Storage Manager GUI to determine if the system is in an optimal state.

- You must have a management connection to the controller before attempting the upgrade because you need to use the Storage Manger client GUI to set the controller to certain states before replacing it, and to verify its operating condition status.

  You need to use the Storage Manger client GUI to properly set the controller state by performing the following:

  - Disable controller caching.
  - Set the controller to off-line state before replacing it.
  - Set controller to on-line state after inserting the new controller.
  - Verify controller operating condition status once the new controller is brought online.

- Save the configuration/profile before upgrading.

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

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

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front. There is also a label giving the cache battery manufacturing and installation dates on the top of the controller unit. Figure 40 on page 51 shows the location of these items.

Ethernet address label

Battery-access panel (on bottom)
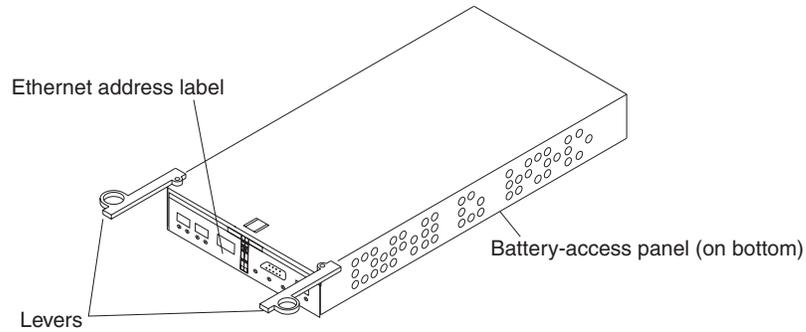
Levers

Figure 40. RAID controller levers and labels

For information about the RAID controller cache memory and rechargeable battery, see "Cache memory and RAID controller battery" on page 46.

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

1. Use the Storage Manager client software to flush and disable the read/write cache on both controllers. Either check that the cache LED on the back of the controller is off or wait two to three minutes. Refer to the Storage Manger software documentation for more details on disabling cache.

2. Place the controller in an offline state. Verify that the controller amber fault light is lit. In the Storage Manger GUI the controller will be displayed with a red ″X″ icon.

3. Label each cable that connects to the RAID controllers. This ensures that all cables will be properly reconnected to the new RAID controllers.

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

4. From the first RAID controller to be upgraded, remove the fibre-channel cables from the SFPs. The location of these components is shown in Figure 41 on page 52.
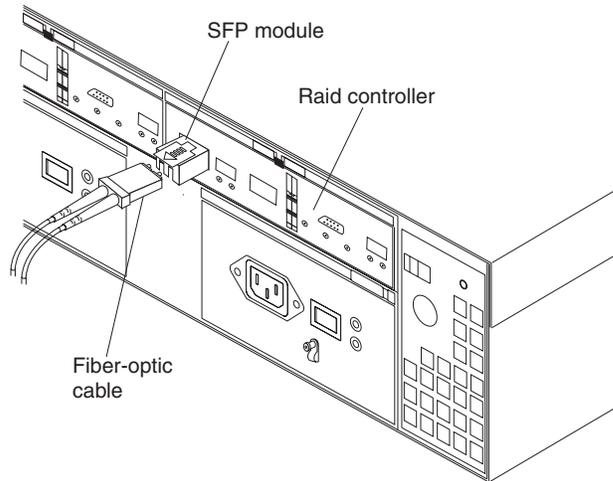
Figure 41. Location of SFPs and fiber-optic cables

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

5. Use the following procedure to remove the SFPs from the RAID controller to be upgraded.

   a. Remove the LC-LC fibre-channel cable from the SFP module. For more information, see "Handling fiber-optic cables" on page 27.

   b. Unlock the SFP module latch:

      • For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 42.
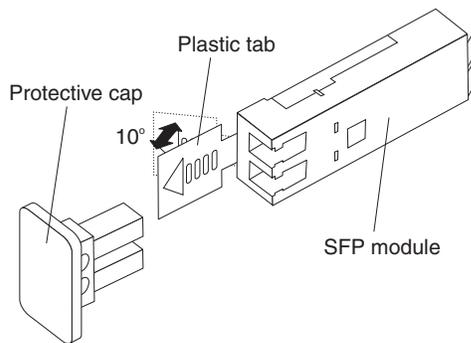
Figure 42. Unlocking the SFP module latch - plastic variety

      • For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 43 on page 53.
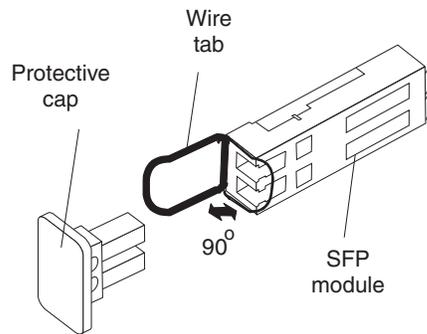
Figure 43. Unlocking the SFP module latch - wire variety

| c. With the SFP latch in the unlocked position, extract the SFP module.

| • For SFP modules that contain plastic tabs, slide the SFP module out of the port.

| • For SFP modules that contain wire tabs, grasp the wire latch and pull the SFP module out of the minihub port.

| d. Replace the protective cap on the SFP module.

| e. Place the SFP module into a static-protective package.

| f. Replace the protective cap on the port.

| 6. Remove the RAID controller to be upgraded, as follows:

| a. Push down on the latch (centered above the RAID controller). Pull both levers at the same time out of the locked position.
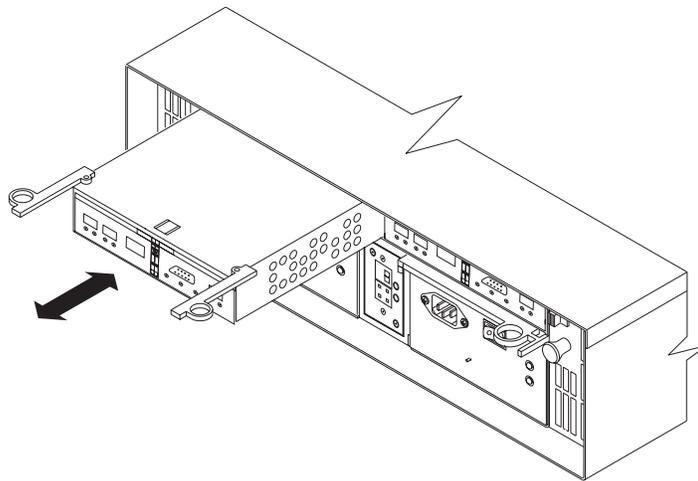
Figure 44. Pull-rings for removing a controller

| b. Grasp the pull-rings; then pull on the levers and remove the RAID controller.

| 7. Unpack the new RAID controller with the 1 GB cache. Verify that the battery is in the controller. If it is not, see "Replacing the battery in the RAID controller" on page 79 to remove the battery from the old controller and install it in the new controller.

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

8. If DHCP/BootP was used to automatically set the IP address of the controller, record the MAC address of the upgrade controller and modify the existing DHCP/BootP record of the RAID controller to be upgraded with the new MAC address. Failure to modify the DHCP/BootP record will result in problems trying to manage the storage server using the existing IP address. This step must be performed before you insert the upgrade controller into the FAStT storage server.

9. Write the battery replacement information on the label on the battery pack.
   - Installed date – Write today's date
   - Replacement Date – Write the date three years from today's date

   Note: The preferred method of checking for the battery operating age is through the storage server management software.

10. Install the new RAID controller, as follows:
    a. Slide the RAID controller all the way into the empty slot.
    b. Close both levers until the latch locks into place.

    Attention: When you replace the old RAID controller, the storage-management software automatically synchronizes the firmware between the existing controller and the new controller. After you replace a controller, always use the storage-management software to verify the firmware levels and NVSRAM files.

11. Insert the SFPs according to the instructions in "Installing SFP modules" on page 28.

12. Connect the fibre-channel cables to their original locations, according to the instructions in "Installing fiber-optic cables" on page 30.

13. Wait approximately one minute, and then check the green Host Loop LED, green Expansion Loop LED, and amber Fault LED on the new RAID controller.
    - If the Expansion Loop LED is off, the RAID controller might not be inserted correctly. Remove the RAID controller and reinsert it.

14. See the storage-management software online help for instructions on bringing the controller online.

15. Check that the controller is online. Use either of the two following methods:
    - Use the Storage Manager Client GUI to verify that the controller is online (up) and running by selecting the menu option to display the properties of the controller that has just been replaced. If the controller is not up, you will get a controller-connection error window instead of the controller properties window. Wait a minute and retry until you get the properties window.
    - Check the LEDs at the back of the controller. All Fault LEDs should be off and the Host Loop and Expansion Loop LEDs should be on.

16. If the Fault LED is on, the Host Loop LED and the Expansion Loop LED stay off, or any other Fault LED is on, see the storage-management software for problem determination.

17. Repeat steps 1 through 16 for the second controller. However, do not continue with this step if the new controller is not in online and optimal state.

18. Enable controller caching.

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

Cold-swap RAID controller upgrade procedure

Important:

- You must upgrade the Storage Manager 8.4 client software in the management workstation or in the host server connected to the FAStT600 that will be upgraded before you replace the old controller with the new controller.

- Schedule down time for the upgrade.

- The upgrade should be preformed when the system is in an optimal state. If it is not, fix the problem before attempting the upgrade. Use the Storage Manager GUI to determine if the system is in an optimal state.

- Save the configuration/profile before upgrading.

- After a cold-swap you will have to re-enable any premium features you might have installed because your premium feature ID will change. You will have to regenerate the key files using your new premium feature ID to re-enable your existing Premium features. Do not use the cold-swap upgrade procedure if you do not have access to the premium feature activation code for your storage subsystem. See the Storage Manager online help for locating your premium feature ID and see the instructions that came with your premium features for more details.

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

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

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front. There is also a label giving the cache battery manufacturing and installation dates on the top of the controller unit. Figure 45 shows the location of these items.
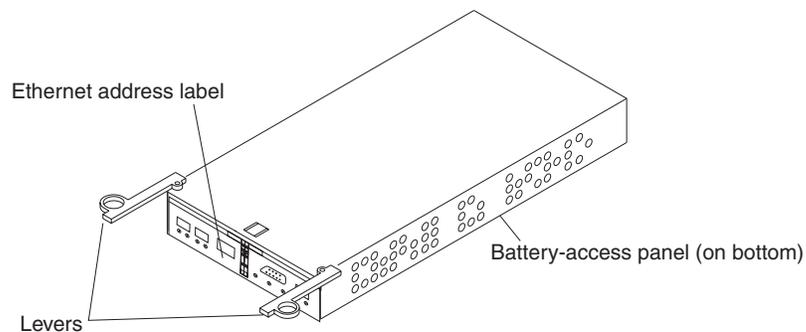
Figure 45. RAID controller levers and labels

For information about the RAID controller cache memory and rechargeable battery, see "Cache memory and RAID controller battery" on page 46.

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

1. Use the Storage Manager client software to flush and disable the read/write cache on both controllers. Either check that the cache LED on the back of the controller is off or wait two to three minutes. Refer to the Storage Manger software documentation for more details on disabling cache.

2. Power down the FAST600 Storage Server.

    Note: Before power down, one should stop I/O to the storage server. In addition, one should unmount any mapped LUNs from this storage server if possible.

3. Label each cable that connects to the RAID controllers. This ensures that all cables will be properly reconnected to the new RAID controllers.

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

4. From both RAID controllers to be upgraded, remove the fibre-channel cables from the SFPs. The location of these components is shown in Figure 46.
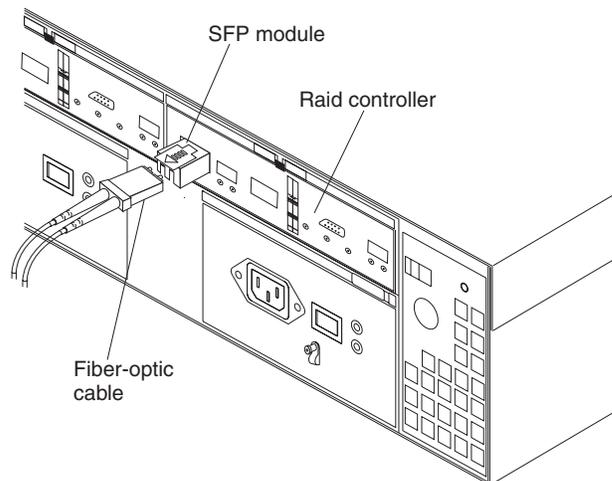
Figure 46. Location of SFPs and fiber-optic cables

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

5. Use the following procedure to remove the SFPs from the RAID controllers to be upgraded.

    a. Remove the LC-LC fibre-channel cable from the SFP module. For more information, see "Handling fiber-optic cables" on page 27.

    b. Unlock the SFP module latch:

        • For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 47 on page 57.
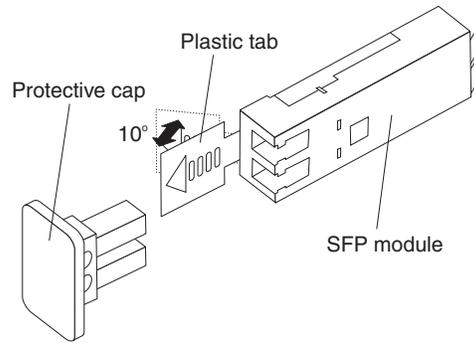
Figure 47. Unlocking the SFP module latch - plastic variety

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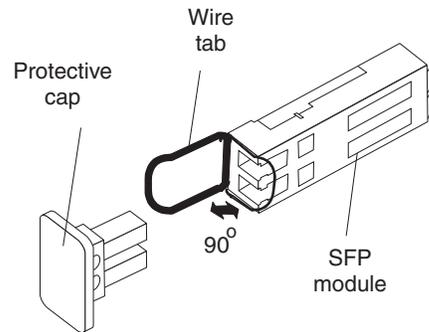
Figure 48. Unlocking the SFP module latch - wire variety

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

d. Replace the protective cap on the SFP module.

e. Place the SFP module into a static-protective package.

f. Replace the protective cap on the port.

6. Remove each RAID controller to be upgraded, as follows:

a. Push down on the latch (centered above the RAID controller). Pull both levers at the same time out of the locked position.
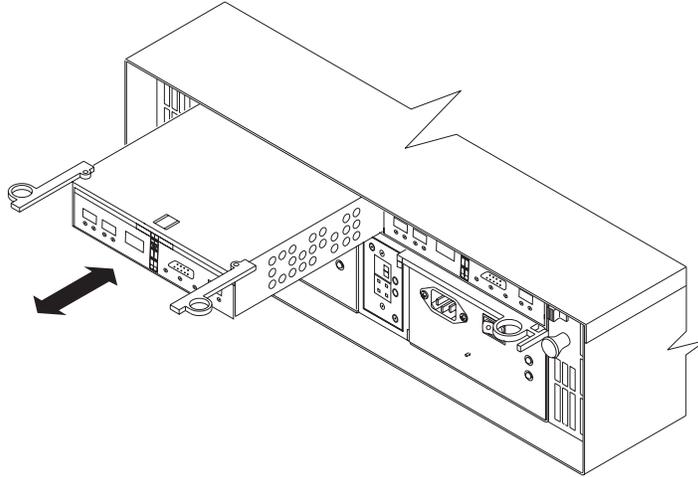
Figure 49. Pull-rings for removing a controller

   b. Grasp the pull-rings; then pull on the levers and remove the RAID controller.

7. Unpack the new RAID controllers with the 1 GB cache. Verify that the battery is in each controller. If it is not, see "Replacing the battery in the RAID controller" on page 79 to remove the battery from the old controller and install it in the new controller.

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

8. If DHCP/BootP was used to automatically set the IP address of the controller, record the MAC address of the upgrade controller and modify the existing DHCP/BootP record of the RAID controller to be upgraded with the new MAC address. Failure to modify the DHCP/BootP record will result in problems trying to manage the storage server using the existing IP address. This step must be performed before you insert the upgrade controller into the FAStT storage server.

9. Write the battery replacement information on the label on the battery pack.
   - Installed date – Write today's date
   - Replacement Date – Write the date three years from today's date

   Note: The preferred method of checking for the battery operating age is through the storage server management software.

10. Install each of the new RAID controllers, as follows:
    a. Slide the RAID controller all the way into the empty slot.
    b. Close both levers until the latch locks into place.

11. Insert the SFPs according to the instructions in "Installing SFP modules" on page 28.

12. Connect the fibre-channel cables to their original locations on both of the upgraded controllers, according to the instructions in "Installing fiber-optic cables" on page 30.

13. Power-on the FAStT600 Storage Server.

14. Wait approximately one minute, and then check the green Host Loop LED, green Expansion Loop LED, and amber Fault LED on the new RAID controllers.

- If the Host Loop LED or the Expansion Loop LED is off, the RAID controller might not be inserted correctly. Remove the RAID controller and reinsert it.
15. Check that the controller are online. Use either of the two following methods:
    - Use the Storage Manager Client GUI to verify that the controllers are online (up) and running by selecting the menu option to display the properties of the controllers that have just been replaced. If the controllers are not up, you will get a controller-connection error window instead of the controller properties window. Wait a minute and retry until you get the properties window.
    - Check the LEDs at the back of each controller. All Fault LEDs should be off and the Host Loop and Expansion Loop LEDs should be on.
16. If the Fault LED is on, the Host Loop LED and the Expansion Loop LED stay off, or any other Fault LED is on, see the storage-management software for problem determination.
17. Enable caching on both controllers.
18. Verify firmware and NVSRAM. Reload the firmware and NVSRAM to the version shipped on the Turbo option CD. Then, check the IBM website for any firmware updates.

Working with hot-swap drives

Drives are devices that the system uses to store and retrieve data. This section explains how you can increase the storage-server capacity by adding more drives or replacing existing drives with ones containing a larger capacity.

Figure 50 shows the location of the hot-swap drive bays that are accessible from the front of the storage server. To maintain proper cooling within the storage server, always keep a filler panel in each drive bay that does not contain a drive CRU.
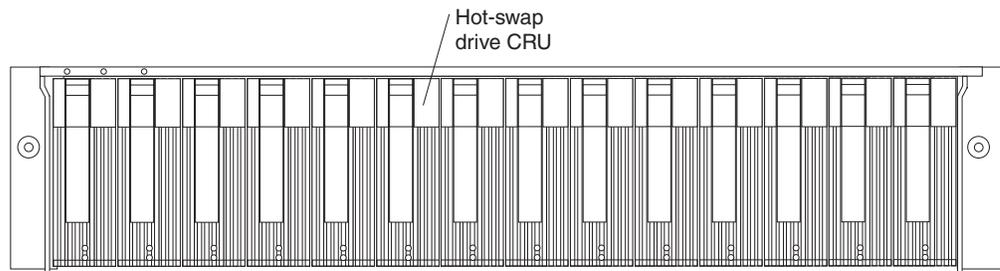
Figure 50. Location of hot-swap drives

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

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

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

Drive CRUs
> The RAID controller supports up to 14 (half-high or slim) 40-pin

fibre-channel hard disk drives. These drives come preinstalled in drive trays. This drive-and-tray assembly is called a *drive CRU*. You can install the drive CRUs in the 14 drive bays on the front of the storage server.

Drive LEDs
Each drive CRU has two LEDs, which indicate the status for that particular drive. For information about the drive LED operating states and descriptions, see Figure 35 on page 43 and Table 8 on page 43.

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

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

Slim drives
You can install slim, hot-swap drive CRUs.

Installing hot-swap drives

Before you begin, take the following precautions:

- Read the safety and handling guidelines that are provided in "Safety" on page iii and "Handling static-sensitive devices" on page 49.
- Ensure that the current system configuration is working properly.
- Back up all important data before you make changes to storage devices, such as hard disk drives.

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

Note: If you are replacing a drive, see "Replacing hot-swap drives" on page 62.

1. Read the instructions that come with the drive CRU.
2. Check for Fault LEDs. If any amber LEDs are lit, see "Checking the LEDs" on page 42 and "Troubleshooting" on page 84.
3. Determine the bay into which you want to install the drive.
4. Install the drive CRU:

   Note: The hard disk drive comes with a tray already attached. Do not attempt to detach the drive **4** from the tray **3** . See Figure 51 on page 61.
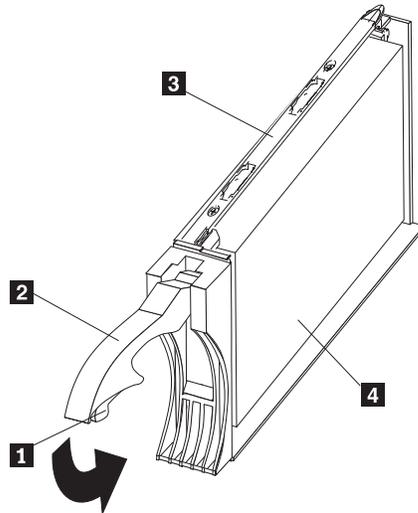
Figure 51. Releasing the drive latch

    a. Release the blue latch **1** on the drive CRU by pressing on the inside of the bottom of the tray handle. See Figure 51.

    b. Pull the handle **2** on the tray out into the open position.

    c. Slide the drive CRU into the empty bay until the tray handle **2** touches the storage-server bezel.

    d. Push the tray handle **2** down into the closed (latched) position.

5. Check the drive LEDs.

    a. When a drive is ready for use, the green Activity LED is continuously on and the amber Drive fault LED is off.

    b. If the amber Drive fault LED is completely on and not flashing, remove the drive from the unit and wait 10 seconds; then reinstall the drive.

6. Use the storage-management software to configure the drive.

7. Update the information in "Records," on page 87.

Replacing hot-swap drives

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

Attention: Failure to replace the drives in their correct bays might result in loss of data. If you are replacing a drive that is part of a RAID level 1 or RAID level 5 logical drive, ensure that you install the replacement drive in the correct bay.

Use the following procedure to replace host-swap drives:

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

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

   a. Press on the inside of the bottom of the tray handle to release the blue latch **1** . See Figure 52.
   b. Pull the handle **2** on the tray **3** out into the open position.
   c. Lift the drive CRU partially out of the bay.
   d. To avoid possible damage to the drive **4** , wait at least 20 seconds before you fully remove the drive CRU from the storage server to allow for the drive to spin down.

Figure 52. Drive latch on a hot-swap drive

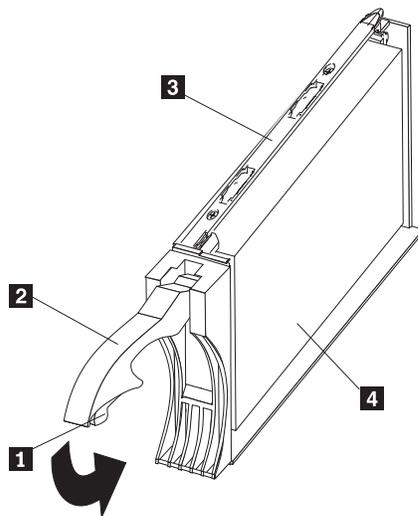   e. Verify that there is proper identification (such as a label) on the drive CRU, and then slide it completely out of the storage server.

5. Install the new drive CRU.

   a. Gently push the drive CRU into the empty bay until the tray handle **2** touches the storage-server bezel.

   b. Push the tray handle **2** down into the closed (latched) position.

6. Check the drive LEDs.

   a. When a drive is ready for use, the green Activity LED is on, and the amber Drive fault LED is off.

   b. If the amber Drive fault LED is on and not flashing, remove the drive from the unit and wait 10 seconds; then reinstall the drive.

7. Return to normal operation.

Upgrading drives

You can upgrade drives in the following two ways:

- By adding drives to empty slots in the storage server (see "Installing hot-swap drives" on page 60)
- By replacing existing drives with larger capacity drives

Adding larger-capacity drives

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

There are two methods for upgrading drives:

- **Replacing all the drives at the same time**

  This method requires that you back up the data on the affected drives and then turn off the storage server. After replacing all the drives, you must reconfigure the new drives and restore data from backup. See the procedure in "Replacing all drives at the same time" on page 64.

  This is the safest way to exchange drives without losing data. However, this method might take a long time to complete because of the backup, reconfiguration, and restoration processes. In addition, other users are not able to use the storage server (or any expansion units attached to the storage server) until you finish the procedure. You must use this method on RAID 0 logical drives.

- **Replacing the drives one at a time**

  In this method, you manually fail each drive, replace it, and wait for the system to restore data to the new drive before installing the next drive. After you install the new drives, you can configure them to make the additional drive space available. See the procedure in "Replacing the drives one at a time" on page 66.

  Using this method, you can replace the drives while the storage server is running, eliminating the down time that is required if you replace all the drives at once. However, this method is more risky because you can lose data if the drive restoration or storage subsystem reconfiguration process fails. In addition, the reconstruction process might take a long time. This method works only on redundant logical drives (RAID 1, 3, or 5). You cannot use this method with any drives containing RAID 0 logical drives.

  Consider backing up your data if you use this method. This safeguards your data if the restoration and reconfiguration process fails or the new drive malfunctions.

The method you use depends on the following considerations:

- Which method most closely matches the recommended drive upgrade procedure that is provided in the operating system or the storage-management software documentation
- Which RAID level is used on the affected drives (RAID 0 requires you to replace all the drives at the same time)
- How much downtime is acceptable as you swap the drives
- The number of drives in an array. Replacing drives one at a time is better suited for arrays consisting of 3 to 5 drives. If you have more than 20 drives, consider replacing all drives at the same time.

Replacing all drives at the same time

Use this procedure to replace all drives at the same time. You must use this method if you are upgrading drives containing RAID 0 logical drives. All the data currently on the drives is lost when you replace the drives; therefore, you must back up all data that is currently on the drives. This procedure also requires you to turn off the storage server, which makes the storage server (and any attached expansion units) inaccessible to other users.

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

1. Read the following information:
   - The information in "Adding larger-capacity drives" on page 63, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
   - The information in your software documentation regarding drive upgrades and installation
   - The documentation that comes with the new drives

     Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information regarding the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.

2. Use the storage-management software to check the status of the storage server. Correct any problems that are reported.

3. Perform a complete backup of the drives that you are replacing.

   You need the backup to restore data on the drives later in this procedure.

   Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see "Handling static-sensitive devices" on page 49.

4. Unpack the new drives.

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

5. Perform the following steps:
   a. Stop all I/O activity to the storage server and attached expansion units. Make sure that:
      1) All of the green Drive activity LEDs on the front of the storage server (and on all attached expansion units) are not flashing.
      2) The green Cache active LEDs are off on the front of the RAID controllers.

b.   If applicable, use the operating system software to disconnect the storage server logical drives from the host before you power off the storage server.

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 6 for the proper shutdown sequence.

6. Turn off the power to each device based on the following shutdown sequence:

a. Turn off power to the host before you turn off power to the storage server. If the host must stay powered on to support an existing network, see 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 expansion units. Turn off both power supply switches on the back of the storage server.

c. Turn off power to other supporting devices (for example, management stations, fibre-channel switches, or Ethernet switches).

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

7. Use the procedures in "Replacing hot-swap drives" on page 62 to remove the drives that you want to replace. Use the procedures in "Installing hot-swap drives" on page 60 to install the new drives into the storage server.

8. After you install all the new drives, check the system documentation for the hardware devices that you intend to power up, and then determine the proper startup sequence. Use the following power-on sequence, where applicable:

a. Turn on the power to the supporting devices (for example, Ethernet switches and management stations) before you turn off power to the storage server.

b. You must turn on the expansion units before the storage server. The controllers might not recognize the correct configuration if the drives are powered up after the storage server. For instructions on powering up the expansion units, see the expansion-unit documentation.

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

9. Turn on the power to each device, based on the power-on sequence in step 8. To turn on power to the storage server, turn on the power-supply switches on the back of the storage server. You must turn on both power-supply switches to take advantage of the redundant power supplies.

10. Check the green Drive activity LED and the amber Drive fault LED below the new drive CRUs.

Make sure that the Drive activity LEDs are on and the Drive fault LEDs are off.

Note: The Drive fault LEDs might flash intermittently while the drives spin up.

- If the Drive activity LED is off, the drive CRU might not be installed correctly. Remove the drive CRU, wait 30 seconds, and then reinstall it.

- If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. See the storage-management software for problem determination.

11. Use the storage-management software to configure the new drives. See the storage-management software in online Help for detailed instructions.

12. Restore the data from backup to all the drives.

Replacing the drives one at a time

Use this procedure to replace all the drives one at a time. You cannot use this procedure on RAID 0 logical drives (use the procedure in "Replacing all drives at the same time" on page 64).

Note: If your storage subsystem has hot spares assigned, you might want to unassign the hot spares while you perform this procedure. If you do not, reconstruction might start on the hot spare before you insert the new drive. The data on the new drive is still rebuilt, but the process takes longer for each drive. Remember to reassign the hot spares when you are finished with this procedure.

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

1. Read the following information:
   - "Adding larger-capacity drives" on page 63, particularly the paragraphs that discuss the differences between the two possible upgrade procedures
   - Your software documentation regarding drive upgrades and installation
   - The documentation that comes with the new drives

   Read all precautionary notes, kit instructions, and other information. Kit instructions often contain the most current information regarding the drives and their installation, plus upgrade or servicing procedures. Compare the kit instructions with this procedure to determine if you need to modify this procedure.

2. Use the storage-management software to check the status of the unit. Correct any problems that are reported.

3. Back up the data on the drives that you are replacing.

   Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see "Handling static-sensitive devices" on page 49.

4. Unpack the new drives.

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

5. Use the storage management software to ensure that the array that was defined using these drives is in optimal (not degraded) state before manually failing the first drive you want to replace. If the array is in degraded state, use the recovery procedures to bring the array into the optimal state.

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

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

   If you remove an active drive accidentally, wait at least 30 seconds and then reinstall it. Because you failed two drives in a RAID array, the array might be marked failed by the controller. This array will not be available to the host for I/O. See the storage-management software for further recovery instructions. Do not attempt to replace any drives until the array is brought back to optimal state.

6. Use the procedures in "Replacing hot-swap drives" on page 62 to remove the failed drive. Use the procedures in "Installing hot-swap drives" on page 60 to install the new drives into the storage server.

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

During data reconstruction, the amber Drive fault LED might come on for a few minutes, then turn off when the green Drive activity LED begins flashing. A flashing Drive activity LED indicates that data reconstruction is in progress.

Note: If your storage subsystem has active hot spares, data might not start copying to the new drive until the data is reconstructed on the hot spare. This increases the time that is required to complete the procedure.

7. Check the green Drive activity LED and the amber Drive fault LED below the new drive CRUs.

Make sure that the Drive activity LEDs are on and the Drive fault LEDs are off.

Note: The Drive fault LEDs might flash intermittently while the drives spin up.

- If the Drive activity LED is off, the drive CRU might not be installed correctly. Remove the drive CRU, wait 30 seconds, and then reinstall it.
- If the Drive fault LED stays on or the Drive activity LED stays off, the new drive might be faulty. See the storage-management software for problem determination.

8. Use the storage-management software to monitor the status of the new drive and the progress of the data reconstruction. Wait for data reconstruction to finish (the Drive activity LED stops flashing).

Note: The Drive activity LED will continue to flash after reconstruction is finished if there is I/O activity to that drive. In that case, use the host software to determine if the data reconstruction is finished.

9. When reconstruction is finished on the new drive, repeat step 5 on page 66 through step 8 for each additional drive that you want to install.

10. Use the storage-management software to configure the additional space on the new drives.

Working with hot-swap cooling fans

The storage server cooling system consists of two fan CRUs, each containing two fans. The fan CRUs circulate air inside the unit by pulling in air through the vents on the front of the drive CRUs and pushing out air through the vents in the back of each fan CRU. See Figure 53 on page 68.

If two fans fail, or the fans cannot maintain an internal temperature below 70°C (158°F), the power supplies in the unit will automatically shut down (an over-temperature condition). If this occurs, you must cool the unit and restart it. See "Restoring power after an over-temperature shutdown" on page 41.

Attention: The fans in the storage server draw in fresh air and force out hot air. These fans are hot-swappable and redundant; however, when one fan fails, you must replace the fan CRU within 48 hours to maintain redundancy and optimum cooling. When you replace the failed fan CRU, be sure to install the second fan CRU within 10 minutes to prevent any overheating due to the lack of the additional fan CRU.
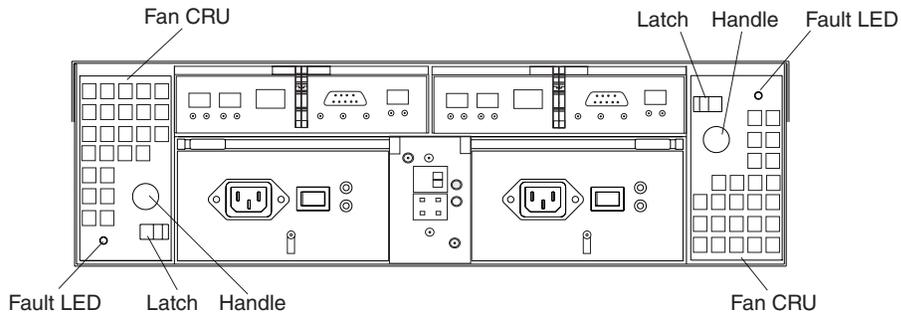
Figure 53. Fan locations

Fan CRUs
> The two fan CRUs are hot-swappable and redundant.

Fault LEDs
> These amber LEDs light when a fan failure occurs.

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

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

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

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

1. Check the LEDs on the back of the storage server.
2. If the amber Fault LED is on, remove the fan CRU that has failed.
   a. Slide the latch to unlock the fan CRU.
   b. Use the handle (black knob) to pull the fan from the storage server. See Figure 54.
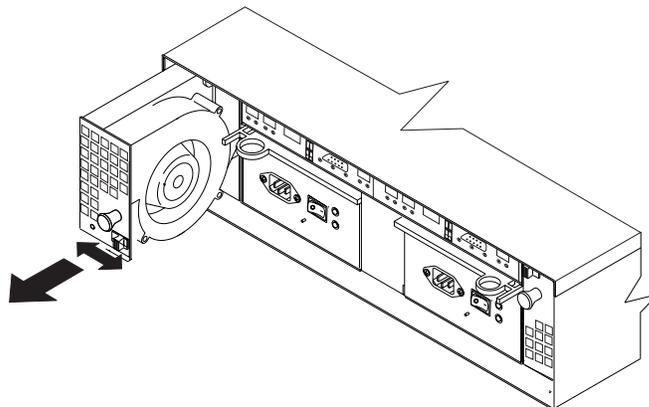
Figure 54. Removing a fan

3. Install the new fan unit.
   a. Place the fan CRU in front of the fan slot.

    b. Hold the latch open, and slide the fan all the way into the slot. If the fan does not go into the bay, rotate it 180°. Ensure that the latch is on the side closest to the center of the storage server.

    c. Release the latch. If the lever remains open, pull back on the fan slightly, and then push it in again until the latch snaps into place.

4. Check the LEDs.

The Fault LEDs turn off after a few seconds. If they remain on, see "Troubleshooting" on page 84.

Working with hot-swap power supplies

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

Each power supply CRU has a built-in sensor that detects the following conditions:
- Over-voltage
- Over-current
- Overheated power supply

If any of these conditions occurs, one or both power supplies will shut down. All power remains off until you cycle the power switches (turn the power switches off, wait at least 30 seconds, then turn the power switches on). For more information, see "Restoring power after an unexpected shutdown" on page 40 and "Restoring power after an over-temperature shutdown" on page 41.

The power supplies are customer replaceable units (CRUs) and do not require preventive maintenance.
- Always keep the power supplies in their proper places to maintain proper controller-unit cooling.
- Use only the supported power supplies for your specific storage server.

The power-supply controls on the rear of the storage server are shown in Figure 55 on page 70.
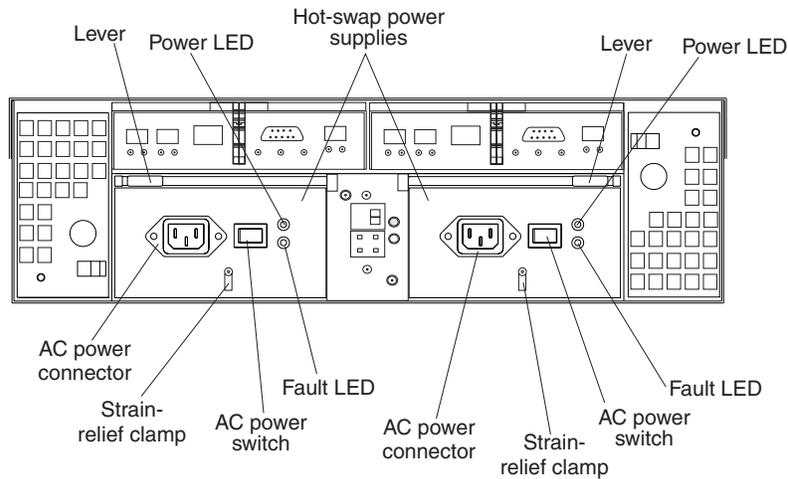
Figure 55. Power supply controls

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

Power LED
> These green LEDs light when the storage server is turned on and receiving ac power.

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

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

AC power connectors
> This connection is for the ac power cord.

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

Removing a hot-swap power supply

Statement 8

CAUTION:

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

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

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

1. Turn off the ac power switch. See Figure 56.
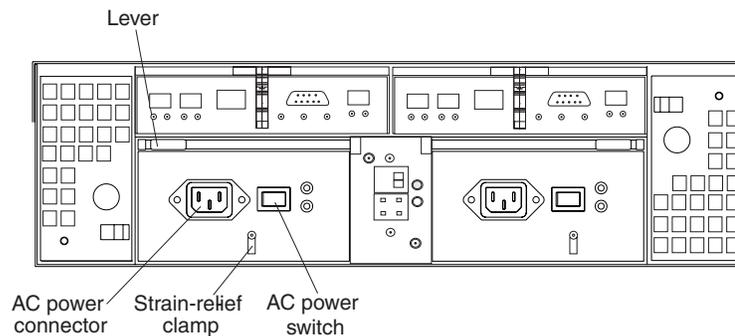
Figure 56. Lever for power supply removal

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

Installing a hot-swap power supply

Note: When you replace a power supply that has failed, ensure that the power supply latch is mounted on the side of the power supply that faces the middle of the storage server. If it is not, remove the lever screw, flip the lever over, and tighten the screw on the opposite side.
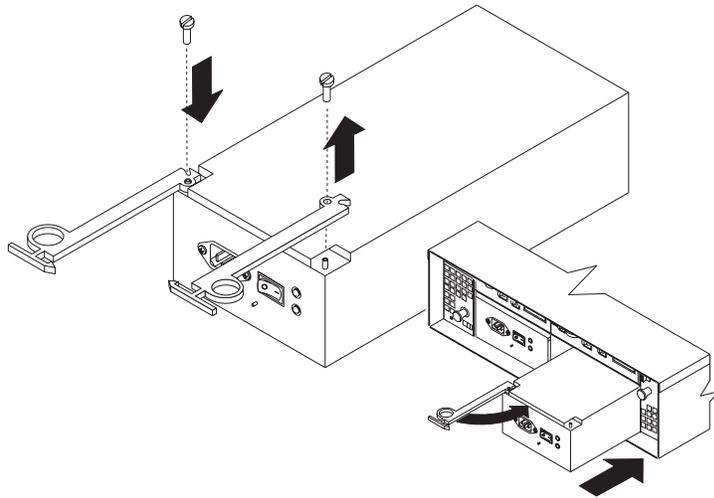
Figure 57. Installing a hot-swap power supply

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

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.

1. Ensure that the ac power switch is off on the power supply that you are installing.
2. Install the power supply in the storage server, as follows:
   a. Slide the power supply into the storage server. Make sure that the lever is pulled straight out as you slide the power supply into the storage server.
   b. Close the lever until the pull-ring latch locks in place. Make sure that the lever locks into place in the storage-server chassis.
3. Wrap the strain-relief clamp around the power cord approximately 20 cm (8 in.) from the power-supply connection end.
4. Attach the power-supply nut and tighten it securely.
5. Connect the power cord to the AC power connector. See Figure 58 on page 73.

Lever

AC power   Strain-relief   AC power
connector   clamp   switch
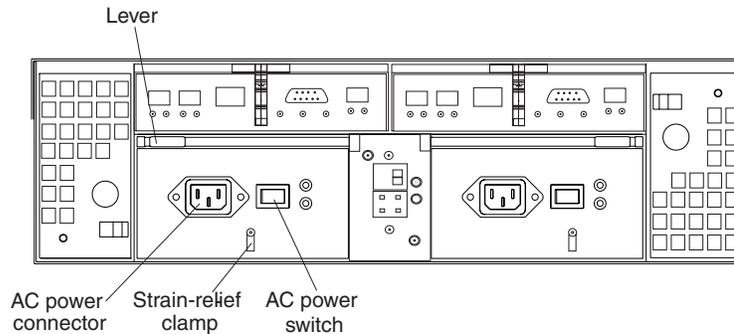
Figure 58. Connecting the power cord to the AC power connector

6. Plug the power cord into a properly grounded electrical outlet.

7. Turn on the power-supply switch.

8. Make sure that the green Power LED on the new power-supply CRU is on and the amber Fault LED is off.

   • If the Power LED is off, the power-supply CRU might not be installed correctly. Remove it and then reinstall it.

   • If the Fault LED is on or the Power LED stays off, see the storage-management software for problem determination.

   For more information about the LEDs, see "Checking the LEDs" on page 42.

Working with hot-swap RAID controllers

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

• Battery

• Cache memory

• Two host ports and one expansion port

• One Ethernet port

• One serial port

Each RAID controller has a unique hardware Ethernet address, which is printed on a label on the front. There is also a label giving the cache battery manufacturing and installation dates on the top of the controller unit. Figure 59 on page 74 shows the location of these items.

Note: The 1 GB cache controller has a different FRU than the one with 256MB cache. Use 24P8225 as the FRU for the 1 GB cache. See the support website for the most recent update to the FRU P/N list.

Figure 59. RAID controller levers and labels

For information about the RAID controller cache memory and rechargeable battery, see "Cache memory and RAID controller battery" on page 46.

Replacing a RAID controller

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

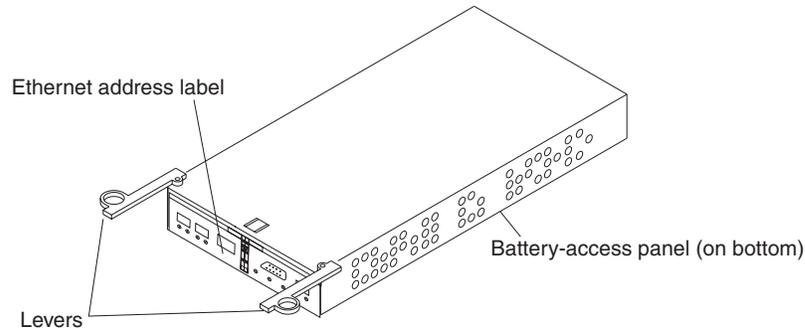**Important:** The replacement RAID controller CRU does not come with a RAID controller cache battery installed, nor the mounting hardware that holds the battery in place inside the RAID controller. You must remove the cache battery that is inside the existing RAID controller that you are replacing,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

Note: Avoid operating the FAStT600 Storage Server with controllers of different cache sizes. Operating the storage server with controllers of different cache size will disable caching and might adversely affect performance.

To replace a RAID controller, perform the following steps:

1. Check the storage-management software for instructions on RAID controller failure-recovery procedures. Follow the steps provided in the software documentation before continuing with step 2.

2. Label each cable that connects to the RAID controller that has failed. This ensures that all cables will be properly reconnected to the new RAID controller.

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

3. From the RAID controller that has failed, remove the fibre-channel cables from the SFPs. The location of these components is shown in Figure 60 on page 75.
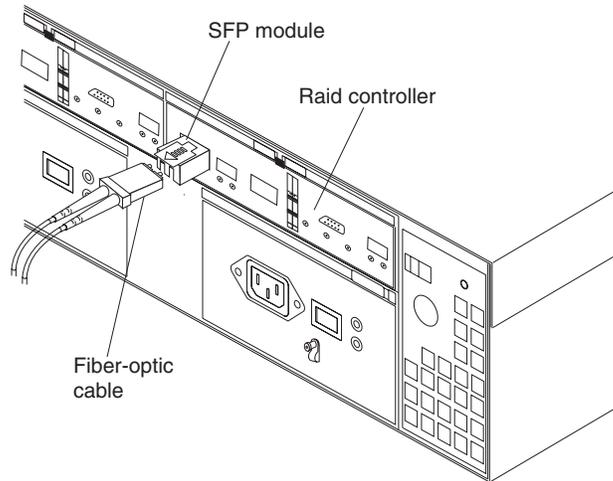
Figure 60. Location of SFPs and fiber-optic cables

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

4. Use the following procedure to remove the SFPs from the RAID controller that has failed.

   a. Remove the LC-LC fibre-channel cable from the SFP module. For more information, see "Handling fiber-optic cables" on page 27.

   b. Unlock the SFP module latch:

      • For SFP modules that contain plastic tabs, unlock the SFP module latch by pulling the plastic tab outward 10°, as shown in Figure 61.
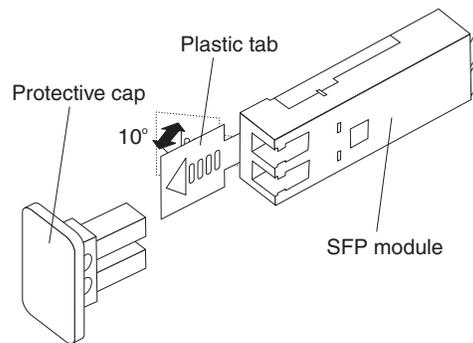
Figure 61. Unlocking the SFP module latch - plastic variety

      • For SFP modules that contain wire tabs, unlock the SFP module latch by pulling the wire latch outward 90°, as shown in Figure 26 on page 30.
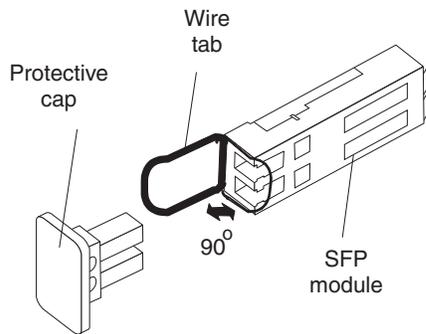
Figure 62. Unlocking the SFP module latch - wire variety

  c. With the SFP latch in the unlocked position, extract the SFP module.

    • For SFP modules that contain plastic tabs, slide the SFP module out of the port.

    • For SFP modules that contain wire tabs, grasp the wire latch and pull the SFP module out of the minihub port.

  d. Replace the protective cap on the SFP module.

  e. Place the SFP module into a static-protective package.

  f. Replace the protective cap on the port.

 5. Remove the failed RAID controller (the Fault LED is on), as follows:

  a. Push down on the latch (centered above the RAID controller). Pull both levers at the same time out of the locked position.
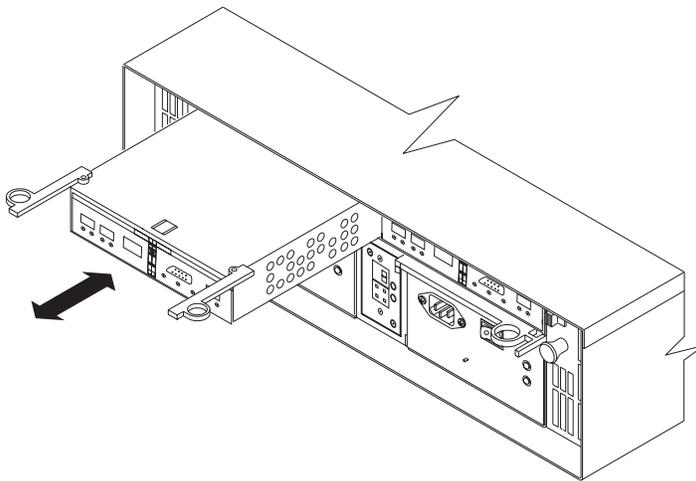
Figure 63. Pull-rings for removing a controller

  b. Grasp the pull-rings; then pull on the levers and remove the RAID controller.

 6. To remove the cache battery, place the RAID controller CRU bottom up on a flat surface. Using a #2 Phillips head screwdriver, remove the six screws (three on each side of the RAID controller) that hold the RAID controller bottom panel to the sides of the RAID controller, as shown in Figure 64 on page 77.

Figure 64. Controller battery-access panel screws

7. Slide the RAID controller bottom panel away from the front side of the RAID controller (away from the SFP slots and black center latch) to unlatch it from the side panels.

8. Carefully flip over the RAID controller bottom panel. Disconnect the battery harness on the battery from the two-pin connector on the controller board, as shown in Figure 65.

Figure 65. Removing the controller battery

9. Remove the screw that holds the battery access panel. Carefully slide the access panel toward the front to unlatch it from the three pins mounted on the RAID controller bottom panel.

10. Remove the battery unit and place it on a dry, level surface. If this is a battery replacement, then replace the old battery with the new one and go to step 18 on page 78.

11. Unpack the new RAID controller.

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

12. Place the replacement RAID controller CRU bottom up on a flat surface. Using a #2 Phillips head screwdriver, remove the six screws (three on each side of

the RAID controller) that hold the RAID controller bottom panel to the sides of the RAID controller, as shown in Figure 64 on page 77.

13. Slide the RAID controller bottom panel away from the front side of the RAID controller (away from the SFP slots and black center latch) to unlatch it from the side panels.

14. Carefully flip over the RAID controller bottom panel.
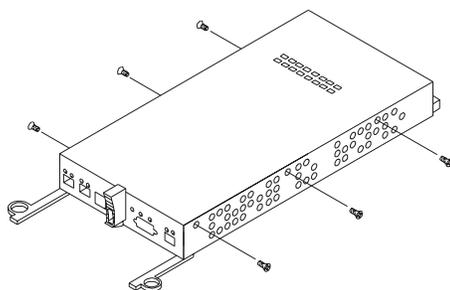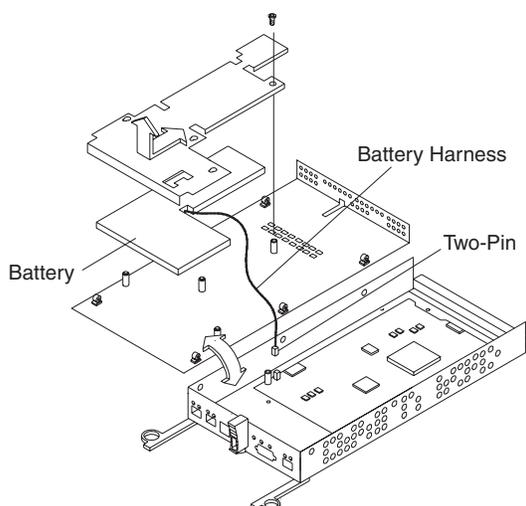
15. Remove the screw that holds the battery access panel. Carefully slide the access panel toward the front to unlatch it from the three pins mounted on the RAID controller bottom panel.

16. If DHCP/BootP was used to automatically set the IP address of the controller, record the MAC address of the upgrade controller and modify the existing DHCP/BootP record of the RAID controller to be upgraded with the new MAC address. Failure to modify the DHCP/BootP record will result in problems trying to manage the storage server using the existing IP address. This step must be performed before you insert the upgrade controller into the FAStT storage server.

17. Write the battery replacement information on the label on the battery pack.
    - Installed date – Write today's date
    - Replacement Date – Write the date three years from today's date

    Note: The preferred method of checking for the battery operating age is through the storage server management software.

18. Position the battery inside the replacement RAID controller.

19. Reassemble the battery access panel to the RAID controller bottom panel by aligning it with the three pins on the RAID controller bottom panel. Slide the battery access panel toward the back until you can reinsert the screw that holds the battery access panel to the RAID controller bottom panel. Do not overtighten.

20. You must reconnect the battery harness to the two-pin connector on the controller board.

    Note: The connector is keyed so that there is only one way to attach the harness to the connector. Do not force fit.

21. Flip the RAID controller bottom panel over and carefully place it on the controller sides. Push the RAID controller bottom panel toward the front to latch it to the side panels. If the controller bottom panel is placed correctly, you should be able to access the mounting holes for the six screws that you removed from step 6 on page 76. Reinsert the six screws. Do not overtighten.

22. Install the new RAID controller, as follows:
    a. Slide the RAID controller all the way into the empty slot.
    b. Close both levers until the latch locks into place.

    Attention: When you replace the failed RAID controller, the storage-management software automatically synchronizes the firmware between the existing controller and the new controller. After you replace a controller, always use the storage-management software to verify the firmware levels and NVSRAM files.

23. Insert the SFPs according to the instructions in "Installing SFP modules" on page 28.

24. Connect the fibre-channel cables to their original locations, according to the instructions in "Installing fiber-optic cables" on page 30.

25. Wait approximately one minute, and then check the green Host Loop LED, green Expansion Loop LED, and amber Fault LED on the new RAID controller.
    - If the Host Loop LED or the Expansion Loop LED is off, the RAID controller might not be inserted correctly. Remove the CRU and reinsert it.
    - If the Fault LED is on, the Host Loop LED and the Expansion Loop LED stay off, or any other Fault LED is on, see the storage-management software for problem determination.
26. See the storage-management software online help for instructions on bringing the controller online.

Replacing the battery in the RAID controller

Each RAID controller contains a rechargeable battery that maintains the data in the cache memory for three days without power to the unit.

Use the following procedure if the storage-management software instructs you to replace the battery because the current battery has failed or is nearing its expiration date. You can also use the storage-management software to check the status of the battery.

1. Check the storage-management software for instructions on battery replacement procedures. If you are not using write-cache mirroring, this might involve clearing cache memory on the RAID controller that contains the battery that has failed. This is done by either placing the controller offline before removing it from the FAStT600 server or turning off caching in the FAStT600 server, using storage-management software. Follow the steps given in the software procedure before you continue with this procedure.

   Attention: When you handle static-sensitive devices, take precautions to avoid damage from static electricity. For details about handling static-sensitive devices, see "Handling static-sensitive devices" on page 49.

2. Unpack the new battery.

   Set the new battery on a dry, level surface. Save all packing materials in case you need to return the battery.

   Note: The battery comes with a new battery label. You will need this label later in the procedure.

3. Review all documentation that comes with the new battery for updated replacement procedures and other information.

4. Use the storage-management software to locate the RAID controller that contains the failed battery (the RAID controller Fault LED might be on).

5. Label each cable that connects to the RAID controller that contains the battery that has failed. This ensures that all cables will be properly reconnected to the RAID controller after you replace the battery.

6. Use the storage management software to take offline the RAID controller that contains the battery that has failed.

   Attention: To prevent data loss, you must shutdown the system before you can replace the RAID controller battery. For the proper shutdown sequence, see "Turning off the storage server" on page 39.

7. Remove the fibre-channel cables and the SFPs from the RAID controller that contains the battery that has failed or is nearing its expiration date. For more information, see "Working with SFPs and fiber-optic cables" on page 27.

8. Remove the RAID controller as described in "Replacing a RAID controller" on page 74.

9. To remove the cache battery, place the RAID controller CRU bottom up on a flat surface. Using a #2 Phillips head screwdriver, remove the six screws (three on each side of the RAID controller) that hold the RAID controller bottom panel to the sides of the RAID controller, as shown in Figure 64 on page 77.

10. Slide the RAID controller bottom panel away from the front side of the RAID controller (away from the SFP slots and black center latch) to unlatch it from the side panels.

11. Carefully flip over the RAID controller bottom panel. Disconnect the battery harness on the battery from the two-pin connector on the controller board as shown in Figure 65 on page 77.

12. Remove the screw that holds the battery access panel. Carefully slide the access panel toward the front to unlatch it from the three pins mounted on the RAID controller bottom panel.

13. Remove the battery unit and place it on a dry, level surface. If this battery is a replacement battery, then replace the old battery with the new one.

14. Write the battery replacement information on the label on the battery pack.
    - Installed date – Write today's date
    - Replacement Date – Write the date three years from today's date

    Note: The preferred method of checking for the battery operating age is through the storage server management software.
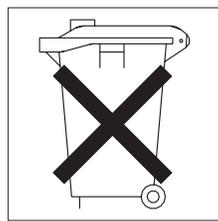
CONTAINS SEALED LEAD BATTERY. BATTERY MUST BE RECYCLED.

Pb

CAUTION:
This product contains a sealed lead acid battery. The battery must be recycled or disposed of properly. In the United States, IBM has established a collection process for reuse, recycling, or proper disposal of used IBM sealed lead acid batteries. For information on proper disposal of these batteries, please contact IBM at 1-800-426-4333 your IBM representative. For information on disposal of sealed lead acid batteries outside the United States, go tohttp:// www.ibm.com/ibm/environment/products/batteryrecycle.shtml or contact your local waste disposal facility. If the battery CRU is physically damaged or leaking electrolyte gel, *do not* ship it to a recycling center. The battery contains sealed lead-acid batteries that might be considered hazardous material. You must handle this unit in accordance with all applicable local and federal regulations.

15. Position the replacement battery inside the RAID controller.

16. Reassemble the battery access panel to the RAID controller bottom panel by aligning it with the three pins on the RAID controller bottom panel. Slide the battery access panel toward the back until you can reinsert the screw that holds the battery access panel to the RAID controller bottom panel. Do not overtighten

17. You must reconnect the battery harness to the two-pin connector on the controller board.

Note: The connector is keyed so that there is only one way to attach the hardness to the connector. Do not force fit.

18. Flip the RAID controller bottom panel over and carefully place it on the controller sides. Push the RAID controller bottom panel toward the front to latch it to the side panels. If the controller bottom panel is placed correctly, you should be able to access the mounting holes for the six screws that you removed in step 6 on page 76. Reinsert the six screws. Do not overtighten.

19. Dispose of the used battery CRU according to local and federal regulations, which might include hazardous material handling procedures.

    This product contains a sealed lead acid battery. The battery must be recycled or disposed of properly. In the United States, IBM has established a collection process for reuse, recycling, or proper disposal of used IBM sealed lead acid batteries. For information on proper disposal of these batteries, please contact IBM at 1-800-426-4333 your IBM representative. For information on disposal of sealed lead acid batteries outside the United States, go to http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml or contact your local waste disposal facility.

20. Install the RAID controller, as shown in Figure 66.
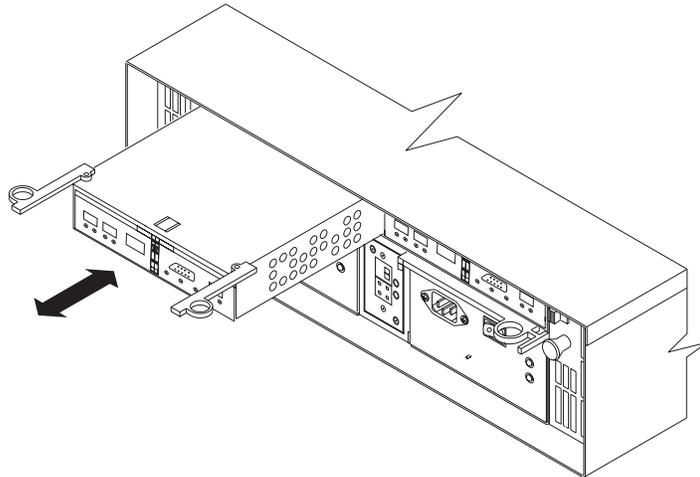
Figure 66. Installing a new RAID controller

    a. Slide the RAID controller all the way into the empty slot.
    b. Close both levers until the latch locks into place.

21. Install the SFPs and then connect the fibre-channel cables to their original locations.

22. Turn on power to the storage server and attached devices. For the proper power-on sequence, see "Turning on the storage server" on page 38.

23. Wait approximately one minute and then use the storage-management software to place the controller in online state (it was placed offline in step 6 on page 79). If the operation fails, repeat the command. If the operation fails again, reseat the controller and repeat this step.

    Note: It might take 15 minutes to a few hours for a new battery to become fully charged. The storage-management software will show the battery as failed until it is fully charged. Controller caching is automatically disabled until the new battery becomes fully charged.

24. Use the storage-management software to monitor the status of the storage server and to reset the battery age.

   Note: There are two cache batteries in the unit (one for each controller). Make sure that you reset the age for the correct battery.

Installing SFPs and fiber-optic cables

Each RAID controller unit has two host ports and one expansion unit port. SFPs are inserted into the ports, and then fibre-channel cables are connected to the SFPs. For information on installing SFPs and fiber-optic cables, see "Working with SFPs and fiber-optic cables" on page 27.

Chapter 6. Solving problems

This chapter contains information to help you solve some of the simpler problems that you might have with your storage server. It contains the problem indicators and error messages along with suggested actions to take to resolve the problem.

For instructions on how to obtain service and technical assistance for your storage server and other IBM products, see "Getting information, help, and service" on page xxi

Note: See the *IBM TotalStorage FAStT Hardware Maintenance Manual and Problem Determination Guide* for additional troubleshooting and debugging procedures.

Troubleshooting

Always use the storage-management software to diagnose storage server problems and component failures. You can use Table 12 to find solutions to problems that have definite indicators.

Table 12. Storage server troubleshooting

Problem indicator	Component	Possible cause	Possible solutions
Amber LED on	Drive CRU	Drive failure	Replace the drive that has failed.
	Fan CRU	Fan failure	Replace the fan that has failed.
	RAID controller Fault LED	RAID controller failure	If the RAID controller Fault LED is on, replace the RAID controller. If theRAID controller has been placed offline by the user, use storage management software to place it online. If the controller failed, replace the RAID controller.
	Expansion or host port bypass LED	SFP port empty	No corrective action is needed if this is a stand-alone storage server with no expansion units attached, and if the system is properly configured. Otherwise, check to make sure that the drive expansion unit is powered on and the FC cables are attached properly.
		Fibre-channel cable is not attached to the expansion unit	Connect the fibre-channel cable to the enclosure port; check other connections.
		The HBA, switch, or expansion units are set at 1Gb/s	The FAStT600 supports 2Gb/s fibre-channel connections only using the 05.33.xx.xx firmware. Make appropriate hardware changes to ensure the FAStT600 ports are connecting to ports that operate at 2Gb/s.
		No incoming signal detected	Reattach the SFPs and fibre-channel cables. Replace input and output SFPs or cables as necessary.
	Front panel	General system error	Indicates that a Fault LED somewhere on the storage server has turned on. (Check for amber LEDs on CRUs.). Use Storage Manager software to diagnose server problems.
Amber LED is off and green LED off	Power-supply CRU	Power switch is turned off or ac power failure	Turn on all power-supply power switches.
Amber and green LEDs on	Power-supply CRU	Power supply failure	Replace the failed power-supply CRU.

Table 12. Storage server troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
All green LEDs off	All CRUs	Subsystem power is off	Check that all storage-server power cords are plugged in and the power switches are on. If applicable, check that the main circuit breakers for the rack are turned on.
		AC power failure	Check the main circuit breaker and ac outlet.
		Power supply failure	Replace the power supply.
		Midplane failure	Have the midplane replaced (service technician only).
Amber LED flashing	Drive CRUs	Drive identify is in process	No corrective action is needed.
One or more green LEDs off	Power supply CRUs	Power cord unplugged or switches turned off	Make sure that the power cord is plugged in and the power-supply switches are turned on.
	All drive CRUs	Midplane failure	Have the midplane replaced (service technician only).
	Front panel	Power supply problem	Make sure that the cords are plugged in and power supplies are turned on.
		Hardware failure	If any other LEDs are on, replace the midplane (service technician only).
	Battery	Battery failure	Replace the battery.
	Cache active	The cache is disabled	Use the storage-management software to enable the logical drive read and write cache settings.
		The cache memory has failed	Replace the RAID controller.
		The cache battery has failed	Use the storage-management software to check and replace the battery.
	Host loop	Host or switch is off or has failed	Check if host or switch is on. Replace attached devices that have failed.
		Fibre-channel cable has failed	Ensure that the fibre-channel cables are undamaged and properly connected.
		SFP has failed	Ensure SFP is seated properly; replace SFP.
		RAID controller has no power or has failed	Ensure that the unit is powered on. Replace RAID controller.

Table 12. Storage server troubleshooting (continued)

Problem indicator	Component	Possible cause	Possible solutions
One or more green LEDs off (continued)	Expansion loop	Drives are improperly installed or not installed	Ensure that the drives are properly installed.
		RAID controller has no power or has failed	Ensure that the unit is powered on. Replace the RAID controller.
		Impending drive failure	A bad drive or drives can issue LIPs that cause the drive expansion loop to go down momentarily. Use the RLS function in the storage-management software to determine which drives are bad. Replace the bad drives.
		Externally attached expansion port device has failed	Replace the expansion unit SFP or fibre-channel cable.
Intermittent or sporadic power loss to the storage server	Some or all CRUs	Defective ac power source or partially plugged-in power cord	Check the ac power source; verify that the ac circuit that the storage server connects to is not being overloaded. Reseat all installed power cables and power supplies. If applicable, check the power components. Replace defective power cords.
		Power supply has failed	Check for a Fault LED on the power supply, and replace the failed CRU.
		Midplane has failed	Have the midplane replaced (service technician only).
Unable to access drives	Drives and expansion loop	Fibre-channel cabling has failed.	Ensure that the fibre-channel cables are undamaged and properly connected.
		RAID controller has failed	Replace the RAID controller.
		SFP has failed	Ensure SFP is seated properly; replace SFP.
Random errors	Subsystem	Midplane has failed	Have the midplane replaced (service technician only).

Appendix. Records

Whenever you add options to your controller unit, be sure to update the information in this appendix. Accurate, up-to-date records make it easier to add other options and provide needed data whenever you contact technical support.

Identification numbers

Record and retain the following information.

Product name:	IBM FAStT600 Storage Server
Machine: Model number:	_____
Serial number:	_____

The serial number is located on the front bottom-right corner of the chassis and on the rear of the storage server.

Installed-device records

Use the following table to keep a record of the options that are installed in or attached to your controller unit. This information can be helpful when you install additional options or if you ever need to report a hardware problem. Copy these tables before recording information in them, in case you need extra space to write new values later, when you update your system configuration.

Drive location	Drive part and model numbers	Drive serial number
Bay 1		
Bay 2		
Bay 3		
Bay 4		
Bay 5		
Bay 6		
Bay 7		
Bay 8		
Bay 9		
Bay 10		
Bay 11		
Bay 12		
Bay 13		
Bay 14		

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Important notes

Processor speeds indicate the internal clock speed of the microprocessor; other factors also affect application performance.

CD-ROM drive speeds list the variable read rate. Actual speeds vary and are often less than the maximum possible.

When referring to processor storage, real and virtual storage, or channel volume, KB stands for approximately 1000 bytes, MB stands for approximately 1 000 000 bytes, and GB stands for approximately 1 000 000 000 bytes.

When referring to hard disk drive capacity or communications volume, MB stands for 1 000 000 bytes, and GB stands for 1 000 000 000 bytes. Total user-accessible capacity may vary depending on operating environments.

Maximum internal hard disk drive capacities assume the replacement of any standard hard disk drives and population of all hard disk drive bays with the largest currently supported drives available from IBM.

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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.

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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.

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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.

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Japanese Voluntary Control Council for Interference (VCCI) 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, Czech Republic, Egypt, Finland, France, French Guiana, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Ivory Coast, Jordan, Lebanon, Luxembourg, Macao S.A.R. of China, Malagasy, Mali, Martinique, Mauritania, Mauritius, Monaco, Morocco, Mozambique, Netherlands, New Caledonia, Niger, Norway, Poland, Portugal, Romania, Senegal, Slovakia, Spain, Sudan, Sweden, Syria, Togo, Tunisia, Turkey, former USSR, Vietnam, former Yugoslavia, Zaire, Zimbabwe
13F9997	Denmark
14F0015	Bangladesh, Burma, Pakistan, South Africa, Sri Lanka
14F0033	Antigua, Bahrain, Brunei, Channel Islands, Cyprus, Dubai, Fiji, Ghana, Hong Kong S.A.R. of China, India, Iraq, Ireland, Kenya, Kuwait, Malawi, Malaysia, Malta, Nepal, Nigeria, Polynesia, Qatar, Sierra Leone, Singapore, Tanzania, Uganda, United Kingdom, Yemen, Zambia
14F0051	Liechtenstein, Switzerland
14F0069	Chile, Ethiopia, Italy, Libya, Somalia
14F0087	Israel
1838574	Thailand
6952301	Bahamas, Barbados, Bermuda, Bolivia, Brazil, Canada, Cayman Islands, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Korea (South), Liberia, Mexico, Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Suriname, Taiwan, Trinidad (West Indies), United States of America, Venezuela

Glossary

This glossary provides definitions for the terminology used for the IBM TotalStorage FAStT. This glossary also provides definitions for the terminology used for the IBM TotalStorage FAStT Storage Manager.

This glossary defines technical terms and abbreviations used in this document. If you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* located at: www.ibm.com/networking/nsg/nsgmain.htm

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 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 (I/Os) between the internal bus of the host system and the external fibre channel 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 an SNMP-TCP/IP network-managing environment.

AGP.   See *accelerated graphics port*.

AL_PA.   See *arbitrated loop physical address*.

arbitrated loop.   A shared 100 MBps fibre channel transport structured as a loop and supporting up to 126 devices and one fabric attachment. A port must successfully arbitrate before a circuit can be established.

arbitrated loop physical address (AL_PA).   One of three existing fibre channel topologies, in which two to 126 ports are interconnected serially in a single loop circuit. Access to the 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 Stealth Mode.

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).   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).   A Transmission Control Protocol/Internet Protocol (TCP/IP) protocol that a diskless workstation or network computer use to obtain its IP address and other network information such as server address and default gateway.

bridge. A SAN device that provides physical and transport conversion, such as fibre channel to SCSI bridge.

bridge group. A bridge and the collection of devices connected to it. Bridge Groups are discovered by the SANavigator tool and displayed with a gray background on the Physical and Data Path Maps.

broadcast. A method of sending an SNMP request for information to all the devices on a subnet that use a single special request. Because of its efficiency, the SANavigator tool sets its default method of discovery to broadcast. However, a network administrator might disable this method on the network router.

cathode ray tube (CRT). An electrical device for displaying images by exciting phosphor dots with a scanned electron beam. CRTs are found in computer VDUs and monitors, televisions, and oscilloscopes.

CDPD. See *cellular digital packet data*.

cellular digital packet data (CDPD). A wireless standard that provides two-way, 19.2 kps packet data transmission over existing cellular telephone channels.

CGA. See *color graphics adapter*.

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.

color graphics adapter (CGA). An early, now obsolete, IBM video display standard for use on IBM PCs. CGA displays 80 x 25 or 40 x 25 text in 16 colors, 640 x 200 pixel graphics in two colors or 320 x 200 pixel graphics in four colors.

command. Any selection on a dialog box or elsewhere in the user interface that causes the SANavigator tool to perform a task.

community strings. The name of a community contained in each SNMP message. SNMP has no standard mechanisms for verifying that a message was sent by a member of the community, keeping the contents of a message private, or for determining if a message has been changed or replayed.

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

cyclic redundancy check (CRC). (1) 1) A redundancy check in which the check key is generated by a cyclic algorithm. (2) 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*.

device type. Identifier used to place devices in the physical map, such as the switch, hub, storage.

direct access storage device (DASD). IBM mainframe terminology for a data storage device by which information can be accessed directly, instead of by-passing sequentially through all storage areas. For example, a disk drive is a DASD, in contrast with a tape drive, which stores data as a linear sequence.

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 controller*.

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 N_Port Identifier for the FC device. It is not used in the 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 random access memory (DRAM). A storage in which the cells require repetitive application of control signals to retain stored data.

E_Port. An expansion port that connects the switches for two fabrics (also used for McData ES-1000 B ports).

ECC. See *error correction coding*.

EEPROM. See *Electrically Erasable Programmable Read-Only Memory*.

EGA. See *enhanced graphics adapter*.

electrically eErasable programmable read-only memory (EEPROM). A type of non-volatile storage device that can be erased with an electrical signal. Writing to EEPROM takes much longer than reading. It also can only be reprogrammed a limited number of times before it wears out. Therefore, 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.

enhanced graphics adapter (EGA). An IBM video display standard that provides text and graphics with a

resolution of 640 x 350 pixels of 16 colors. It emulates the Color/Graphics Adapter (CGA) and the Monochrome Display Adapter (MDA) and was superseded by the Video Graphics Display (VGA).

enhanced small disk interface (ESDI).   A hard disk controller standard that allows disks to communicate with computers at high speeds. ESDI drives typically transfer data at about 10 megabits per second, although they are capable of doubling that speed.

error correction coding (ECC).   A method for encoding data so that transmission errors can be detected and corrected by examination of the data on the receiving end. Most ECCs are characterized by the maximum number of errors they can detect and correct.

error detection coding.   A method for encoding data so that errors that occur during storage or transmission can be detected. Most error detection codes are characterized by the maximum number of errors they can detect. The simplest form of error detection is by using a single added parity bit or a cyclic redundancy check. Adding multiple parity bits can detect not only that an error has occurred, but also which bits have been inverted, thereby indicating which bits should be re-inverted to restore the original data.

ESD.   See *electrostatic discharge*.

ESDI.   See *enhanced small disk interface*.

eXtended graphics array (XGA).   An IBM advanced standard for graphics controller and display mode design introduced in 1990. XGA, used mostly on workstation-level systems, supports a resolution of 1024 x 768 pixels with a palette of 256 colors, or 640 x 480 with high color (16 bits per pixel). XGA-2 added 1024 x 768 support for high color and higher refresh rates, improved performance, and supports 1360 x 1024 in 16 colors.

F_Port.   A port that supports an N_Port on a fibre channel switch.

fabric group.   A collection of interconnected SAN devices discovered by the SANavigator tool and displayed with a blue background on the Physical and Data Path Maps.

fibre channel.   A bi-directional, full-duplex, point-to-point, serial data channel structured for high performance capability. Physically, fibre channel interconnects devices, such as host systems and servers, FC hubs and disk arrays, through ports, called N_Ports, in one of three topologies: a point-to-point link, an arbitrated loop, or a cross point switched network, which is called a fabric. FC can interconnect two devices in a point-to-point topology, from two to 126 devices in an arbitrated loop. FC is a generalized transport mechanism that can transport any existing protocol, such as SCSI, in FC frames.

Fibre Channel Protocol for SCSI (FCP).   A high-level fibre channel mapping layer (FC-4) that uses lower-level fibre channel (FC-PH) services to transmit SCSI command, 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 FRU might contain other field replaceable units.

FRU.   See *field replaceable unit*.

general purpose interface bus (GPIB).   An 8-bit parallel bus developed for the exchange of information between computers and industrial automation equipment.

GPIB.   See *general purpose interface bus.*.

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 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.   The collection of HBAs and NASs in a fabric discovered by the SANavigator tool and displayed with a yellow background on the Physical and Data Path Maps.

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.

IC.   See *integrated circuit.*

IDE.   See *integrated drive electronics.*

In-band.   Transmission of management protocol over the fibre channel transport.

Industry Standard Architecture (ISA). A bus standard for IBM compatibles that allows components to be added as cards plugged into standard expansion slots. ISA was originally introduced in the IBM PC/XT with an 8-bit data path. It was later expanded to permit a 16-bit data path when IBM introduced the PC/AT.

initial program load (IPL). The part of the boot sequence during which a computer system copies the operating system kernel into main memory and runs it.

integrated circuit (IC). Also known as a *chip*. 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.

integrated drive electronics (IDE). Also known as an Advanced Technology Attachment Interface (ATA). A disk drive interface based on the 16-bit IBM PC ISA in which the controller electronics reside on the drive itself, eliminating the need for a separate adapter card.

integrated services digital network (ISDN). A digital end-to-end telecommunication network that supports multiple services including, but not limited to, voice and data. ISDNs are used in public and private network architectures.

interrupt request (IRQ). A type of input found on many processors that causes the processor to suspend normal instruction execution temporarily and start executing an interrupt handler routine. Some processors have several interrupt request inputs that allow different priority interrupts.

Internet Protocol 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.

IP address. See *Internet Protocol address*.

IPL. See *initial program Load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

ISDN. See *Integrated Services Digital Network*.

isolated group. A collection of isolated devices not connected to the SAN but discovered by the SANavigator tool. The Isolated Group displays with a gray background near the bottom of the Physical and Data Path Maps.

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 addressing*.

local area network (LAN). A computer network located on a user's premises within a limited geographic area.

logical block addressing (LBA). A hard disk sector addressing scheme in which the addressing conversion is performed by the hard disk firmware. LBA is used on all SCSI hard disks and on ATA-2 conforming IDE hard disks.

logical unit number (LUN). An identifier used on a small computer systems 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 SAN devices that are interconnected serially in a single loop circuit. Loop Groups are discovered by the SANavigator tool and displayed with a gray background on the Physical and Data Path Maps.

loop port (FL_Port). An N-Port or F-Port that supports arbitrated loop functions associated with an arbitrated loop topology.

LUN. See *logical unit number*.

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.

management information base (MIB). The information that is on an agent. It is an abstraction of configuration and status information.

MCA. See *micro channel architecture*.

MIB. See *management information base*.

micro channel architecture (MCA). IBM's proprietary bus that is used in high-end PS/2 personal computers. Micro Channel is designed for multiprocessing and functions as either a 16-bit or 32-bit bus. It eliminates potential conflicts that arise when installing new peripheral devices.

MIDI. See *musical instrument digital interface*.

model. The model identification assigned to a device by its manufacturer.

musical instrument digital interface (MIDI). A protocol that allows a synthesizer to send signals to another synthesizer or to a computer, or a computer to a musical instrument, or a computer to another computer.

NDIS. See *network device interface specification*.

network device interface specification (NDIS). An application programming interface (API) definition that allows DOS or OS/2 systems to support one or more network adapters and protocol stacks. NDIS is a 16-bit, Ring O (for the OS/2 operating system) API that defines a specific way for writing drivers for layers 1 and 2 of the OSI model. NDIS also handles the configuration and binding of these network drivers to multiple protocol stacks.

network management station (NMS). In the Simple Network Management Protocol (SNMP), a station that executes 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.

N_Port. A node 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.

node. A physical device that allows for the transmission of data within a network.

nonvolatile storage (NVS). A storage device whose contents are not lost when power is cut off.

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.

PCI local bus. See *peripheral component interconnect local bus*.

PDF. See *portable document format*.

peripheral component interconnect local bus (PCI local bus). A standard that Intel Corporation introduced for connecting peripherals. The PCI local bus allows up to 10 PCI-compliant expansion cards to be installed in a computer at a time. Technically, PCI is not a bus but a bridge or mezzanine. It runs at 20 - 33 MHz and carries 32 bits at a time over a 124-pin connector or 64 bits over a 188-pin connector. A PCI controller card must be installed in one of the PCI-compliant slots. The PCI local bus is processor independent and includes buffers to decouple the CPU from relatively slow peripherals, allowing them to operate asynchronously. It also allows for multiplexing, a technique that permits more than one electrical signal to be present on the PCI local bus at a time.

performance events. Events related to thresholds set on SAN performance.

polling delay. The time in seconds between successive discovery processes during which Discovery is inactive.

port. The hardware entity that connects a device to a fibre channel topology. 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.

private loop. A freestanding Arbitrated Loop with no fabric attachment.

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*.

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.

read-only memory (ROM). Memory in which the user cannot changed stored data except under special conditions.

RDAC. See *redundant dual active controller*.

redundant dual active controller (RDAC). A controller, used with AIX and Solaris hosts, that provides a multipath driver for a storage subsystem. An RDAC is also known as redundant disk array controller.

red, green, blue (RGB). (1) Color coding in which the brightness of the additive primary colors of light, red, green, and blue are specified as three distinct values of white light. (2) Pertaining to a color display that accepts signals that represent red, green, and blue.

RGB. See *red, green, blue*.

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.

SAN. See *storage area network*.

SCSI. See *small computer system interface*.

segmented loop ports (SL_Ports). SL_Ports allow you to divide 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.

serial storage architecture (SSA). An interface specification from IBM in which devices are arranged in a ring topology. SSA, which is compatible with SCSI devices, allows full-duplex packet multiplexed serial data transfers at rates of 20Mb/sec 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.

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 ports*.

small computer system interface (SCSI). A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

SNMP. See *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*.

SNMP time-out. The maximum amount of time the SANavigator tool will wait for a device to respond to a request. The specified time applies to one retry only.

SNMP trap events. SNMP is based on a manager/agent model. SNMP includes a limited set of management commands and responses. The management system issues messages that tell an agent to retrieve various object variables. The managed agent sends a Response message to the management system. That message is an event notification, called a trap, that identifies conditions, such as thresholds, that exceed a predetermined value.

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 switched off.

storage area network (SAN). A network that links servers or workstations to disk arrays, tape backup subsystems, and other devices, typically over fibre channel.

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 I/O path.

subnet. An interconnected but independent segment of a network that is identified by its Internet Protocol (IP) address.

super video graphics array (SVGA). A video display standard that Video Electronics Standards Association (VESA) created to provide high resolution color display on IBM PC compatible personal computers. The resolution is 800 x 600 4-bit pixels. Each pixel can therefore be one of 16 colors.

SVGA. See *super video graphics array*.

sweep method. A method of sending SNMP requests for information to all the devices on a subnet by sending the request to every device on the network. Sweeping an entire network can take a half an hour or more. If broadcast is disabled, the recommended method is to enter the individual IP addresses of the SAN devices into the SANavigator tool. This method produces good results without unnecessarily using time to wait for

responses from every IP address in the subnet, especially for IP addresses where no devices are present. There might, however, be times when a full subnet sweep will produce valuable diagnostic information about the network or a device's configuration.

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 Groups are discovered by the SANavigator tool and displayed with a gray background on the Physical and Data Path Maps.

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.

TFT. See *thin-film transistor*.

thin-film transistor (TFT). A transistor created by using thin film methodology.

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_Ports. See *translated loop port*.

translated loop ports (TL_Ports). Each TL_Port connects to a private loop and allows connectivity between the private loop devices and *off loop* devices (devices not connected to that particular TL_Port).

Transmission Control Protocol (TCP). A communication protocol used in the Internet and in any network that follows the Internet Engineering Task Force (IETF) standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packed-switched communication networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP). A set of communication protocols that provide peer-to-peer connectivity functions for both local and wide-area networks.

trap. In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition.

trap recipient. Receiver of a forwarded SNMP trap. Specifically, a trap receiver is defined by an 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*.

user action events. Actions that the user takes, such as changes in the SAN, changed settings, and so on. Each such action is considered a User Action Event.

vendor. Property value that the SANavigator tool uses to launch third-party software. Vendor property might be discovered but will always remain editable.

VGA. See *video graphics adapter*.

video graphics adapter (VGA). A computer adapter that provides high-resolution graphics and a total of 256 colors.

video random access memory (VRAM). A special type of dynamic RAM (DRAM) used in high-speed video applications, designed for storing the image to be displayed on a computer's monitor.

VRAM. See *video random access memory*.

WORM. See *write-once read-many*.

Worldwide Name (WWN). A registered, unique 64–bit identifier assigned to nodes and ports.

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. Typically the storage medium is an optical disk whose surface is permanently etched by using a laser in order to record information. WORM media are high-capacity storage devices and have a significantly longer shelf life than magnetic media.

WWN. See *worldwide name*.

XGA. See *eXtended graphics array*.

zoning. A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

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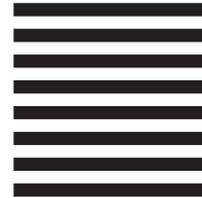
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