IBM TotalStorage DS4000

Hardware Maintenance Manual

IBM TotalStorage DS4000

Hardware Maintenance Manual

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Safety

Before installing this product, read the Safety information.

قبل تركيب هذا المنتج، يجب قراءة الملاحظات الآمنية

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

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

安裝本產品之前，請先閱讀「安全資訊」。

Prije instalacije ovog produkta obavezno pročitajte Sigurnosne Upute.

Před instalací tohoto produktu si 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.

Caution notice

The following Caution notice is printed in English throughout this document. For a translation of this notice, see *IBM® Safety Information*.

Statement 5:

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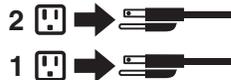
Safety information

Before you service an IBM computer, you must be familiar with the following safety information.

General safety

Follow these rules to ensure general safety:

- Observe good housekeeping in the area of the machines during and after maintenance.
- When lifting any heavy object:
  1. Ensure that you can stand safely without slipping.
  2. Distribute the weight of the object equally between your feet.
  3. Use a slow lifting force. Never move suddenly or twist when you attempt to lift.
  4. Lift by standing or by pushing up with your leg muscles; this action removes the strain from the muscles in your back. *Do not attempt to lift any objects that weigh more than 16 kg (35 lb) or objects that you think are too heavy for you.*
- Do not perform any action that causes hazards to the customer, or that makes the equipment unsafe.
- Before you start the machine, ensure that other service representatives and the customer's personnel are not in a hazardous position.
- Place removed covers and other parts in a safe place, away from all personnel, while you are servicing the machine.
- Keep your tool case away from walk areas so that other people will not trip over it.

- Do not wear loose clothing that can be trapped in the moving parts of a machine. Ensure that your sleeves are fastened or rolled up above your elbows. If your hair is long, fasten it.
- Insert the ends of your necktie or scarf inside clothing or fasten it with a nonconductive clip, approximately 8 centimeters (3 in.) from the end.
- Do not wear jewelry, chains, metal-frame eyeglasses, or metal fasteners for your clothing. **Remember:** Metal objects are good electrical conductors.
- Wear safety glasses when you are doing any of the following: hammering, drilling soldering, cutting wire, attaching springs, using solvents, or working in any other conditions that might be hazardous to your eyes.
- After service, reinstall all safety shields, guards, labels, and ground wires. Replace any safety device that is worn or defective.
- Reinstall all covers correctly before returning the machine to the customer.

Grounding requirements

Electrical grounding of the computer is required for operator safety and correct system function. Proper grounding of the electrical outlet can be verified by a certified electrician.

Electrical safety

Important
Use only approved tools and test equipment. Some hand tools have handles that are covered with a soft material that does not insulate you when working with live electrical currents.
Many customers have, near their equipment, rubber floor mats that contain small conductive fibers to decrease electrostatic discharges. Do not use this type of mat to protect yourself from electrical shock.

Observe the following rules when working on electrical equipment.
- Find the room emergency power-off (EPO) switch, disconnecting switch, or electrical outlet. If an electrical accident occurs, you can then operate the switch or unplug the power cord quickly.
- Do not work alone under hazardous conditions or near equipment that has hazardous voltages.
- Disconnect all power before doing any of the following tasks:
  - Performing a mechanical inspection
  - Working near power supplies
  - Removing or installing main units
- Before you start to work on the machine, unplug the power cord. If you cannot unplug it, ask the customer to power-off the wall box that supplies power to the machine and to lock the wall box in the off position.
- If you need to work on a machine that has *exposed* electrical circuits, observe the following precautions:
  - Ensure that another person, familiar with the power-off controls, is near you.
    Remember: Another person must be there to switch off the power, if necessary.
  - Use only one hand when working with powered-on electrical equipment; keep the other hand in your pocket or behind your back.

Remember: There must be a complete circuit to cause electrical shock. By observing the previous rule, you might prevent a current from passing through your body.

  – When using testers, set the controls correctly and use the approved probe leads and accessories for that tester.

  – Stand on suitable rubber mats (obtained locally, if necessary) to insulate you from grounds such as metal floor strips and machine frames.

  Observe the special safety precautions when you work with very high voltages; these instructions are in the safety sections of maintenance information. Use extreme care when measuring high voltages.

- Regularly inspect and maintain your electrical hand tools for safe operational condition.
- Do not use worn or broken tools and testers.
- *Never assume* that power has been disconnected from a circuit. First, *check* that it has been powered-off.
- Always look carefully for possible hazards in your work area. Examples of these hazards are moist floors, nongrounded power extension cables, power surges, and missing safety grounds.
- Do not touch live electrical circuits with the reflective surface of a plastic dental mirror. The surface is conductive and can cause personal injury and machine damage.
- Do not service the following parts (or similar units) *with the power on* when they are removed from their normal operating places in a machine. This practice ensures correct grounding of the units.

  – Power supply units

  – Pumps

  – Blowers and fans

  – Motor generators

- If an electrical accident occurs:

  – **Use caution; do not become a victim yourself.**

  – **Switch off power.**

  – **Send another person to get medical aid.**

Handling ESD-sensitive devices

Any computer part that contains transistors or integrated circuits (ICs) should be considered sensitive to electrostatic discharge (ESD). ESD damage can occur when there is a difference in charge between objects. Protect against ESD damage by equalizing the charge so that the machine, the part, the work mat, and the person that is handling the part are all at the same charge.

Notes:

1. Use product-specific ESD procedures when they exceed the requirements noted here.

2. Make sure that the ESD protective devices that you use have been certified (ISO 9000) as fully effective.

Use the following precautions when handling ESD-sensitive parts:

- Keep the parts in protective packages until they are inserted into the product.
- Avoid contact with other people.
- Wear a grounded wrist strap against your skin to eliminate static on your body.

- Prevent the part from touching your clothing. Most clothing is insulative and retains a charge even when you are wearing a wrist strap.
- Select a grounding system, such as those listed below, to provide protection that meets the specific service requirement.

  Note: The use of a grounding system is desirable but not required to protect against ESD damage.
    - Attach the ESD ground clip to any frame ground, ground braid, or green-wire ground.
    - Use an ESD common ground or reference point when working on a double-insulated or battery-operated system. You can use coax or connector-outside shells on these systems.
    - Use the round ground-prong of the ac plug on ac-operated computers.
- Use the black side of a grounded work mat to provide a static-free work surface. The mat is especially useful when handling ESD-sensitive devices.

Safety inspection procedure

Use this safety inspection procedure to identify potentially unsafe conditions on a product. Each machine, as it was designed and built, had required safety items installed to protect users and service personnel from injury. This procedure addresses only those items. However, good judgment should be used to identify any potential safety hazards due to attachment of non-IBM features or options not covered by this inspection procedure.

If any unsafe conditions are present, you must determine how serious the apparent hazard could be and whether you can continue without first correcting the problem.

Consider these conditions and the safety hazards they present:
- Electrical hazards, especially primary power (primary voltage on the frame can cause serious or fatal electrical shock).
- Explosive hazards, such as a damaged cathode ray tube (CRT) face or bulging capacitor
- Mechanical hazards, such as loose or missing hardware

Complete the following checks with the power off, and with the power cord disconnected.
1. Check the exterior covers for damage (loose, broken, or sharp edges).
2. Check the power cord for the following conditions:
   a. A third-wire ground connector in good condition. Use a meter to measure third-wire ground continuity for 0.1 ohm or less between the external ground pin and frame ground.
   b. The power cord should be the appropriate type as specified in the parts listings.
   c. Insulation must not be frayed or worn.
3. Remove the cover.
4. Check for any obvious non-IBM alterations. Use good judgment as to the safety of any non-IBM alterations.
5. Check the inside the unit for any obvious unsafe conditions, such as metal filings, contamination, water or other liquids, or signs of fire or smoke damage.
6. Check for worn, frayed, or pinched cables.

7. Check that the power supply cover fasteners (screws or rivets) have not been removed or tampered with.

About this document

This document provides information about hardware maintenance for some IBM TotalStorage® FAStT and DS4000 products

Note: Maintenance information about DS4300 and DS4500 storage subsystems is no longer included in this document. You can now find the information in the following publications:

- *IBM System Storage DS4300 Storage Subsystem Installation, User's, and Maintenance Guide*
- *IBM System Storage DS4500 Storage Subsystem Installation, User's, and Maintenance Guide*

In addition, you can find maintenance information about other DS4000 storage subsystems and expansion enclosures in the Installation, User's, and Maintenance Guide that is included with the product documentation at the time of purchase. These publications are also available at the following Web site:

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

FAStT product renaming

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

Table 1. Mapping of FAStT names to DS4000 Series names

Previous FAStT Product Name	Current DS4000 Product Name
IBM TotalStorage FAStT Storage Server	IBM TotalStorage DS4000
FAStT	DS4000
FAStT Family	DS4000 Mid-range Disk System
FAStT Storage Manager vX.Y (for example v9.10)	DS4000 Storage Manager vX.Y (for example v9.10)
FAStT100	DS4100
FAStT600	DS4300
FAStT600 with Turbo Feature	DS4300 Turbo
FAStT700	DS4400
FAStT900	DS4500
EXP700	DS4000 EXP700
EXP710	DS4000 EXP710
EXP100	DS4000 EXP100
FAStT FlashCopy	FlashCopy for DS4000
FAStT VolumeCopy	VolumeCopy for DS4000
FAStT Remote Mirror (RM)	Enhanced Remote Mirroring for DS4000
FAStT Synchronous Mirroring	Metro Mirroring for DS4000

Table 1. Mapping of FAStT names to DS4000 Series names (continued)

Previous FAStT Product Name	Current DS4000 Product Name
	Global Copy for DS4000 (New Feature = Asynchronous Mirroring without Consistency Group)
	Global Mirroring for DS4000 (New Feature = Asynchronous Mirroring with Consistency Group)

Who should read this document

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

How this document is organized

The *IBM TotalStorage DS4000 Hardware Maintenance Manual* contains basic information, such as specifications and symptom lists, about many of the components of a fibre channel configuration. You can use this information to complete the tasks that are given in the *IBM TotalStorage DS4000 Problem Determination Guide*, which contains information that you can use to isolate and solve problems that might occur in your fibre channel configurations. It provides problem determination and resolution information for the issues most commonly encountered with IBM fibre channel devices and configurations.

This document contains the following chapters:

Chapter 1, "About hardware maintenance," on page 1 provides a brief overview on how to use the hardware maintenance, diagnostic, and test information provided in this document.

Chapter 2, "Type 3523 Fibre Channel Hub and GBIC," on page 3 provides service and diagnostic information for the Type 3523 fibre channel hub and GBIC.

Chapter 3, "Fibre Channel PCI Adapter," on page 11 provides service and diagnostic information for the fibre channel adapter (FRU 01K7354).

Chapter 4, "DS4000 Host Adapter," on page 13 provides service and diagnostic information for the DS4000 host adapter (FRU 09N7292).

Chapter 5, "DS4000 FC2-133 Host Bus Adapter," on page 17 provides service and diagnostic information for the IBM DS4000 FC2-133 (FRU 24P0962) host bus adapter.

Chapter 6, "Type 3526 Fibre Channel RAID Controller," on page 21 provides service and diagnostic information for the Type 3526 fibre channel RAID controller.

Chapter 7, "FAStT200 Type 3542 and FAStT200 HA Type 3542," on page 35 provides service and diagnostic information for the Type 3542 FAStT200 and Type 3542 FAStT200 HA.

Chapter 8, "Type 3552 FAStT500 RAID Controller," on page 47 provides service and diagnostic information for the Type 3552 FAStT500 RAID controller.

Chapter 9, "Type 1742 DS4400 Storage Server," on page 61 provides service and diagnostic information for the Type 1742 DS4400 storage server.

Chapter 10, "IBM TotalStorage FAStT EXP15 and EXP200 Storage Expansion Units," on page 73 provides service and diagnostic information for both the EXP15 and EXP200 storage expansion units.

Chapter 11, "IBM TotalStorage FAStT EXP500 Storage Expansion Unit," on page 79 provides service and diagnostic information for the EXP500 storage expansion unit.

Chapter 12, "IBM Storage Area Network Data Gateway Router (2108-R03)," on page 87 provides service and diagnostic information for the Storage Area Network Data Gateway Router.

Appendix A, "Power cords," on page 103 lists required power cords for the DS4000 storage components discussed in this document by country and region.

Notices used in this document

This document can contain the following notices that are 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 IBM Support Web site:

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

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

You can solve many problems without outside assistance by following the troubleshooting procedures that IBM provides in the online help or in the documents that are provided with your system and software. The information that comes with your system also describes the diagnostic tests that you can perform. Most xSeries and IntelliStation systems, operating systems, and programs come with information that contains troubleshooting procedures and explanations of error messages and error codes. If you suspect a software problem, see the information for the operating system or program.

Using the documentation

Information about your xSeries or IntelliStation system and preinstalled software, if any, is available in the documents that come with your system. This includes printed documents, online documents, readme files, and help files. See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other software.

Web sites

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

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

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

  The support page has many sources of information and ways for you to solve problems, including:
  - Diagnosing problems, using the IBM Online Assistant
  - Downloading the latest device drivers and updates for your products
  - Viewing frequently asked questions (FAQ)
  - Viewing hints and tips to help you solve problems
  - Participating in IBM discussion forums
  - Setting up e-mail notification of technical updates about your products
- You can order publications through the IBM Publications Ordering System at the following Web site:
  www.elink.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 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 DS4000 Interoperability Matrix at the following Web site:

  www.storage.ibm.com/disk/fastt/supserver.htm

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.

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 you are commenting on, such as a page number or table number.
- Mail

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

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

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. About hardware maintenance

This hardware maintenance manual contains basic information, such as specifications and symptom lists, about many of the components of some FAStT and DS4000 fibre-channel configurations. You can use this information to complete the tasks given in the problem determination procedures provided in the *IBM TotalStorage DS4000 Problem Determination Guide*.

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

The component information that is provided in this document has been extracted from the individual Hardware Maintenance Manuals or Installation and User's Guides for each component. Therefore, you might find it helpful to see the individual documents for specific components.

Note: For information about how to use and troubleshoot problems with the FC 6228 2 gigabit fibre channel adapter in IBM @server pSeries® AIX hosts, see *Fibre Channel Planning and Integration: User's Guide and Service Information*, SC23-4329.

Finding maintenance information about other DS4000 models

This publication contains information about older models of FAStT and DS4000 storage subsystems and storage expansion enclosures.

Information about the following DS4000 storage subsystems and expansion enclosures is not included in this publication:

DS4000 Storage Subsystems

- DS4100 Storage Subsystem
- DS4300 Storage Subsystem
- DS4500 Storage Subsystem
- DS4200 Express Storage Subsystem
- DS4700 Storage Subsystem
- DS4800 Storage Subsystem

DS4000 EXP Storage Expansion Enclosures

- EXP100 Storage Expansion Enclosure
- EXP420 Storage Expansion Enclosure
- EXP700/710 Storage Expansion Enclosure
- EXP810 Storage Expansion Enclosure

See the appropriate *IBM DS4000 Storage Subsystem Installation, User's, and Maintenance Guide* or *IBM DS4000 EXP Storage Expansion Enclosure Installation, User's, and Maintenance Guide* for maintenance information about these DS4000 products. You can find these publications at the IBM Disk Support Web site:

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

Where to start

Start with the General Checkout sections in each chapter to help you to diagnose problems with the IBM fibre channel products that this document describes.

For error codes and error messages, see the Symptom-to-FRU Index for the server that the fibre channel hub, adapter, or RAID controller is connected to.

Related documents

For information about managed hubs and switches that can be in your installation, see the following publications:

- *IBM 3534 SAN Fibre Channel Managed Hub Installation and Service Guide*, SY27-7616
- *IBM SAN Fibre Channel Switch 2109 Model S08 Installation and Service Guide*, SC26-7350
- *IBM SAN Fibre Channel Switch 2109 Model S16 Installation and Service Guide*, SC26-7352

This installation and service information can be found at the following Web site:

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

Chapter 2. Type 3523 Fibre Channel Hub and GBIC

Note: The problem determination (PD) maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

The type 3523 fibre channel hub and Gigabit Interface Converter (GBIC) are compatible with the following IBM products:

- Fibre channel PCI adapter (FRU 01K7354) (see Chapter 3 on page 11)
- IBM DS4000 host adapter (FRU 09N7292) (see Chapter 4 on page 13)
- Type 3526 fibre channel RAID controller (see Chapter 6 on page 21)

The IBM fibre channel hub is a 7-port central interconnection for Fibre Channel Arbitrated Loops (FC-AL) that follow the ANSI FC-AL standard. Each fibre channel hub port receives serial data from an attached node and retransmits the data out of the next hub port to the next node attached in the loop. Each reception includes data regeneration (both signal timing and amplitude) that supports full-distance optical links.

The fibre channel hub detects any loop node that is missing or is inoperative and automatically routes the data to the next operational port and attached node in the loop. LED indicators provide status information to indicate whether the port is active or bypassed.

Each port requires a GBIC to connect it to each attached node. The fibre channel hub supports any combination of short-wave or long-wave optical GBICs. The GBICs are *hot-pluggable* into the fibre channel hub, which means you can add host computers, servers, and storage modules to the arbitrated loop dynamically without powering off the fibre channel hub or any connected devices. If you remove a GBIC from a fibre channel hub port, that port is automatically bypassed. The remaining hub ports continue to operate normally with no degradation of system performance. Conversely, if you plug a GBIC into the fibre channel hub, it is automatically inserted and becomes a node on the loop if valid fibre channel data is received from the device.

Data transfer within the fibre channel hub is implemented in serial differential Positive Emitter Coupled Logic (PECL) AC coupled logic. Each fibre channel hub port monitors the serial data input stream as well as the GBIC connected to it.

The following conditions cause the fibre channel hub to bypass a port:

- TX_FAULT: Detects a GBIC transmitter fault
- RX_LOS: Detects a loss of received signal amplitude from the device
- MOD_DEF: Detects the absence of a GBIC

The fibre channel hub circuitry detects off-frequency data, excessive jitter, or inadequate edge transition density on a per-port basis. The fibre channel hub uses the standardized AMP SCA2 20-pin connector to implement hot plugging. Surge currents, caused by hot plugging, are minimized by slow-start circuitry and a pin-sequencing procedure on the GBIC. Electrostatic discharge (ESD) transients are minimized by means of sequenced connector contacts.

The fibre channel hub includes a universal power supply that can operate from 95 to 250 V ac and from 50 to 60 Hz.

General checkout

Installation and operational problems in an arbitrated loop environment are typically caused by one of the following situations:

- Faulty cabling or cable connector
- Incorrect cable plugging
- Faulty GBIC
- Faulty hubs
- Invalid fibre channel signaling from the host bus adapter (HBA) or disk array
- Device driver or microcode conflicts between the HBAs and other devices

The following information will help you to isolate and correct the physical layer problems. For protocol-related problems, such as inoperability between devices, see the documentation that came with the individual devices.

Port Status LEDs

The hub provides two status LEDs for each port (see Table 2). Use these LEDs to help you quickly diagnose and recover from problems.

The upper, green LED is lit when an operational GBIC is installed. The lower, amber LED is lit when the port is in the bypass mode. In the bypass mode, a port is disabled, which prevents erratic signals or data from disrupting loop activity. The bypass mode could be triggered by the loss of a valid signal or by a GBIC fault. The combination of green and amber LEDs indicates one of the four following states.

Table 2. Type 3523 fibre channel hub port status LEDs

Green LED	Amber LED	Port State
Off	Off	No GBIC Installed
On	Off	Operational GBIC; Valid Signal
Off	On	Faulty GBIC; Port Bypassed
On	On	Operational GBIC; No Valid Signal; Port Bypassed

Verifying GBIC and cable signal presence

Note: Do *not* look directly into any fiber cable or GBIC optical output. To view an optical signal, use a mirror to view the reflected light.

Verifying signal presence

In addition to verifying port LED status, you can verify signal presence by using a mirror to look for a reflected light at the fiber-optic cable ends and the GBIC transmitter. To verify signal presence at the hub end of a link, insert a GBIC into the hub and place a mirror at the bottom of the SC connector. If a signal is present, you will see a low intensity red light in the mirror reflecting from the GBIC transmitter. See Figure 1 on page 5.
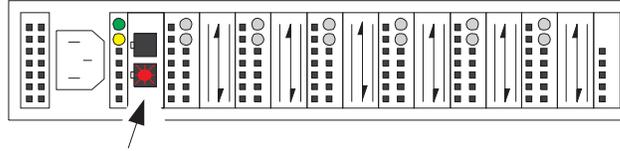
Figure 1. Verifying signal presence

Verifying node end

To verify the integrity of the fiber-optic cable at the node end of a link, make sure the cable is attached to the GBIC at the hub and the hub is turned on. Dual SC fiber-optic cable connectors are keyed and will insert into a GBIC in one direction only. Place a mirror at the node end of the link. A low intensity red light is visible in the mirror reflection of one of the SC leads, as shown in Figure 2.

Connector Keys
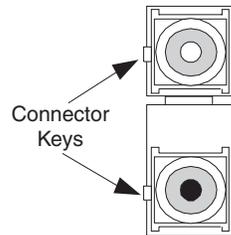
Figure 2. Verifying node end

If a fiber-optic cable has good transmitter output but a broken or degraded receiver lead, the end node might sense a *loop down* state. Because the transmitter is good, the hub responds to the end node valid fibre channel signal and adds the device to the loop. But, because the end node is not receiving fibre channel signals, it will stream loop-down sequences onto the loop. This prevents all data communications among the devices on the loop and will continue to do so until the condition is corrected.

Verifying hub end

To verify the integrity of the fiber-optic cable at the hub end, make sure the fiber-optic cable is plugged into the host bus adapter at the host or into a disk-array controller and that the device is enabled on the loop. Using a mirror, examine the cable SC leads to verify that a low-intensity red light is visible on the receiver lead.

Note: Some fiber-optic cables are marked with an A on the receiver lead and a B on the transmitter lead and are keyed. Some multimode cables plugged into a GBIC, HBA, or disk array controller are key-oriented with the B lead inserted into the device transmitter. Place a mirror on the opposite end of the cable to see the low-intensity red light on the A receiver lead.

Additional service information

This section contains additional service information for the fibre channel hub.

Applications and configurations

The fibre channel hub modular interface provides flexibility and is upgradable to available short-wave and long-wave optical fibre channel product port interfaces. Fibre channel products that are commonly interconnected to the fibre channel hub

are fibre channel host bus adapters, FC-AL storage devices, and FC-AL storage arrays. SCSI initiators (workstations and servers) set up and initiate the transfer of data to or from the storage devices. The storage devices that receive the requests made by the SCSI initiators are the SCSI targets. Initiators and targets represent individual nodes that are linked by the shared FC-AL. See Figure 3.
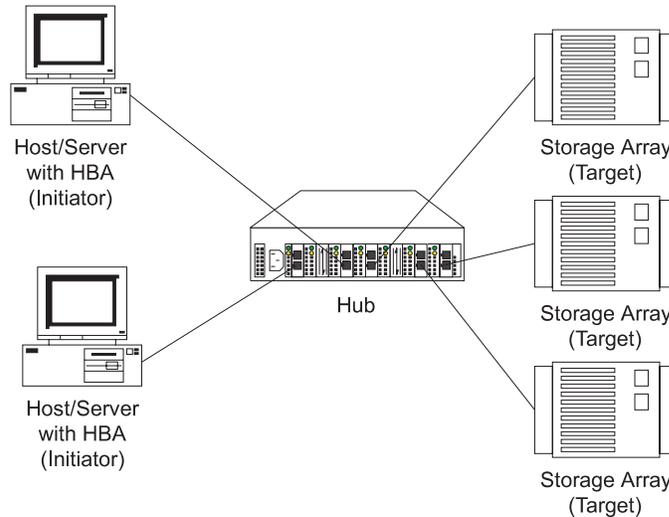
Figure 3. Type 3523 fibre channel hub

Power on systems check for the fibre channel hub

Power on the storage modules first, then the controller and the fibre channel hub, then everything else.

Note: Make sure the fibre channel hub is powered on before the host adapter to insure proper loop initialization.

Perform the following steps to insure proper operation of the fibre channel hub:

1. Connect the power cord to the fibre channel hub, then to the electrical outlet. See Figure 4.
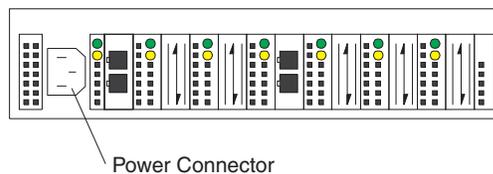
Power Connector

Figure 4. Type 3523 fibre channel hub power connector

2. Power on the attached FC-AL compatible nodes.
3. Check the Device Active (green) LEDs on the fibre channel hub ports. See Figure 5 on page 7.
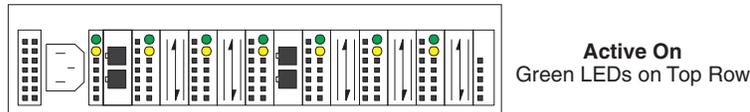
Figure 5. Type 3523 fibre channel hub active LEDs

LED On

This indicates that a GBIC is present and functioning properly.

LED Off

This indicates a fault condition. Examples of a fault condition include: a GBIC transmitter fault, an improperly seated GBIC, an absent GBIC, or another failed device. The port will be in the bypass state, which precludes the port from participating in the FC-AL. This is the normal status of operation for fibre channel hub ports in which GBICs are not installed.

Note: FC-AL compatible nodes must perform loop initialization procedures at power on to function properly on the loop. FC-AL nodes also perform loop initialization or reinitialization depending on their prior state of operation.

4. Check the Port Bypass (amber) LEDs. See Figure 6.
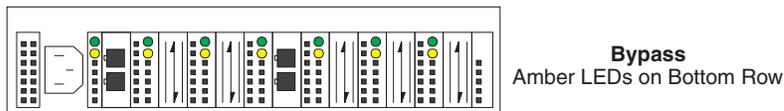
Figure 6. Type 3523 fibre channel hub port bypass LEDs

LED On

If the Active (green) LED of the port is off, the port is nonoperational and the Bypass (amber) LED for the port is on. If a properly functioning port (the Active green LED is on) with a GBIC present also has the Bypass LED on, either the loss of signal or poor signal integrity has caused the port to go into the bypass state. When the port is in this state, it cannot participate in the FC-AL.

The bypass state is also the normal status condition when no GBIC is present in the port, a GBIC is present but not attached to a FC-AL node, or a GBIC is attached to a cable assembly with nothing attached at the opposite end. Replacing such a port (or removing and reinserting the GBIC into the same port twice) is considered to be a loop configuration change that invokes the Loop Initialization Procedure.

LED Off

This indicates that the fibre channel hub port and device are fully operational and actively participating in the FC-AL.

5. The FC-AL should be fully operational. Check that proper loop discovery has taken place and all required devices are participating in the loop. Some host bus adapters might provide this level of functionality or it might be resident in the application software on the host operating system.

Symptom-to-FRU index

The Symptom-to-FRU index (see Table 3) lists symptoms, errors, and the possible causes. The most likely cause is listed first.

The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

Note:

1. Always start with the "General checkout" on page 4. For IBM devices not supported by this index, see the manual for that device.
2. Do *not* look directly into any fiber cable or GBIC optical output. Read "Notices" on page 119. To view an optical signal, use a mirror to view the reflected light.

Table 3. Symptom-to-FRU index for Type 3523 fibre channel hub and GBIC

Problem	Action/FRU
GBIC installed in one or more ports but no LED is lit.	1. **Power cord** 2. Power source
GBIC installed but only the amber LED is lit.	1. **Reseat GBIC** 2. GBIC
GBIC installed and both green and amber LEDs are lit.	**The hub is not receiving a valid fibre channel signal from the end node.** Perform the following steps: 1. Unplug the fiber cable from the node and, using a mirror, verify that an optical signal is present on the cable. If no red light is visible, replace the cable. 2. Using a mirror, examine the SC connectors on the HBA or disk controller. If no red light is visible, check the HBA or disk controller. 3. If a light is present on both the cable lead and the end node, check the HBA or the disk controller.
GBIC is installed, only the green LED is lit, but no communication occurs between the devices.	**The hub is receiving a valid fibre channel signal from the end device, but no upper-level protocols are active.** Perform the following steps: 1. Verify that the proper HBA device drivers are loaded for the appropriate operating system and that the host has been configured to recognize the attached disk devices. 2. Unplug the fiber cable from the end node and verify that an optical signal is present on the cable lead. If no signal is present, the lead of the cable might be defective. Replace the cable.

Parts listing (Type 3523 fibre channel hub and GBIC)

Figure 7 and the following table provide a parts listing for the type 3523 fibre channel hub and GBIC.
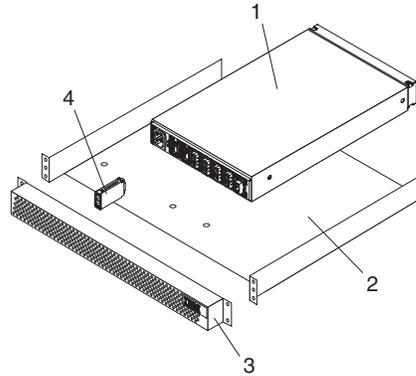
Figure 7. Type 3523 fibre channel hub parts listing

Index	Fibre channel hub (Type 3523)	FRU
1	Port Fibre Hub Assembly	01K6738
2	Hub Tray Assembly	10L7042
3	Hub Tray Bezel	10L7041
4	Short-Wave GBIC	03K9206
	Long-Wave GBIC (option)	03K9208
	Misc. Hardware Kit	01K6739

Chapter 3. Fibre Channel PCI Adapter

Note: The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

The fibre channel PCI adapter (FRU 01K7354) is compatible with the following IBM products:

- Type 3523 fibre channel hub and GBIC (see Chapter 2 on page 3)
- Type 3526 fibre channel RAID controller (see Chapter 6 on page 21)
- Type 2109 fibre channel switch
- Type 3534 managed hub

The *IBM TotalStorage DS4000 Problem Determination Guide* provides detailed configuration information for advanced users who want to use IBM Fast!UTIL to customize the configuration of the fibre channel PCI adapter (FRU 01K7354).

General checkout

The following three basic types of problems can cause the fibre channel PCI adapter to function incorrectly:

- Hardware problems
- System configuration problems
- Fibre channel problems

Hardware problems

The following list will help you determine whether a problem was caused by the hardware:

- Verify that all of the adapters are installed securely.
- Verify that all of the cables are connected securely to the correct connectors. Be sure that the SC connectors that attach from the J1 connector on the fibre channel PCI adapter to the device are connected correctly.
- Verify that the fibre channel PCI adapter is installed correctly and seated firmly in the expansion slot.
- Verify that all peripheral devices are properly powered on. See the *IBM TotalStorage DS4000 Problem Determination Guide* for information about how to use IBM Fast!UTIL to display attached devices.

System configuration problems

To determine whether a problem was caused by the system configuration, check the system board to make sure it is configured properly (see the appropriate IBM TotalStorage DS4000 Product Installation Guide).

Fibre channel problems

To determine whether a problem was caused by the fibre channel, verify that all of the FC devices were powered on before you powered on the server.

Additional service information

The following information supports the fibre channel PCI adapter.

The IBM fibre channel PCI adapter operating environment and specification information is detailed in Table 4 and Table 5.

Table 4. Fibre channel PCI adapter operating environment

Environment	Minimum	Maximum
Operating temperature	0° C (32° F)	55° C (131° F)
Storage temperature	-20° C (-4° F)	70° C (158° F)
Relative humidity (noncondensing)	10%	90%
Storage humidity (noncondensing)	5%	95%

Table 5. Fibre channel PCI adapter specifications

Type	Specification
Host bus	Conforms to PCI Local Bus Specification, revision 2.1
PCI signaling environment	3.3 V and 5.0 V buses supported
PCI transfer rate	264 MB per second maximum burst rate for 33 MHz operation (ISP2100 chip)
Fibre channel specifications	Bus type: fiber-optic media (QLA2100F) Bus transfer rate: 100 MB per second maximum
Central processing unit (CPU)	Single chip design that includes a RISC processor, fibre channel protocol manager, PCI DMA controller, and 1-gigabit transceivers
Host data transfer	64-bit, bus master DMA data transfers to 264 MB per second
RAM	128 KB of SRAM
BIOS ROM	128 KB of flash ROM in two 64-KB, software selectable banks. The flash is field-programmable.
NVRAM	256 bytes, field-programmable
Onboard DMA	Three independent DMA channels: two data and one command. Integrated 4-KB frame buffer FIFO for each data channel
Connectors (external)	SC-style connector that supports non-OFC, multimode fiber-optic cabling using 1x9 fiber-optic transceiver module. Total cable length cannot exceed 500 meters.
Form factor	17.78 cm x 10.67 cm (7.0 in. x 4.2 in.)
Operating power	Less than 15 watts

Chapter 4. DS4000 Host Adapter

Note: The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

The IBM DS4000 host adapter (FRU 09N7292) is a high-performance, direct memory access (DMA), bus-master host adapter designed for high-end systems. The function and performance are derived from the ISP2200A chip, making the DS4000 host adapter a leading-edge host adapter.

The ISP2200A chip combines a powerful RISC processor, a fibre protocol module (FPM) with gigabit transceivers, and a 64-bit peripheral component interconnect (PCI) local bus interface in a single-chip solution. The DS4000 host adapter supports all fibre channel peripheral devices that support private-loop direct attach (PLDA) and fabric-loop attach (FLA).

The IBM DS4000 host adapter is compatible with the following IBM products:
- Type 3526 fibre channel RAID controller (see Chapter 6 on page 21)
- Type 3552 FAStT500 RAID controller (see Chapter 8 on page 47)
- FAStT200 Type 3542 and FAStT200 HA Type 3542 (see Chapter 7 on page 35)
- Type 2109 fibre channel switch
- Type 3534 managed hub

The *IBM TotalStorage DS4000 Problem Determination Guide* provides detailed configuration information for advanced users who want to use IBM Fast!UTIL to customize the configuration of the fibre channel adapter (FRU 09N7292).

General checkout

The following types of problems can cause the adapter to malfunction:
- Hardware problems
- System configuration problems
- Fibre channel problems

Hardware problems

The following list will help you determine whether your installation problem is caused by the hardware:
- Verify that all adapters are installed securely.
- Verify that all cables are attached securely to the correct connectors. Be sure that the FC connectors that attach from the J1 connector on the adapter to the device are connected securely.
- Verify that the adapter is installed correctly and fully seated in the expansion slot. Check for interference due to nonstandard PCI connectors.
- Verify that all peripheral devices are turned on. See the *IBM TotalStorage DS4000 Problem Determination Guide* for information about how to use IBM Fast!UTIL to display attached devices.

System configuration problems

To determine whether a problem was caused by the system configuration, check the system board to make sure that it was configured properly (see the appropriate IBM TotalStorage DS4000 Product Installation Guide).

Fibre channel problems

To determine whether your installation problem is caused by the fibre channel, verify that all of the fibre channel devices were turned on before you turned on the server. Also, ensure that all cables are connected properly.

The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

Additional service information

The following information supports the DS4000 host adapter.

This section contains the DS4000 host adapter operating environment and specification information.

Table 6. DS4000 host adapter operating environment

Environment	Minimum	Maximum
Operating temperature	0° C (32° F)	55° C (131° F)
Storage temperature	-20° C (-4° F)	70° C (158° F)
Relative humidity (noncondensing)	10%	90%
Storage humidity (noncondensing)	5%	95%

Table 7. DS4000 host adapter specifications

Type	Specification
Host bus	Conforms to PCI Local Bus Specification, revision 2.2
PCI signaling environment	3.3 V and 5.0 V buses supported
PCI transfer rate	• 264 MB per second maximum burst rate for 33 MHz operation (ISP2200A chip) • Supports dual address bus cycles
Fibre channel specifications	• Bus type: fiber-optic media (shortwave 50 micron) • Bus transfer rate: 100 MB per second maximum (200 full-duplex) • Supports both FCP-SCSI and IP protocols • Supports point-to-point fabric connection: F-Port Fabric Login • Supports FC-AL public loop profile: FL-Port Login • Supports fibre channel services class 2 and 3 • FCP SCSI initiator and target operation • Full-duplex operation
Processor	Single chip design that includes a RISC processor, fibre channel protocol manager, PCI DMA controller, and 1-gigabit transceivers
Host data transfer	64-bit, bus master DMA data transfers to 528 MB per second
RAM	128 KB of SRAM
BIOS ROM	128 KB of flash ROM in two 64 KB, software selectable banks. The flash is field-programmable.
NVRAM	256 bytes, field-programmable
Onboard DMA	Three independent DMA channels: two data and one command. Integrated 4 KB frame buffer FIFO for each data channel

Table 7. DS4000 host adapter specifications (continued)

Type	Specification
Connectors (external)	• SC-style connector that supports non-OFC, multimode fiber-optic cabling using 1x9 fiber-optic transceiver module • Total cable length cannot exceed 500 meters • Two three-position, point-to-point cable (internal)
Form factor	17.8 cm x 10.7 cm (7.0 in. x 4.2 in.)
Operating power	Less than 15 watts
Other compliance	• PCI 98, including ACPI • Less than 28% processor utilization as measured in a TPCC benchmark • Operation system support for Microsoft® Windows NT® version 4, Windows® 2000 version 1, NetWare version 4.x and 5.x, SCO UnixWare version 7.x • Worldwide agency compliance as defined for IBM products • 100% Plug and Play compatibility with your existing fibre channel RAID controller

Chapter 5. DS4000 FC2-133 Host Bus Adapter

Note: The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

The IBM DS4000 FC2-133 host bus adapter (single port model, FRU 24P0962) is a 2 Gbps high-performance, direct memory access (DMA), bus master, fibre channel host adapter designed for high-end systems. The function and performance are derived from the ISP2312/ISP2340 chips, making the IBM DS4000 FC2-133 host bus adapter a leading-edge host adapter.

The ISP2312/ISP2340 chips combine a powerful, reduced instruction set computer (RISC) processor, a fibre channel protocol manager (FPM) with one 2 Gbps fibre channel transceiver, and a peripheral component interconnect (PCI) or peripheral component interconnect-extended (PCI-X) local bus interface in a single-chip solution. The IBM DS4000 FC2-133 host bus adapter supports all fibre channel (FC) peripheral devices that support private-loop direct attach (PLDA) and fabric-loop attach (FLA).

The *IBM TotalStorage DS4000 Problem Determination Guide* provides detailed configuration information for advanced users who want to use IBM Fast!UTIL to customize the configuration of the DS4000 FC2-133 host bus adapter.

Note: For information about how to use and troubleshoot problems with the FC 6228 2 Gigabit fibre channel adapter in pSeries AIX® hosts, see *Fibre Channel Planning and Integration: User's Guide and Service Information*, SC23-4329-03.

General checkout

The following types of installation problems might cause your DS4000 FC2-133 host bus adapter to function incorrectly:
- Hardware problems
- System configuration problems
- Fibre channel problems

If you are having problems, use the following information to help you determine the cause of the problem and the action to take.

Hardware problems

Take the following actions to determine if your installation problem is caused by the hardware:
- Verify that all adapters are installed securely.
- Verify that all cables are attached securely to the correct connectors. Be sure that one end of the LC-LC fibre channel cable is attached to the optical interface connector (located at J1 on the adapter) and that the other end is connected to the fibre channel device.
- Verify that the DS4000 FC2-133 host bus adapter is installed correctly and is fully seated in the expansion slot. Check for interference due to nonstandard PCI connectors.
- Verify that the Fast!UTIL data-rate setting is correct. The Fast!UTIL data-rate setting must match the speed of the device to which you are connected.

- Verify that all peripheral devices are turned on. See the *IBM TotalStorage DS4000 Problem Determination Guide* for information about how to use Fast!UTIL to display attached fibre channel devices.

System configuration problems

To verify that your installation problem is caused by the system configuration, check your server to ensure that it is configured properly (see the appropriate IBM TotalStorage DS4000 Product Installation Guide).

Note: All PCI-compliant and PCI-X-compliant systems automatically detect 32-bit or 64-bit adapters and set the appropriate bus speed (for example, 66 MHz or 133 MHz).

Fibre channel problems

To determine if your installation problem is caused by an attached fibre channel device, perform the following actions:

- Verify that all of the fibre channel devices were turned on before you turned on the server.
- Ensure that all cables are connected properly.
- Verify that you configured your RAID storage subsystems using the utilities that the manufacturer provided.
- If your fibre channel switch supports zoning, make sure that your peripheral device is configured to the same switch zone as the DS4000 FC2-133 host bus adapter. For more information, see your fibre channel switch documentation.

Additional service information

Table 8 and Table 9 contain the DS4000 FC2-133 host bus adapter operating environment and specification information.

Table 8. DS4000 FC2-133 host bus adapter operating environment

Environment	Minimum	Maximum
Operating temperature	0° C (32° F)	55° C (131° F)
Storage temperature	-20° C (-4° F)	70° C (158° F)
Relative humidity (noncondensing)	10%	90%
Storage humidity (noncondensing)	5%	95%

Table 9. DS4000 FC2-133 host bus adapter specifications

Type	Specification
Host bus	Conforms to Intel™ PCI Local Bus Specification, revision 2.2 and the PCI-X Addendum, revision 1.0.
PCI/PCI-X signaling environment	3.3 V and 5.0 V buses supported
PCI/PCI-X transfer rate	• Support for 32 bit and 64 bit PCI bus at 33 MHz and 64 MHz • Support for 64 bit PCI-X bus at 50 MHz, 100 MHz, and 133 MHz • PCI transfer rate 264 MB per second maximum burst rate for 33 MHz operation (ISP2312/ISP2340 chips) • Support for dual address bus cycles

Table 9. DS4000 FC2-133 host bus adapter specifications (continued)

Type	Specification
Fibre channel specifications	• Fiber-optic media (shortwave multimode 50 micron cable) • Bus transfer rate: 200 MBps maximum at half-duplex and at 400 MBps maximum full-duplex • Interface chip: ISP2312/ISP2340 (PCI-X QLA23xx boards) • Support for both FCP-SCSI and IP protocols • Support for point-to-point fabric connection: F-port Fabric Login • Support for FC-AL public loop profile: FL-port Login • Support for fibre channel services class 2 and 3 • Support for FCP SCSI initiator and target operation • Support for full-duplex operation
Processor	Single-chip design that includes a RISC processor, fibre channel protocol manager, PCI/PCI-X DMA controller, and integrated serializer/deserializer (SERDES) and electrical transceivers that can auto-negotiate a data rate of 2 Gbps
Host data transfer	64-bit, bus-master DMA data transfers to 528 MBps
RAM	256 KB of SRAM supporting parity protection
BIOS ROM	128 KB of flash ROM in two 64 KB, software selectable banks. The flash is field programmable.
NVRAM	256 bytes, field-programmable
Onboard DMA	Five-channel DMA controller: two data, one command, one auto-DMA request, and one auto-DMA response
Frame buffer FIFO	Integrated 4 KB transmit and 6 KB receive frame buffer first-in first-out (FIFO) for each data channel
Connectors (external)	• LC-style connector that supports non-OFC, multimode fiber-optic cabling using a small form factor (SFF) fiber-optic transceiver module. • Total cable length cannot exceed 500 m
Form factor	5.15 cm x 16.75 cm (2.5 in. x 6.7 in.)
Operating power	Less than 15 watts

Chapter 6. Type 3526 Fibre Channel RAID Controller

The Type 3526 fibre channel RAID controller is compatible with the following IBM products:

- Type 3523 fibre channel hub and GBIC (see Chapter 2 on page 3)
- Fibre channel PCI adapter (FRU 01K7354) (see Chapter 3 on page 11)
- IBM DS4000 host adapter (FRU 09N7292) (see Chapter 4 on page 13)
- Type 2109 fibre channel switch
- Type 3534 managed hub

General checkout

Use the status LEDs and the "Symptom-to-FRU index" on page 32 to diagnose problems.

Note: The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

The LEDs of the control unit indicate the hardware status:

- Green LED indicates normal operation
- Amber LED indicates a hardware problem

The LEDs on the controller unit indicate the status of the controller unit and its individual components. The green LEDs indicate a normal operating status; amber LEDs indicate a hardware fault. Check all of the LEDs on the front and back of the controller unit when it is powered on.

Notes:

1. If power was just applied to the controller unit, the green and amber LEDs might turn on and off intermittently. Wait until the controller unit finishes powering up before you begin checking for faults.
2. To view the controller Customer Replaceable Unit (CRU) LEDs, the front cover must be removed from the controller unit.

Also use LEDs on the front cover, controller CRUs, and drive units (if applicable) to determine whether the controllers and drives are responding to I/O transmissions from the host.

The following list describes LED activities:

- If a Fast Write Cache operation to the controller unit (or attached drive units), or if other I/O activity is in progress, then you might see several green LEDs blinking, including: the Fast Write Cache LED (on the front cover), controller CRU status LEDs, or applicable drive activity LEDs.
- The green Heartbeat LEDs on the controller CRUs blink continuously. The number and pattern of green status LEDs lit on the controllers depend on how the system is configured. An active controller will not have the same status LEDs lit as a passive controller. See the appropriate IBM TotalStorage DS4000 Product Installation Guide.

Additional service information

This section provides additional service information about the Type 3526 fibre channel RAID controller.

Powering on the controller

Note: All drive modules must be powered on before you power on the controller.

The controller might take from three to 10 seconds to power on. During this time, the amber and green LEDs on the controller unit flash.

After power on, check all fault LEDs to make sure they are off. If a fault LED is on, see the "Symptom-to-FRU index" on page 32.

Recovering from a power supply shutdown

Both power supplies have a built-in temperature sensor designed to prevent the power supplies from overheating. If a temperature sensor detects an over-temperature condition (ambient air temperature of 70° C (158° F) or above), the overheated power supply automatically shuts down. The other power supply remains on as long as its temperature remains below 70° C (158° F). If not, the second power supply shuts down, which turns off all power to the controller unit.

After the air temperature cools to below 70° C (158° F), the power supplies automatically restart. An automatic restart resets the controllers, attempts to spin up the drives (which has no effect on the drives if they are already running), and returns the controller unit to a normal operating state. Typically, you will not need to perform recovery procedures after an automatic power supply shutdown and restart.

After a power supply shutdown, check all controller LEDs.

If the power supply power LED is off, or the amber power supply LED on the front cover is on, go to the "Symptom-to-FRU index" on page 32.

Connectors and host IDs

The host ID switches and connectors for interface cables are on the connector plate located on the back of the controller unit.

Host and drive ID numbers

Each controller must have a unique Fibre Host ID number (see Figure 8 on page 23). The Host ID numbers assigned to each controller are based on two elements:

- Host ID numbers set through hardware switches on the controller unit. Five Host ID switches allow you to set ID numbers 0 through 127 for each controller. The factory default settings are ID #5 for Controller A and ID #4 for controller B.
- Software algorithms that calculate the actual fibre channel address, based on the controller unit's hardware settings and position on the loop or hub

Note: The preferred ID is assigned on the fibre channel loop unless it is already being used. If the ID is already in use, a soft ID is assigned.
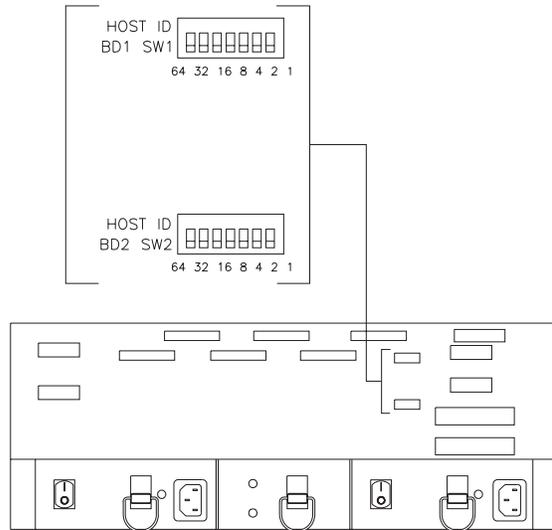
Figure 8. Fibre Host ID

Fibre channel host cable requirements

For the Type 3526 fibre channel RAID controller, you must use multi-mode, 50-micrometer fiber-optic cable and a Media Interface Adapter (MIA), shown in Figure 9.
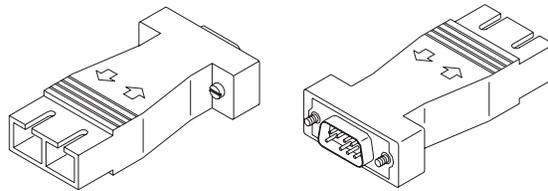
Figure 9. Media Interface Adapter

Table 10 provides specifications for the MIA.

Table 10. Type 3526 fibre channel RAID controller MIA specifications

Cable	Media type	Data size	Transfer speed	Range
Fiber-optic (multi-mode, 50-micrometer)	Short-wave laser	100 MBps	1062.5 Mbaud	up to 500 m (1640 ft.)

LVD-SCSI drive cable requirements

To connect the controller unit to a drive module, you must use 68-pin, VHDCI (very high density cable interface) LVD, Ultra 2 SCSI cables. The controller unit has six drive connectors that support 16-bit interface protocols. Each connector represents a single drive channel that supports up to 10 drives per channel for a total of 60 drives.

Specifications

Size
- With front panel:
  - Depth: 610 mm (24 in.)
  - Height: 174 mm (6.8 in.)
  - Width: 482 mm (19 in.)

Weight
- Controller unit maximum weight: 34.5 kg (76 lb)
- Controller unit empty: 14.3 kg (31.6 lb)
- Battery: 9.7 kg (21.4 lb)

Electrical Input
- Sign-wave input (50 to 60 Hz)
  - Low range: Minimum: 90 V ac Maximum: 127 V ac
  - High range: Minimum: 198 V ac Maximum: 257 V ac
- Input Kilovolt-amperes (kVA) approximately:
  - Minimum configuration: 0.06 kVA
  - Maximum configuration: 0.39 kVA

Environment
- Air temperature:
  - hub on: 10° to 35° C (50° to 95° F) Altitude: 0 to 914 m (3000 ft.)
  - hub on: 10° to 32° C (50° to 90° F) Altitude: 914 m (3000 ft.) to 2133 m (7000 ft.)
- Humidity:
  - 8% to 80%

Heat Output
- Approximate heat output in British Thermal Units (BTU) per hour:
  - Maximum configuration: 731.8 BTU (214 watts)

Acoustical Noise Emissions Values
- Sound Power (idling and operating):
  - 6.4 bels
- Sound Pressure (idling and operating):
  - 50 dBA

Tested configurations

The following configurations (Figure 10 on page 25 through Figure 21 on page 31) are for the Type 3526 fibre channel RAID controller.

Basic Configuration

3526
RAID Controller Unit

EXP10, 15 or 200
(up to 6 units)

FC Host adapter

Ctrl
A
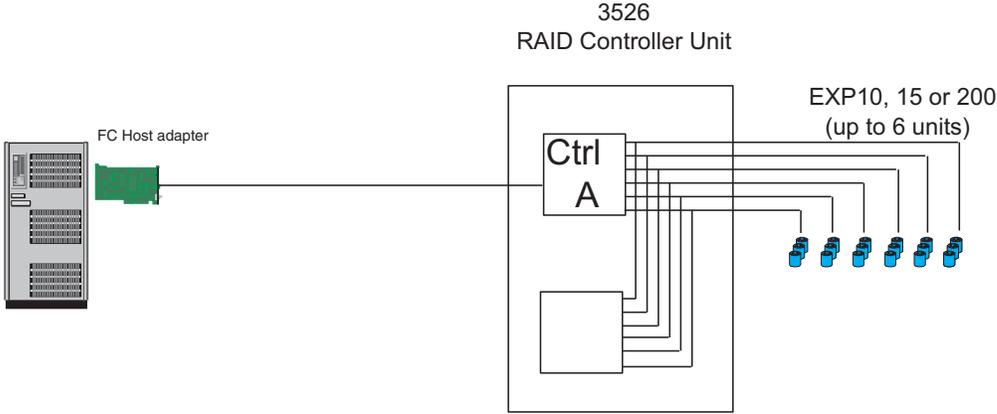
Note: Basic as shipped, single controller, no hubs or switches

Figure 10. Type 3526 fibre channel RAID controller basic configuration

Basic Dual Controller Configuration

3526
RAID Controller Unit

EXP10, 15 or 200
(up to 6 units)

FC host adapter

Ctrl
A

Note 1

FC host adapter

Ctrl
B
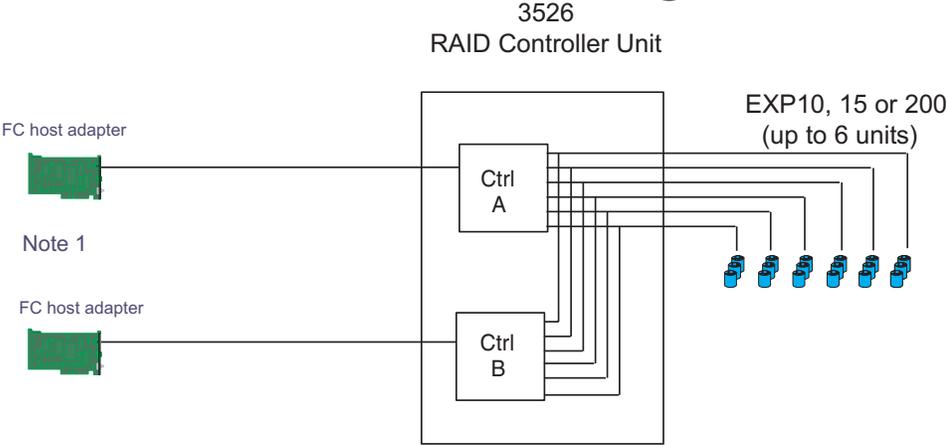
Note 1: Adapters can be in the same or different systems; choice affects total redundancy
Note 2: No hubs or switches
Note 3: For max redundancy on the drive side use orthagonal striping (see orthagonal striping chart)
Note 4: This config does not provide for "NO single point of failure"

Figure 11. Type 3526 fibre channel RAID controller basic dual controller configuration

Orthogonal Data Striping

Data striped across channels
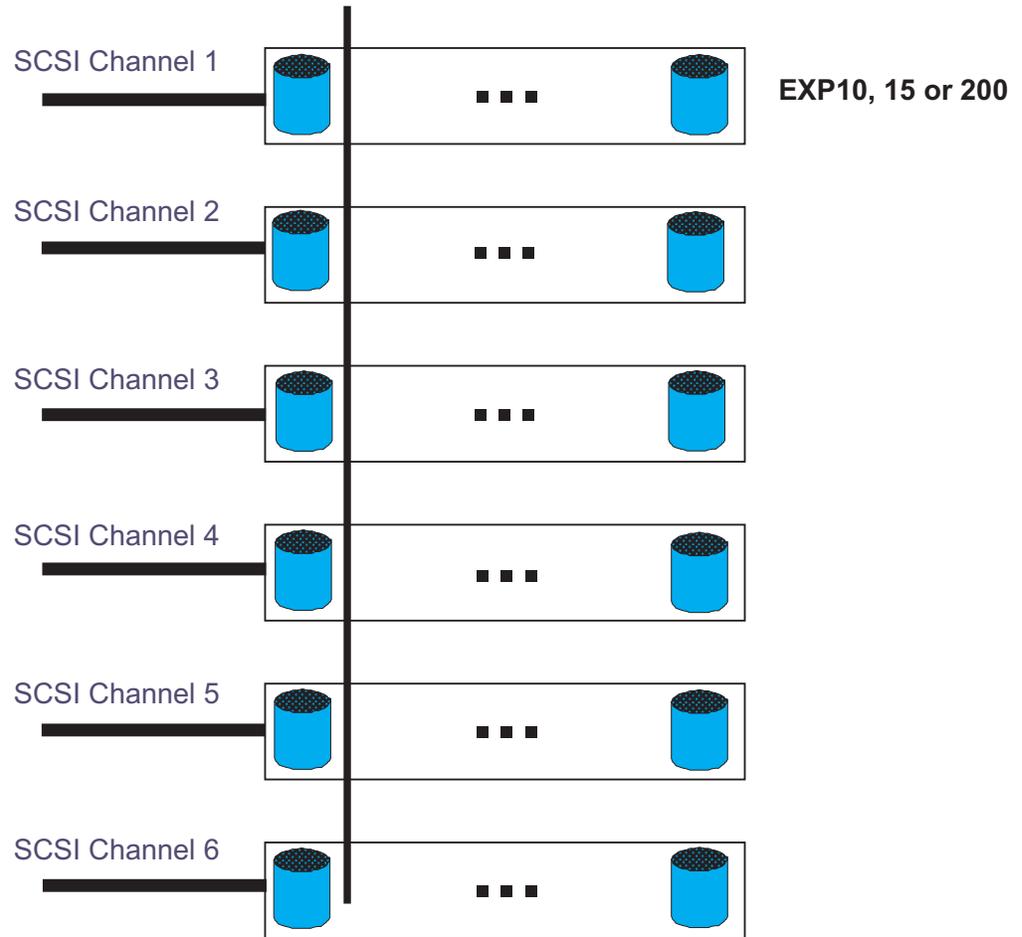
Figure 12. Type 3526 fibre channel RAID controller orthogonal data striping

Simple Fully Redundant
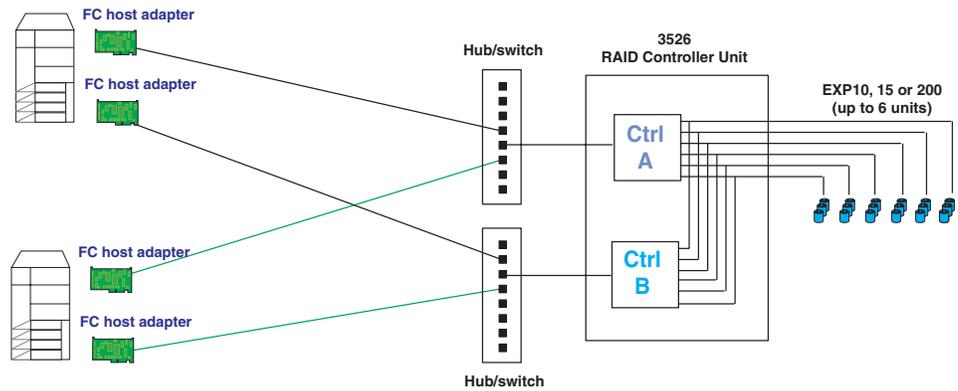
Note 1: Since disks are seen from multiple places some form of protection such as MSCS, storage partitioning, Sanergy, Oracle etc must be used.
Note 2: For best performance and managibility, a managed hub switch is preferred.
Note 3: Always try to keep connections to hub on adjacent ports and unplug all unused GBICs

Figure 13. Type 3526 fibre channel RAID controller simple fully redundant

Cluster/Non-Cluster Share
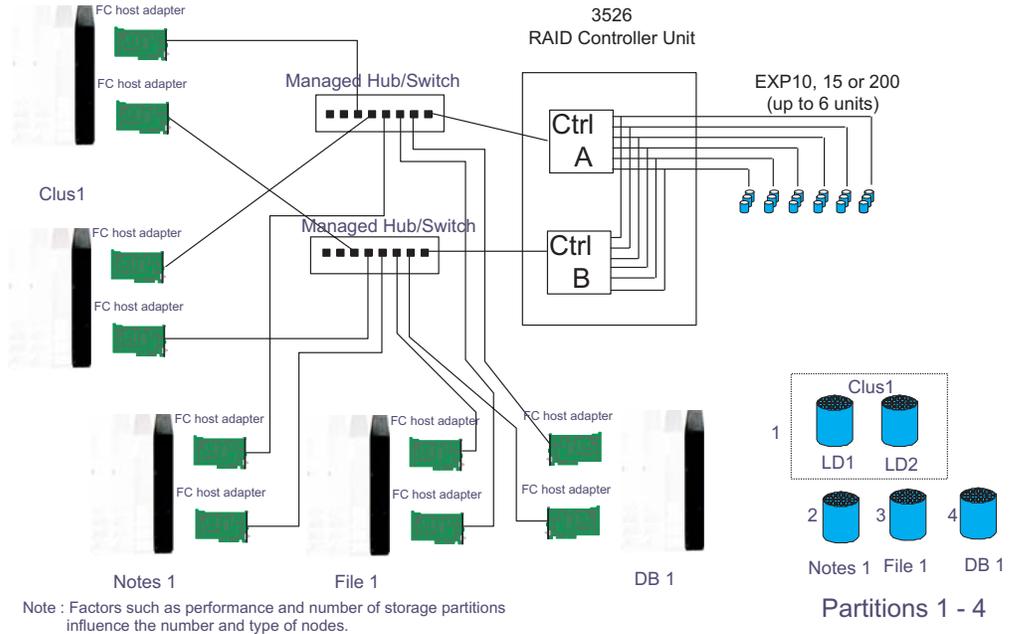
Note : Factors such as performance and number of storage partitions influence the number and type of nodes.

Figure 14. Type 3526 fibre channel RAID controller cluster/non-cluster share

Multi-MSCS No External Hubs
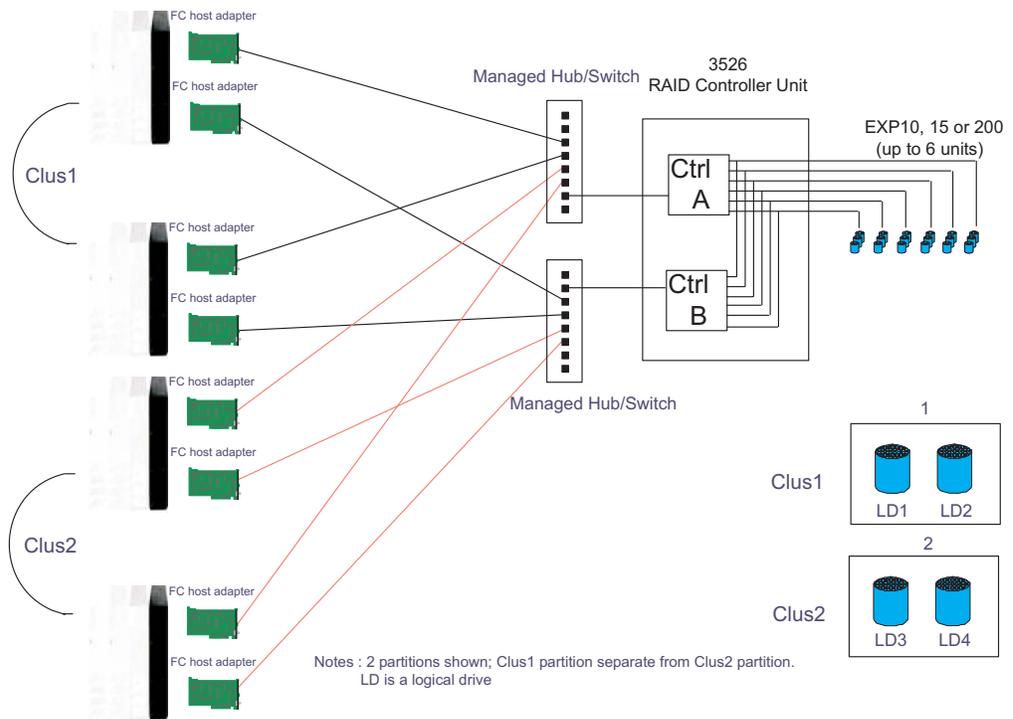
Figure 15. Type 3526 fibre channel RAID controller multi-MSCS no external hubs
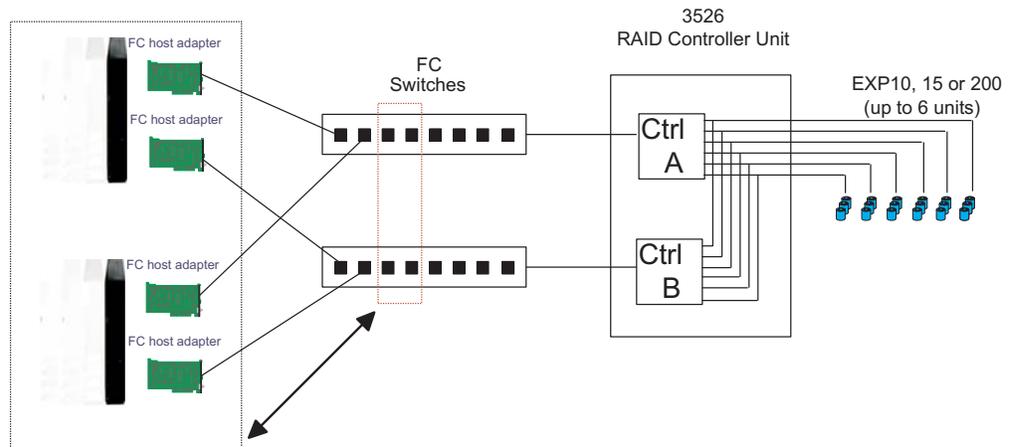
Multi-MSCS extended

Notes :
- Each group of 4 ports on the switches (red dash box) can support one cluster element (black dash box)
- Storage partitioning is used to separate clusters
- Match performance needs of servers to max I/o available from 60 drives
- You may use some the switch ports to add 3526 units rather than hosts. Extending this to 16 port switches allows more of both

Figure 16. Type 3526 fibre channel RAID controller multi-MSCS extended

Cornhusker configuration
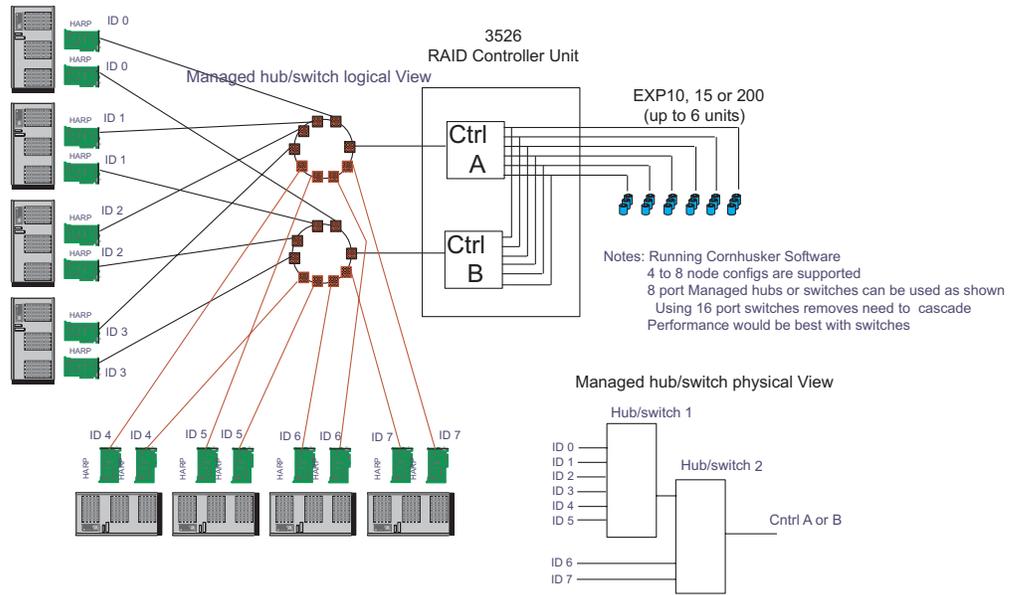
Figure 17. Type 3526 fibre channel RAID controller cornhusker configuration

Base Storage Partitions
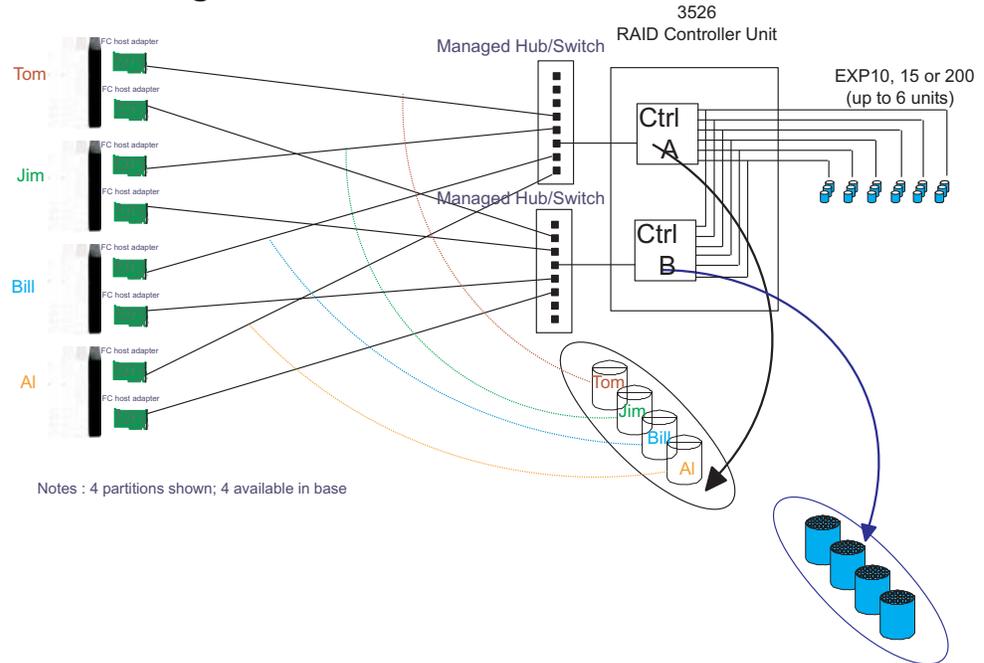
Figure 18. Type 3526 fibre channel RAID controller basic storage partitions

Capacity Configuration
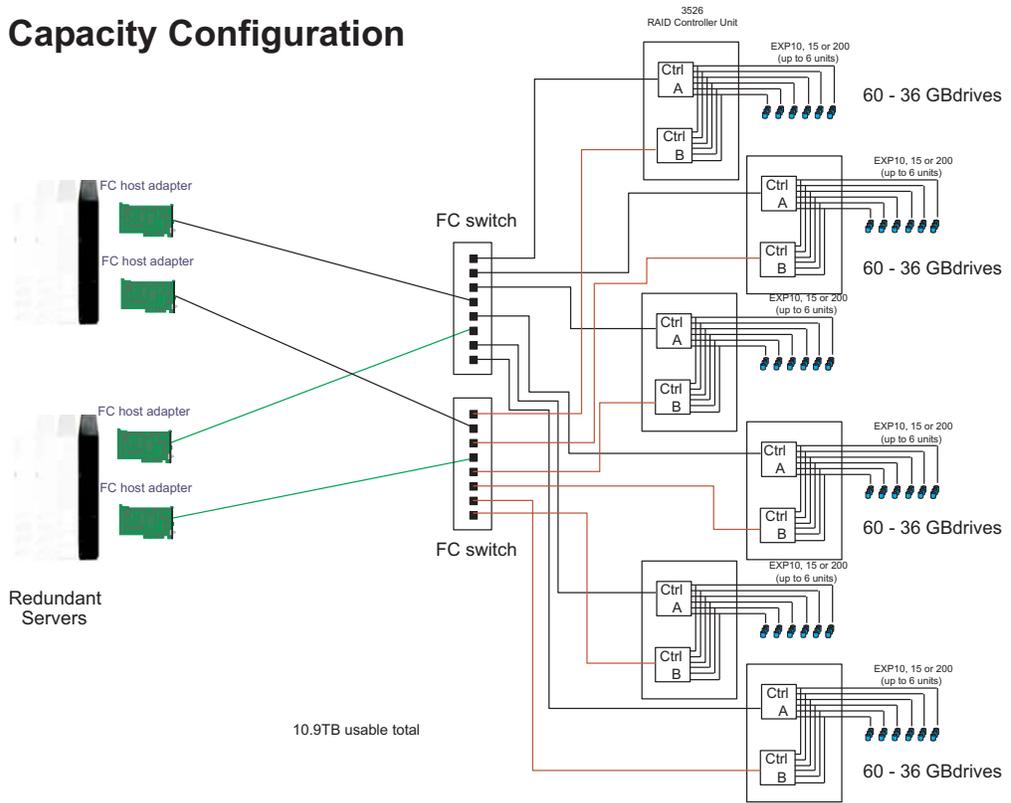
Figure 19. Type 3526 fibre channel RAID controller capacity configuration

SAN - Using Partitions of Clusters
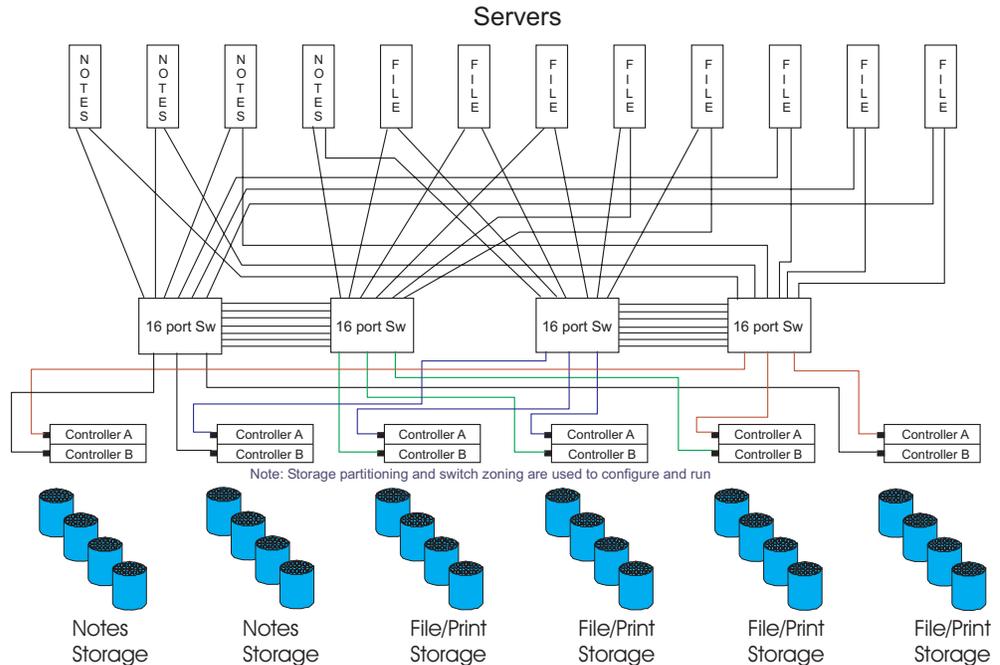
Figure 20. Type 3526 fibre channel RAID controller SAN - Using partitions of clusters

Legato HA/Replication for MSCS

Client Interconnect

Private Interconnect

Primary writes over FCP

Primary writes over FCP

Mirrored writes over IP

Site A   Site B

Up to 10Km

FC-AL

Ethernet, Token Ring, etc.

Gigabit Ethernet

Note 1: Mirroring is done over IP using Gigabit ethernet
Note 2: Requires Legato LME and MSCS
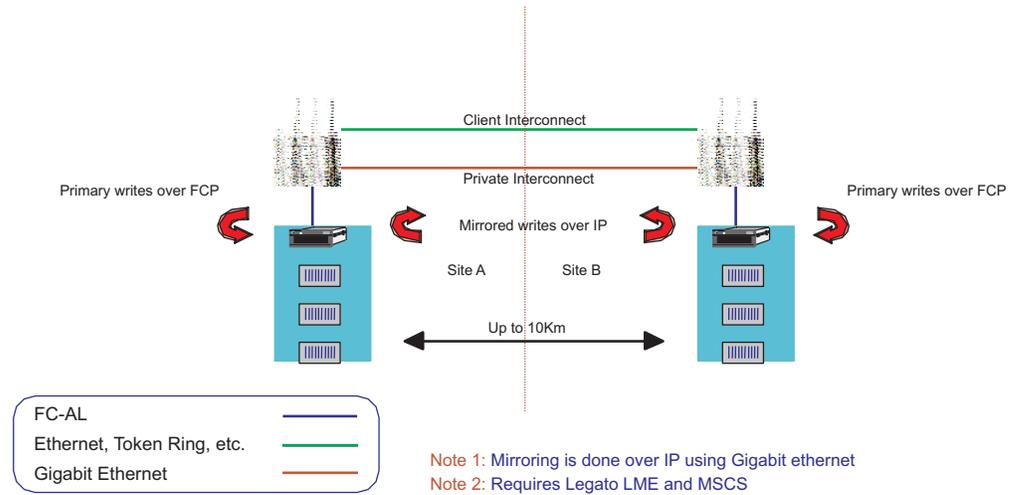
Figure 21. Type 3526 fibre channel RAID controller Legato HA/replication for MSCS

Symptom-to-FRU index

The Symptom-to-FRU index (Table 11) lists symptoms and the possible causes. The most likely cause is listed first.

The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* also provide you with additional diagnostic aids.

Notes:

1. Always start with the "General checkout" on page 21. For IBM devices not supported by this index, see the manual for that device.
2. Do *not* look directly into any fiber cable or GBIC optical output. Read "Notices" on page 119. To view an optical signal, use a mirror to view the reflected light.

Table 11. Symptom-to-FRU index for Type 3526 fibre channel RAID controller

Problem	Action/FRU
Controller LED (front cover) is on.	1. **Reseat Controller CRU** 2. Place Controller online using DS4000 Storage Manager GUI 3. If in passive mode, check Fibre path/GBIC 4. Controller CRU
Software issued a controller error message.	1. **Check Controller Fan** 2. Controller CRU
Software errors occur when attempting to access controllers or drives.	1. **Check appropriate software and documentation to make sure the system is set up correctly and the proper command was run**. 2. Power to the Controller 3. Interface cables 4. ID settings 5. Controller 6. Drive 7. Controller backpanel
Fan LED (front cover) is on.	1. **Power supply fan CRU** 2. Controller fan CRU
Controller and Fan fault LEDs (front cover) are on.	1. **Check both Fan and Controller CRUs for fault LED and replace faulty CRU.**
Fault-A or Fault-B LED (battery CRU) is on. **Note:** The Fault-A or Fault-B LED *will* be on during battery charging.	1. **Battery CRU**
Full Charge-A or Full Charge-B LED (battery CRU) is off.	1. **Power on Controller and allow batteries to charge for 24 hours until the Full Charge LEDs are on.** 2. Battery CRU 3. Both power supplies
No power to controller (all power LEDs off).	1. **Check power switches and power cords.** 2. Power supplies

Table 11. Symptom-to-FRU index for Type 3526 fibre channel RAID controller (continued)

Problem	Action/FRU
Power Supply LED is off.	1. **Check and reseat power supply.** 2. Check for overheating. Wait ten minutes for the power supply CRU to cool down. See "Recovering from a power supply shutdown" on page 22. 3. Power supply CRU
Power Supply CRU LEDs are on, but all other CRU LEDs are off.	1. **DC power harness**

Parts listing

Figure 22 and the following table provide a parts listing for the type 3526 fibre channel RAID controller.
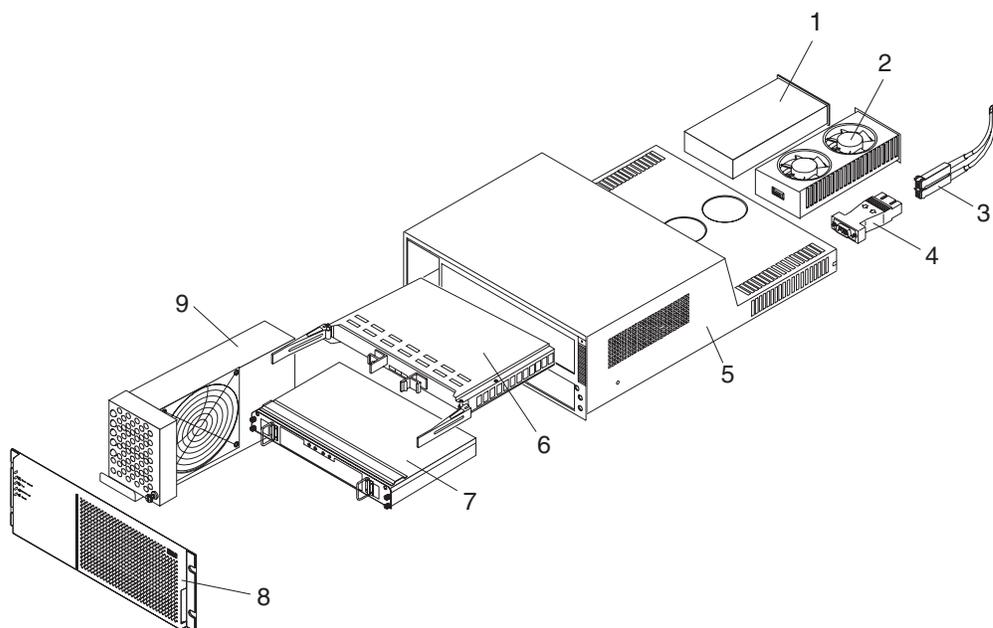
Figure 22. Type 3526 fibre channel RAID controller parts list

Index	Fibre channel RAID controller (Type 3526)	FRU
1	350-W Power Supply	01K6743
2	Rear Fan Assembly (Power Supply Fan)	01K6741
3	Optical Cable - 5 Meters (option)	03K9202
3	Optical Cable - 25 Meters (option)	03K9204
4	Media Interface Adapter (MIA)	03K9280
5	Frame Assembly with Midplane	10L6981
6	Controller Assembly with 32 MB memory/128 MB cache	10L6993
7	Battery Backup Assembly	01K6742
8	Bezel Assembly	10L7043

Index	Fibre channel RAID controller (Type 3526)	FRU
9	Front Fan Assembly (Controller CRU Fan)	01K6740
	128 MB cache module	10L5862
	Battery Cable	03K9285
	Fan Cable	03K9281
	Power Cable	03K9284
	Miscellaneous Hardware Kit	01K6739
	Rail Kit	10L6982

Appendix A, "Power cords," on page 103 lists required power cords for the DS4000 storage components discussed in this document by country and region.

Chapter 7. FAStT200 Type 3542 and FAStT200 HA Type 3542

The FAStT200 Type 3542 and FAStT200 HA Type 3542 are compatible with the following IBM products:

- IBM DS4000 host adapter (FRU 09N7292) (see Chapter 4 on page 13)
- IBM FAStT EXP500 storage expansion unit (see Chapter 11 on page 79)
- Type 3534-F08 fibre channel switch
- Type 2109 Series fibre channel switches
- Type 2005 Series fibre channel switches
- DS4000 FC2-66 host bus adapter (FRU 19K1247)
- DS4000 FC2-133 host bus adapter (FRU 24P0962) (see Chapter 5 on page 17)

General checkout

Use the status LEDs, symptom-to-FRU list, and the storage management software to diagnose problems. See "Monitoring status through software" on page 40 and "Checking the LEDs" on page 40.

To diagnose a cluster system, use the cluster problem determination procedure in the *IBM TotalStorage DS4000 Problem Determination Guide*. The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* also provide you with additional diagnostic aids.

Note: If power was just applied to the controller unit, the green and amber LEDs might turn on and off intermittently. Wait until the controller unit finishes powering up before you begin to check for faults.

General information

The IBM FAStT200 storage server is available in two models.

The IBM FAStT200 HA storage server (Model 3542-2RU) 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 IBM FAStT200 storage server (Model 3542-1RU) comes with one RAID controller, two power supplies, and two cooling units and provides battery backup of the RAID controller cache. A FAStT200 Redundant RAID controller option is available for purchase. Contact your IBM reseller or IBM marketing representative.

The IBM FAStT200 HA storage server is designed to provide maximum host- and drive-side redundancy. Each RAID controller supports direct attachment of one host that contains one or two host adapters. By using external managed hubs and switches in conjunction with the storage server, you can build even larger configurations. (Throughout this chapter, the use of hub or external hub refers to a managed hub.)

Note: Throughout this chapter, the term *storage server* refers to both the IBM FAStT200 storage server (Model 3542-1RU) and the IBM FAStT200 HA storage server (Model 3542-2RU). Model-specific information is noted where applicable.

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Additional service information

This section provides additional service information about the IBM FAStT200 storage server.

Operating specifications

Table 12 summarizes the operating specifications of the controller unit.

Table 12. Model 3542-2RU storage server operating specifications

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

• Depth: 57.5 cm (22.6 in)
• Height: 13.2 cm (5.2 in)
• Width: 48 cm (18.9 in)
 	
Weight
• Standard storage server as shipped: 25.74 kg (56.7 lb)
• Typical storage server fully configured: 37.65 kg (83 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 (8 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)
		  – 65 dBA (typical)
		• Sound pressure (operating):
		  – 47 dBA (open bay)
		  – 68 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.

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 a hot-swap device is removed, installed, or replaced.

Front view

Figure 23 on page 37 shows the components and controls on the front of the server.
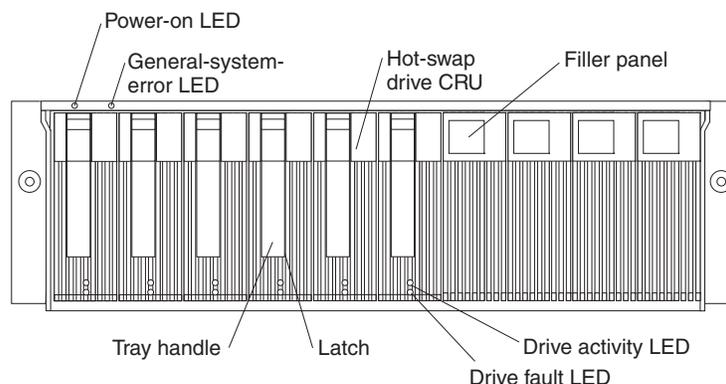
Figure 23. FAStT200 and FAStT200 HA storage server front view

Power-on LED

When on, this green light indicates that the unit has adequate 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 40.

Hot-swap drive CRU

You can install up to 10 hot-swap drive 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 you install new drives, you must remove the filler panels and save them. Each of the 10 bays must always contain either a filler panel or a drive CRU. Each filler panel contains a filler piece for use with a slim drive.

Drive activity LED

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

Drive fault LED

Each drive CRU has an amber Drive fault LED. When on, this amber LED indicates a drive failure. When flashing, this amber LED indicates that a drive identify or rebuild process 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 the appropriate IBM TotalStorage DS4000 Product Installation Guide. For more information about the LEDs, see "Checking the LEDs" on page 40.

Back view

Figure 24 shows the components at the back of the storage server.

Note: If your storage server is a Model 1RU, there is only one RAID controller. There is a blank panel in the second RAID controller opening. The blank panel must remain in place to maintain proper cooling.
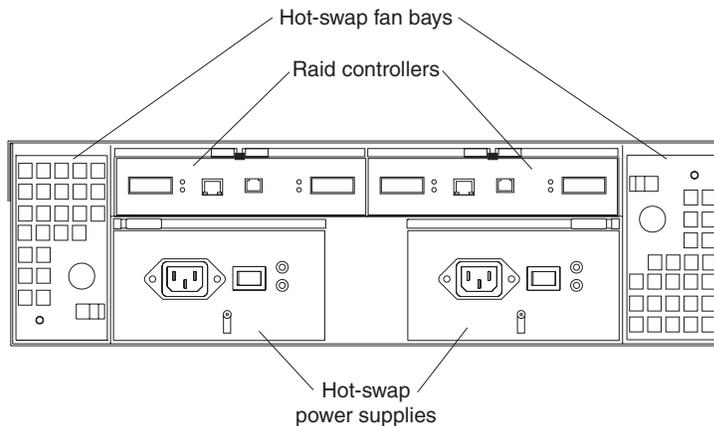
Figure 24. FAStT200 and FAStT200 HA storage server bays (back view)

RAID controller

The storage server comes with one or two hot-swap RAID controllers. Each RAID controller contains two ports for Gigabit Interface Converters (GBICs) which connect to the fibre channel cables. One GBIC connects to a host system. The other GBIC 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 the appropriate IBM TotalStorage DS4000 Installation and User's Guide.

Important: The replacement RAID controller CRU does not come with a RAID controller cache battery installed. 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. For the steps to remove and replace the battery, see the appropriate IBM TotalStorage DS4000 Installation and User's Guide.

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 your 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 25 on page 39 shows the ports and switches on the back of the storage server.
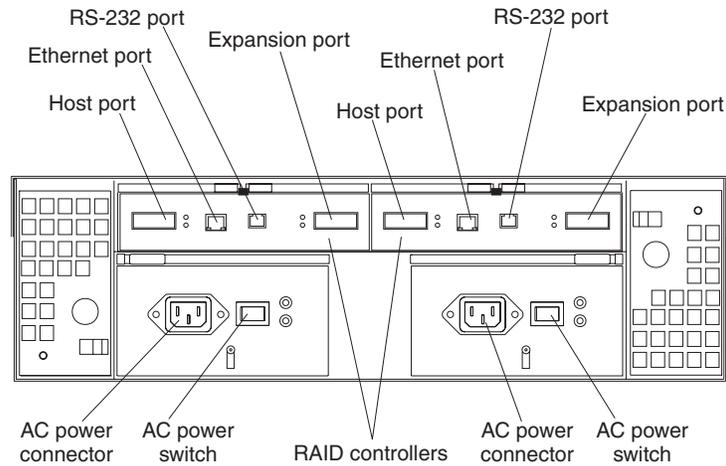
Figure 25. FAStT200 and FAStT200 HA storage server interface ports and switches

RAID controller

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

Host port

The host port is used to connect fibre channel cables from the host systems. You first insert a GBIC into the port and then connect the fibre channel cables.

Ethernet port

The Ethernet port is for an RJ-45 10 BASE-T or 100 BASE-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 can connect one expansion unit to each RAID controller. You first insert a GBIC into the port and then connect the fibre channel cables.

RS-232 port

The RS-232 port is a TJ-6 modular jack and is used for an RS-232 serial connection. The RS-232 port is used by service personnel to perform diagnostic operations on the RAID controllers. An RS-232 cable comes with the storage server.

Diagnostics

To diagnose fibre channel problems, use FAStT MSJ (see the *IBM TotalStorage DS4000 Problem Determination Guide*).

To diagnose the Type 3542 storage system, use the following diagnostic tools:

* Storage management software
* Checking LEDs

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 failed or needs to be replaced, or which type of recovery procedure that 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 whether the drives are responding to I/O transmissions from the host.

Storage server LEDs (front)
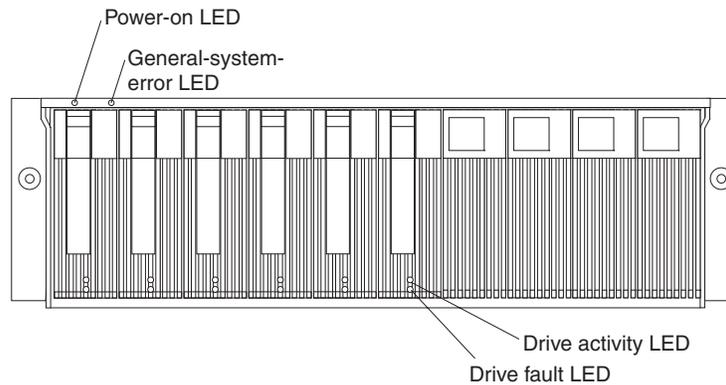
Figure 26. FAStT200 and FAStT200 HA storage server LEDs (front)

Table 13. FAStT200 and FAStT200 HA storage server LEDs (front)

LED	Color	Operating states[1]

Drive active	Green	• **On** - Normal operation
		• **Flashing** - The drive is reading or writing data.
		• **Off** - One of the following situations has occurred:
		  – The storage server has no power.
		  – The storage subsystem has no power.
		  – The drive is not properly seated in the storage server.
		  – The drive has not spun up.

Drive fault	Amber	• **Off** - Normal operation • **Flashing** - The storage management software is locating a drive, logical drive, or storage subsystem. • **On** - The drive failed, or a user failed the drive.

Power	Green	• **On** - Normal operation
		• **Off** - One of the following situations has occurred:
		  – The storage server has no power.
		  – The storage subsystem has no power.
		  – The power supply failed.
		  – There is an overtemperature condition.

General-system-error	Amber	• **Off** - Normal operation • **On** - A storage server component failed[2].
[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 40.		

Storage server LEDs (rear)
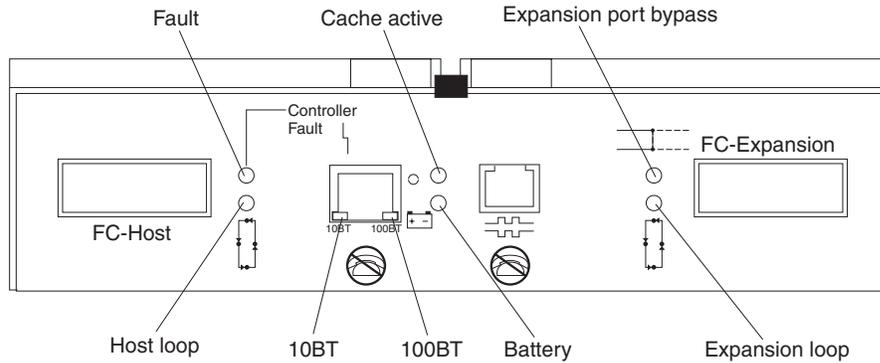
Figure 27. FAStT200 and FAStT200 HA storage server LEDs (rear)

Table 14. FAStT200 and FAStT200 HA storage server RAID controller LEDs

Icon	LED	Color	Operating states[1]
	Fault	Amber	• **Off** - Normal operation • **On** - The RAID controller failed.

	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 GBIC failed, or the host port is not occupied.
			  – The RAID controller circuitry 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 failed, or the battery failed.

	Battery	Green	• **On** - Normal operation • **Flashing** - The battery is recharging or performing a self-test. • **Off** - The battery or battery charger failed.

	Expansion port bypass	Amber	• **Off** - Normal operation
			• **On** - One of the following situations has occurred:
			  – The expansion port is not occupied.
			  – The fibre channel cable is not attached to an expansion unit.
			  – The attached expansion unit is not turned on.
			  – A GBIC failed, a fibre channel cable failed, or a GBIC failed on the attached expansion unit.

	Expansion loop	Green	• **On** - Normal operation • **Off** - The RAID controller circuitry failed, or the RAID controller has no power.

Icon	LED	Color	Operating states[1]
No icon	10BT	Green	• **If the Ethernet connection is 10BASE-T:** The 10BT LED is on, 100BT LED flashes faintly.
No icon	100BT		• **If the Ethernet connection is 100BASE-T:** The 10BT LED is off, 100BT LED is on. • **If there is no Ethernet connection:** Both LEDs are off.
[1] Always use the storage management software to identify the failure.			

Fan and power supply LEDs
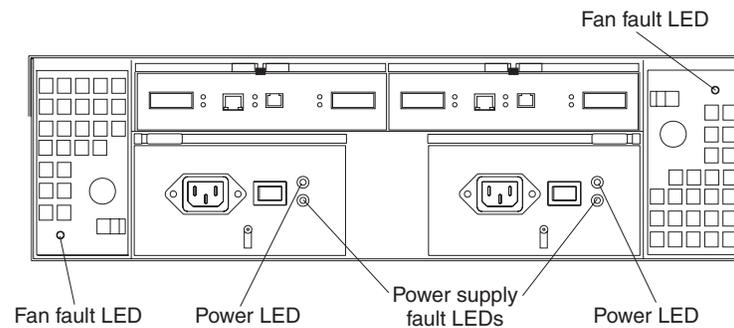
Figure 28. FAStT200 and FAStT200 HA fan and power supply LEDs

Table 15. FAStT200 and FAStT200 HA fan LEDs

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

Table 16. FAStT200 and FAStT200 HA power supply LEDs

LED	Color	Operating states[1]
Fault	Amber	• **Off** - Normal operation • **On** - One of the following situations has occurred: – The power supply failed. – An overtemperature condition has occurred. – The power supply is turned off.
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.
[1] Always use the storage management software to identify the failure.		

Symptom-to-FRU index

Use the storage management software to diagnose and repair controller unit failures. Use Table 17 also to find solutions to problems that have definite symptoms.

See the PD maps in the *IBM TotalStorage DS4000 Problem Determination Guide* for more detailed procedures for problem isolation.

Table 17. Symptom-to-FRU index for FAStT200 and FAStT200 HA Type 3542 controller

Problem Indicator	Action/FRU
Amber LED on - Drive CRU	1. **Replace the drive that failed**.
Amber LED on - Fan CRU	1. **Replace the fan that failed.**
Amber LED on - RAID controller Fault LED	1. **If the RAID controller Fault LED is lit, replace the RAID controller.**
Amber LED on - Expansion port Bypass LED	1. **No corrective action needed if system is properly configured and no attached expansion units.** 2. Reattach the GBICs and fibre channel cables. Replace input and output GBICs or cables as necessary. 3. Expansion unit
Amber LED on - Front panel	1. **Indicates that a Fault LED somewhere on the storage server has turned on. (Check for amber LEDs on CRUs).**
Amber LED on and green LED off - Power supply CRU	1. **Turn on all power supply power switches.** 2. Check ac power.
Amber and green LEDs on - Power-supply CRU	1. **Replace the failed power-supply CRU.**
All green LEDs off - All CRUs	1. **Check that all storage server power cords are plugged in and the power switches are on** 2. Check that the main circuit breakers for the rack are turned on. 3. Power supply 4. Midplane
Amber LED flashing - Drive CRUs	1. **No corrective action is needed. (Drive rebuild or identity is in process.)**
One or more green LEDs off - Power supply CRUs	1. **Make sure that the power cord is plugged in and the power-supply switches are turned on.**
One or more green LEDs off - All drive CRUs	1. **Midplane**
One or more green LEDs off - Front panel	1. **Make sure that the cords are plugged in and power supplies are turned on.** 2. Midplane
One or more green LEDs off - Battery	1. **Battery**
One or more green LEDs off - Cache active	1. **Use the storage management software to enable the cache.** 2. RAID controller 3. Battery

One or more green LEDs off - Host Loop	1. **Check if host managed hub or switch is on. Replace attached devices that have failed.** 2. Fibre channel cables 3. GBIC 4. RAID controller
One or more green LEDs off - Expansion Loop	1. **Ensure drives are properly seated.** 2. RAID controller 3. Drive 4. GBIC or fibre channel cable
Intermittent or sporadic power loss to the storage server - Some or all CRUs	1. **Check the ac power source.** 2. Reseat all installed power cables and power supplies. 3. Replace defective power cords. 4. Check for a Fault LED on the power supply, and replace the failed CRU. 5. Midplane
Unable to access drives on Drives and fibre channel loop	1. **Ensure that the fibre channel cables are undamaged and properly connected.** 2. RAID controller
Random errors on Subsystem	1. **Midplane**
The Storage Manager client Enterprise Management window sees each storage server controller as an independent storage subsystem.	**No drives are present in the storage server.** Ensure that at least one drive is present in the storage server so that it can be configured properly. **One controller was replaced incorrectly. The controller firmware versions probably failed to synchronize correctly.** To recover, perform the following steps: 1. Remove and reinsert the controller blade. 2. Wait 5 minutes. 3. Delete the controller entry with the incorrect firmware version from the DS4000 Storage Manager Enterprise Management window. 4. Add the controller back to the DS4000 Storage Manager Enterprise Management window using the **Add Device** menu option in the Enterprise Management window. 5. If the Storage Manager client Enterprise Management window still shows each storage server controller as an independent storage subsystem or a partially managed device, repeat this procedure. If the problem still persists, contact IBM support.

Note: If you cannot find the problem in Table 17 on page 44, test the entire system.

Parts listing

Figure 29 on page 46 and the following table provide a parts listing for the FAStT200 and FAStT200 HA controllers.
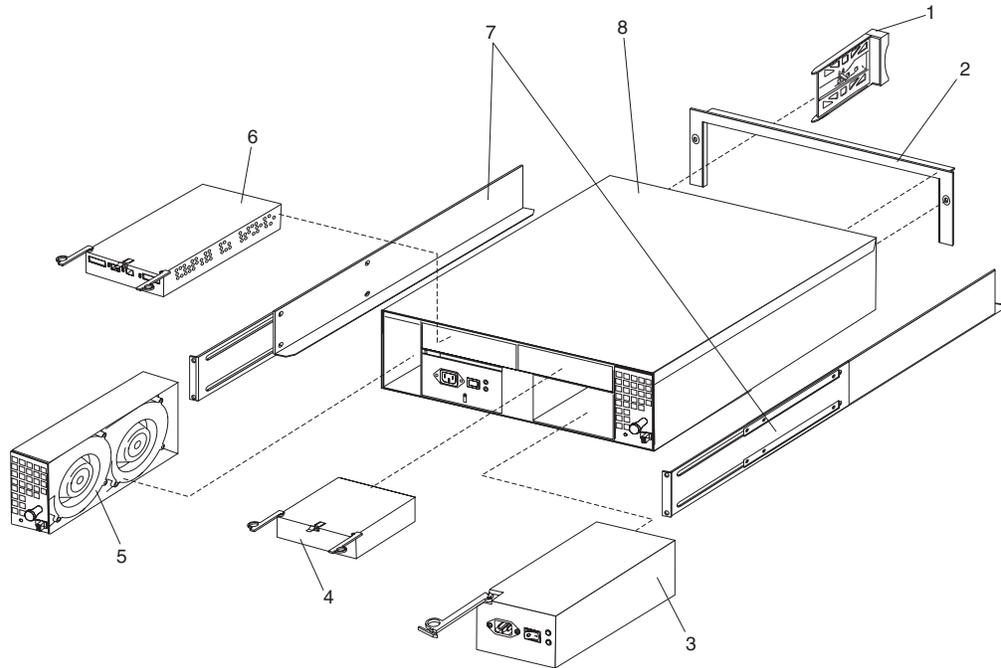
Figure 29. FAStT200 and FAStT200 HA controller parts list

This parts listing supports the following models: 1RU, 1RX, 2RU, and 2RX.

Index	Type 3542- IBM FAStT200 and FAStT200 HA storage servers	FRU No.
1	DASD Bezel Filler Asm (all models)	37L0198
2	Decorative Bezel (all models)	09N7307
3	Power Supply Asm (350 W) (all models)	19K1164
4	Blank, controller (model 1RU, 1RX)	19K1229
5	Blower Asm (all models)	09N7285
6	FC Controller, (all models)	19K1115
7	Rail Kit Left/Right (all models)	37L0067
8	Midplane/Frame (all models)	19K1220
	Misc. Hardware Kit (all models)	09N7288
	Short Wave GBIC (all models)	03K9206
	Long Wave GBIC (all models)	03K9208
	Cable, 5M Optical (all models)	03K9202
	Cable, 25M Optical (all models)	03K9204
	Cable, Serial (all models)	19K1179
	Cable, 1M Optical (all models)	37L0083
	9' Line Cord (all models)	6952300
	Battery, Cache (all models)	19K1219
	Line Cord Jumper, High Voltage (model 1RX, 2RX)	36L8886

Appendix A, "Power cords," on page 103 lists required power cords for the DS4000 storage components discussed in this document by country and region.

Chapter 8. Type 3552 FAStT500 RAID Controller

The IBM FAStT500 RAID controller is compatible with the following IBM products:
- IBM FAStT EXP500 storage expansion unit (see Chapter 11 on page 79)
- Type 2109 Series fibre channel switches
- Type 2005 Series fibre channel switches
- Type 3534-F08 fibre channel switch
- DS4000 FC2-66 host bus adapter (FRU 19K1247)
- DS4000 FC2-133 host bus adapter (FRU 24P0962) (see Chapter 5 on page 17)

General checkout

Use the indicator lights and the "Symptom-to-FRU index" on page 57 to diagnose problems.

Note: The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

Checking the indicator lights

The controller unit indicator lights (see Figure 30 on page 48) display the status of the controller unit and its components. Green indicator lights mean normal operating status; amber indicator lights mean a possible failure.

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

Perform the following steps to check the controller unit indicator lights and operating status.
1. To view the indicator lights, remove the controller unit bezel.
2. Check the indicator lights on the front of the controller unit.
3. Check the indicator lights on the back of the controller unit.
4. Check the indicator lights on the mini hubs.
5. If all indicator lights show a normal status, replace the bezel; otherwise, run the storage management software to diagnose and repair the problem.
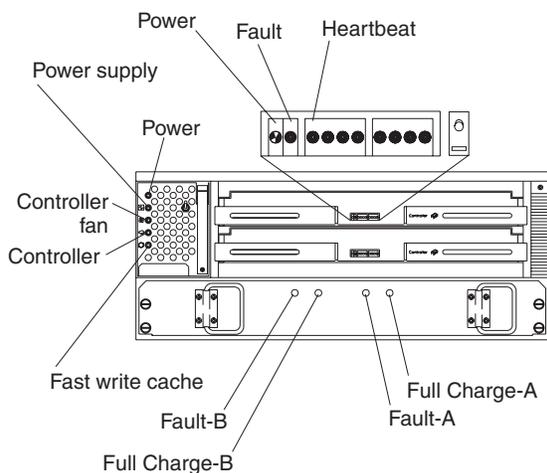
Figure 30. FAStT500 RAID controller indicator lights (front panel)

Table 18. FAStT500 RAID controller indicator lights (front panel)

Indicator light	Color	Normal Operation	Problem Indicator	Possible conditions suggested by the problem indicator (1)
Component: controller CRU				
Power	Green	On	Off	• No power to controller unit • No power to storage subsystem • Cables are loose or the switches are off • Power supply failed, is missing, or is not fully seated • Overtemperature condition
Fault	Amber	Off	On	Controller failure; controller fault condition
Heartbeat	Green	Blinking (2)	Not blinking (2)	No controller activity
Status (eight lights including Heartbeat)	Green	Various patterns depending on the condition	Various patterns depending on the condition	If the second, third, sixth, and seventh lights are on or if all eight lights are on, there is a memory fault that indicates that the controller CRU failed.
Component: controller fan				
Power	Green	On	Off	• No power to controller unit • No power to storage subsystem • Cables are loose or the switches are off • Power supply failed, is missing, or is not fully seated in controller unit • Overtemperature condition
Power supply fault	Amber	Off	On	• Power supply failed • Overtemperature • Power supply is turned off, disconnected, or not fully seated in controller unit • No power to controller unit or storage subsystem (all indicator lights are off)

Indicator light	Color	Normal Operation	Problem Indicator	Possible conditions suggested by the problem indicator (1)
Controller fan fault	Amber	Off	On	• Controller fan failed • Fan and communications module is missing, unplugged, or failed • Circuitry failure • Overtemperature condition
Controller fault	Amber	Off	On	Controller failed; one or more memory modules failed (SIMMs or DIMMs).
Fast write cache	Green	Steady or blinking (3)	Software dependent (3)	Normal operation is off if: • Cache is not enabled. • Battery is not ready.
Component: battery				
Fault-A or Fault-B	Amber	Off	On	• Left or right battery bank failed. • Battery is either discharged or defective.
Full Charge-A or Full Charge-B	Green	On (4)	Off	• Left or right battery bank is not fully charged. • Power has been off for an extended period and has drained battery power. • Batteries are weak.
1. Always use the storage management software to identify the failure.				
2. There are eight status lights (the Heartbeat and seven others) that glow in various patterns, depending on the controller status.				
3. The fast write cache indicator light is on when there is data in the cache and it blinks during a fast write operation.				
4. If either Full Charge-A or Full Charge-B indicator light blink, the battery is in the process of charging.				

More indicator lights are located on the back of the controller unit, as shown in Figure 31.

Power supply fault   Fan and communications module fault   Power supply fault
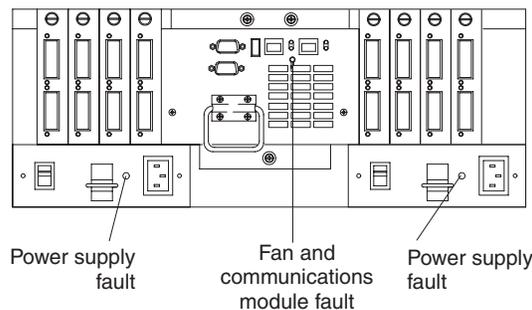
Figure 31. FAStT500 RAID controller indicator lights (back panel)

Table 19 on page 50 describes the back panel FAStT500 RAID controller indicator lights.

Table 19. FAStT500 RAID controller indicator lights (back panel)

Indicator light	Color	Normal Operation	Problem Indicator	Possible conditions suggested by the problem indicator (1)
Fan and communications module				
Fan and communication fault	Amber	Off	On	• Fan and communications module failed or is installed incorrectly • Overtemperature condition
Power supply				
Power supply	Green	On	Off	• No power to controller unit • No power to storage subsystem • Power supply failed • Overtemperature condition
1. Always use the storage management software to identify the failure.				

The mini hub indicator lights on the back of the controller unit are shown in Figure 32.
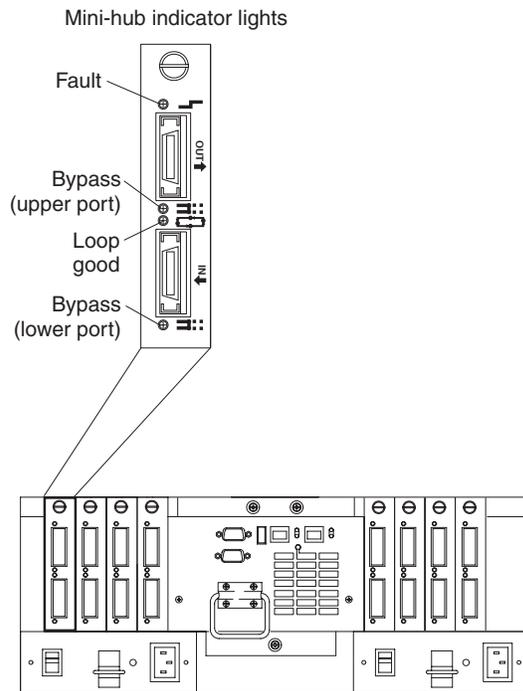
Figure 32. FAStT500 RAID controller mini hub indicator lights

Table 20 on page 51 describes the mini hub indicator lights.

Table 20. FAStT500 RAID controller mini hub indicator lights

Icon	Indicator light	Color	Normal Operation	Problem Indicator	Possible conditions suggested by the problem indicator
Component: mini hub (host-side)					
	Fault	Amber	Off	On	Mini hub or GBIC failed. **Note:** If a host-side mini hub is not connected to a controller, this fault light is always on.
	Bypass (upper port)	Amber	Off	On	• Upper mini hub port is bypassed. • Mini hub or GBIC failed, is loose, or is missing. • Fiber-optic cables are damaged. **Note:** If the port is unoccupied, the light is on.
	Loop good	Green	On	Off	• The loop is not operational. • Mini hub failed or a faulty device might be connected to the mini hub. • Controller failed. **Note:** If a host-side mini hub is not connected to a controller, the green light is always off and the fault light is always on.
	Bypass (lower port)	Amber	Off	On	• Lower mini hub port is bypassed. • Mini hub or GBIC failed, is loose, or is missing. • Fiber-optic cables are damaged. **Note:** If the port is unoccupied, the light is on.
Component: Mini hub (drive-side)					
	Fault	Amber	Off	On	Mini hub or GBIC failed. **Note:** If a drive-side mini hub is not connected to a controller, this fault light is always on.
	Bypass (upper port)	Amber	Off	On	• Upper mini hub port is bypassed. • Mini hub or GBIC failed, is loose, or is missing. • Fiber-optic cables are damaged. **Note:** If the port is unoccupied, the light is on.
	Loop good	Green	On	Off	• The loop is not operational. • Mini hub failed or a faulty device might be connected to the mini hub. • Drive failed. **Note:** If a drive-side mini hub is not connected to a controller, the green light is always off and the fault light is always on.
	Bypass (lower port)	Amber	Off	On	• Lower mini hub port is bypassed. • Mini hub or GBIC failed, is loose, or is missing. • Fiber-optic cables are damaged. **Note:** If the port is unoccupied, the light is on.

Tested configurations

The following configurations (shown in Figure 33 through Figure 43 on page 57) are for the IBM FAStT500 RAID controller.

Basic Configuration
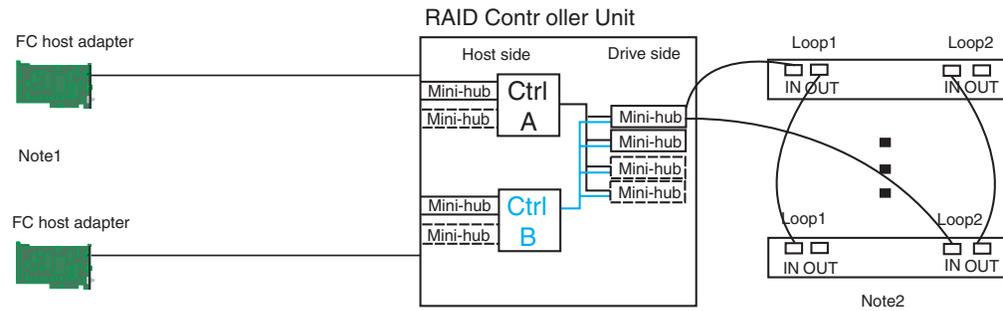
Note1: Adapters can be in the same or different systems
Note 2: Redundant drive loops are shown and required
Note 3: Mini-hubs in dashes are options
Note 4: For dual redundant loops connect to the optional set of mini-hubs shown as dashed on the drive side

Figure 33. FAStT500 RAID controller basic configuration

Simple Fully Redundant
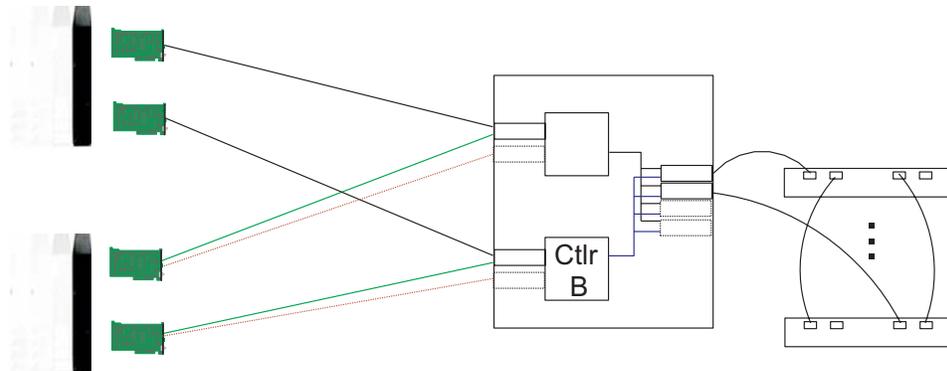
must .

Figure 34. FAStT500 RAID controller simple fully redundant

Cluster/Non-Cluster Share

Note : Factors such as performance and number of storage partitions influence the number and type of nodes.

Figure 35. FAStT500 RAID controller cluster/non-cluster share

Multi-MSCS No External Hubs

Note: 2 partitions shown; Clus 1 partition separate from Clus 2 partition
LD is a logical drive

Figure 36. FAStT500 RAID controller multi-MSCS no external hubs

Multi-MSCS extended

Notes:
- Each group of 4 ports on the switches (red dash box) can support one cluster element (black dash box)
- Storage partitioning is used to separate clusters
- 16 port switches allow more clusters but this has to be within performance needs and available partitions

Figure 37. FAStT500 RAID controller multi-MSCS extended

Cornhusker configuration

Notes: Running Cornhusker Software
4 to 8 node configs are supported
Managed hubs can be combined with optional mini-hubs or
use 16 ports switches without the optional mini-hubs
Performance would be best with external 16 port switches
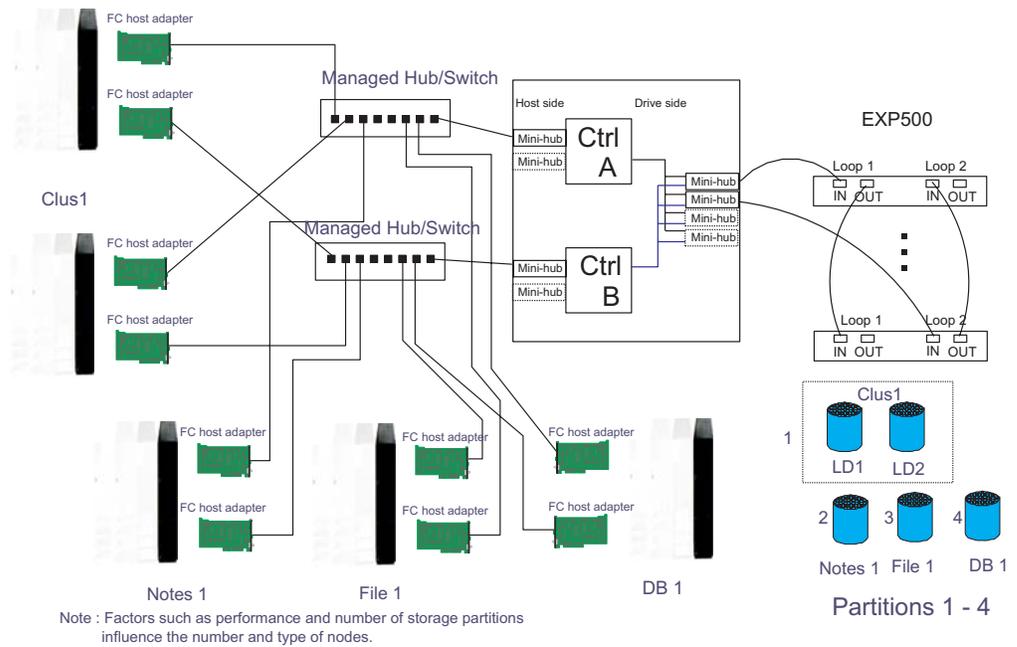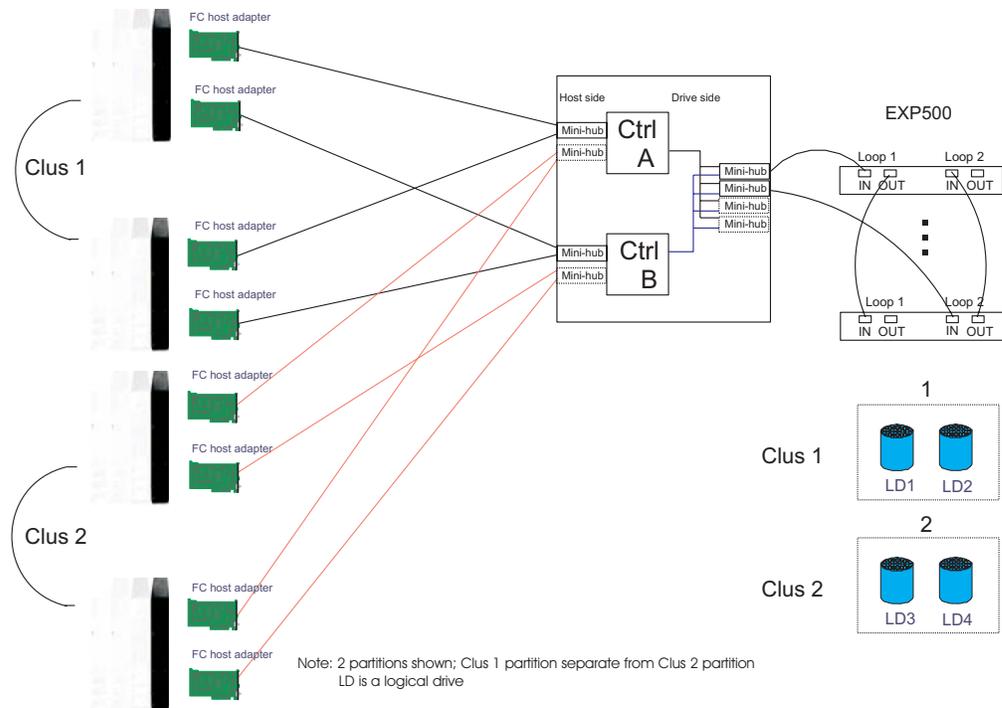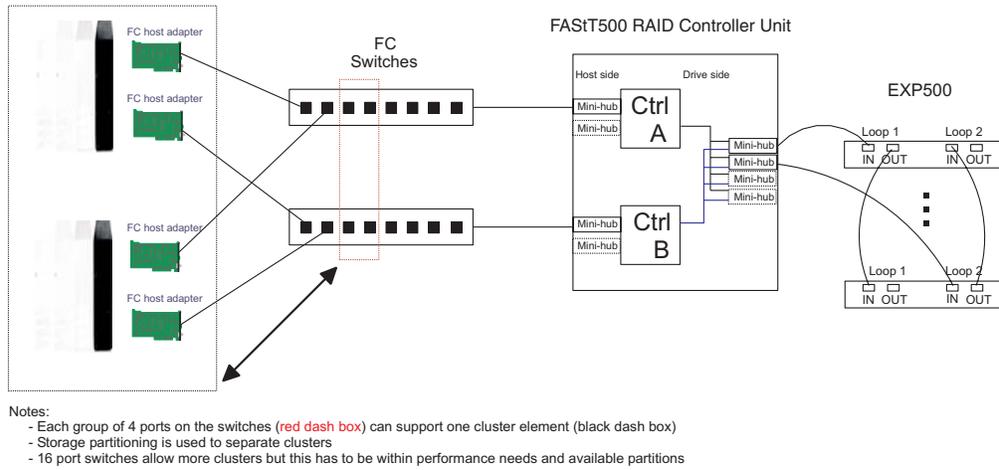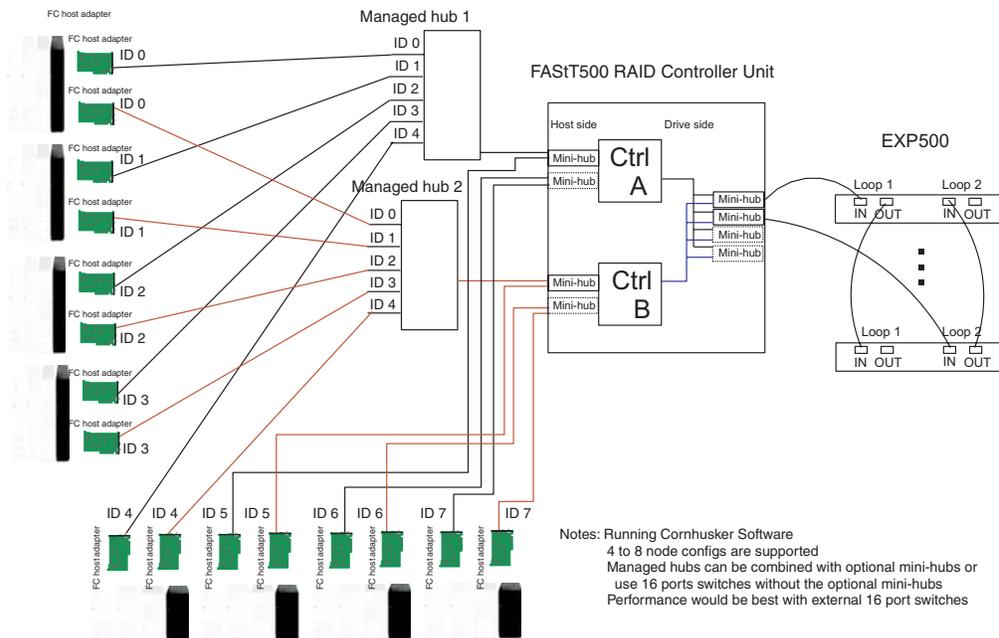
Figure 38. FAStT500 RAID controller cornhusker configuration

Base Storage Partitions

Figure 39. FAStT500 RAID controller basic storage partitions

Capacity Configuration
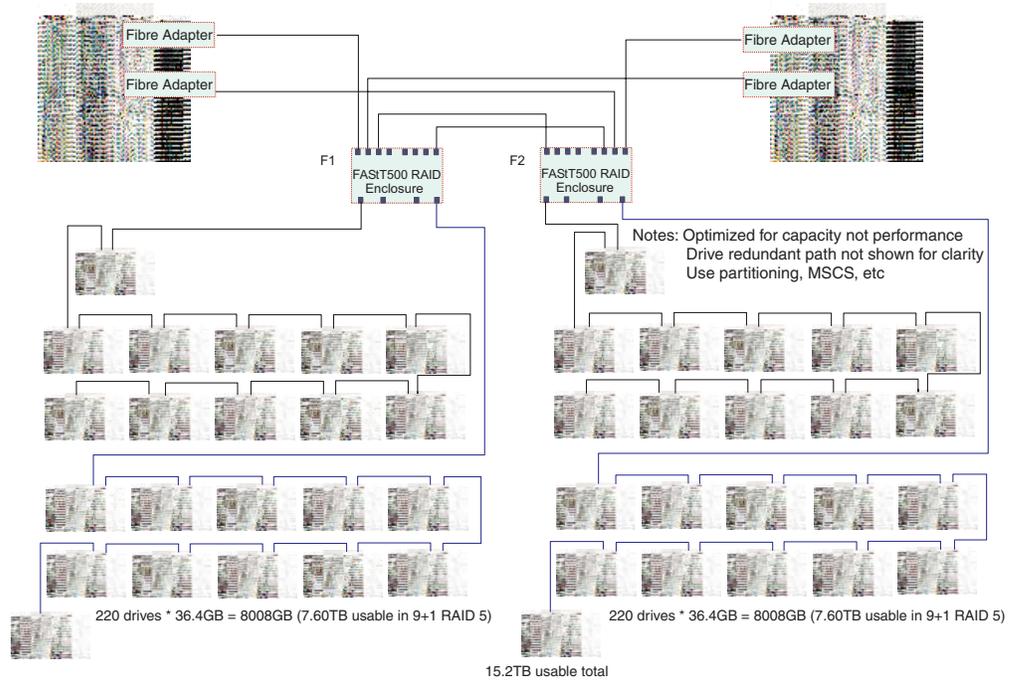
Figure 40. FAStT500 RAID controller capacity configuration

Capacity Configuration - host detail

Host-side view
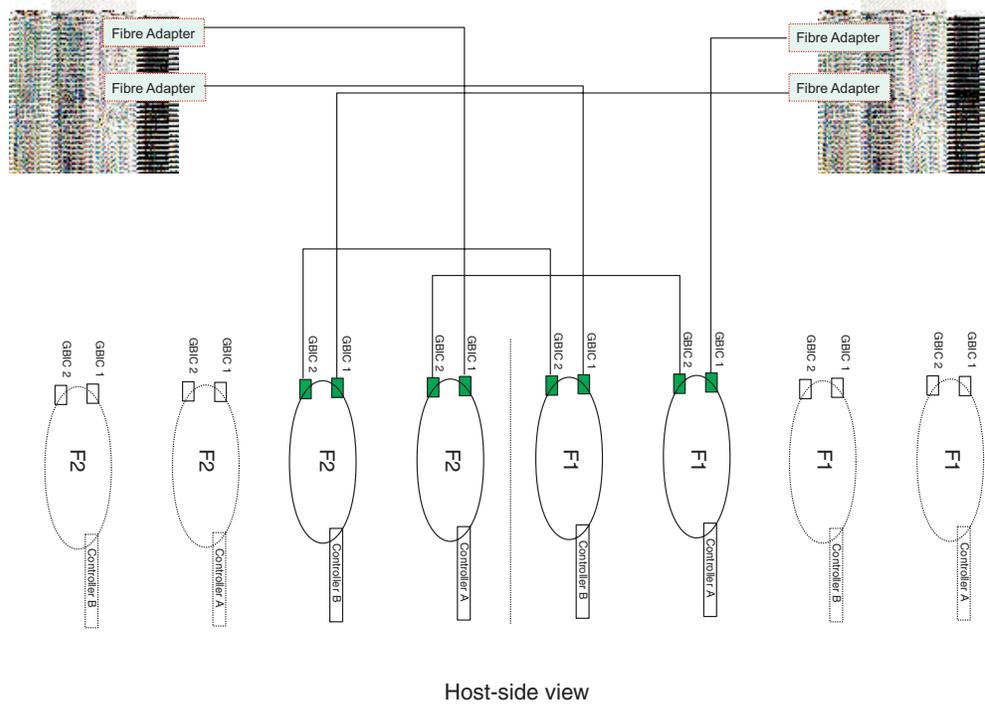
Figure 41. FAStT500 RAID controller capacity configuration host detail

SAN - Using Partitions of Clusters
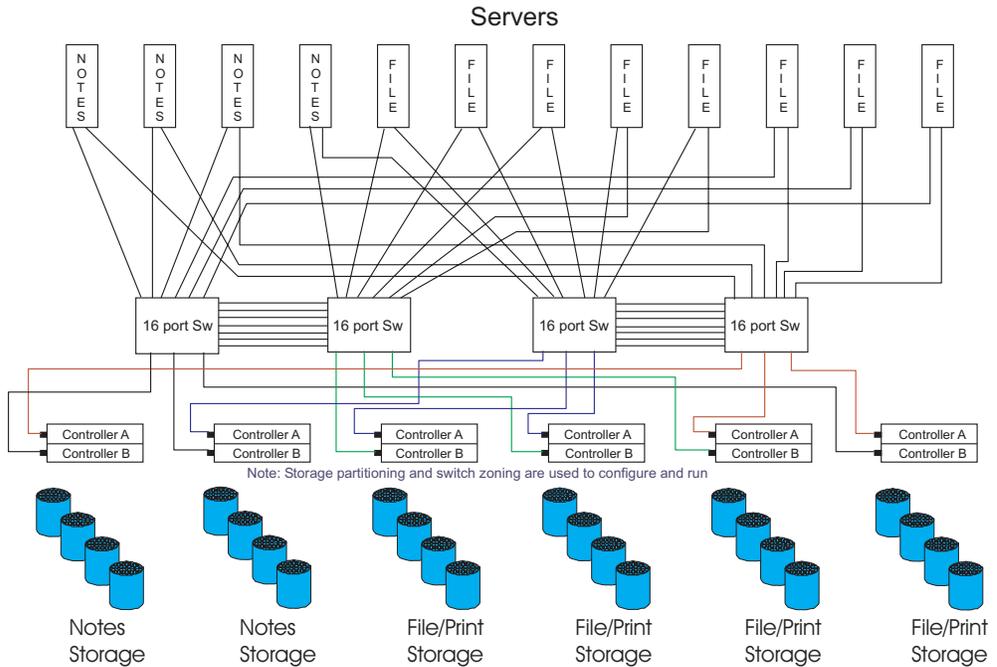
Figure 42. FAStT500 RAID controller SAN - Using partitions of clusters

Legato HA/Replication for MSCS
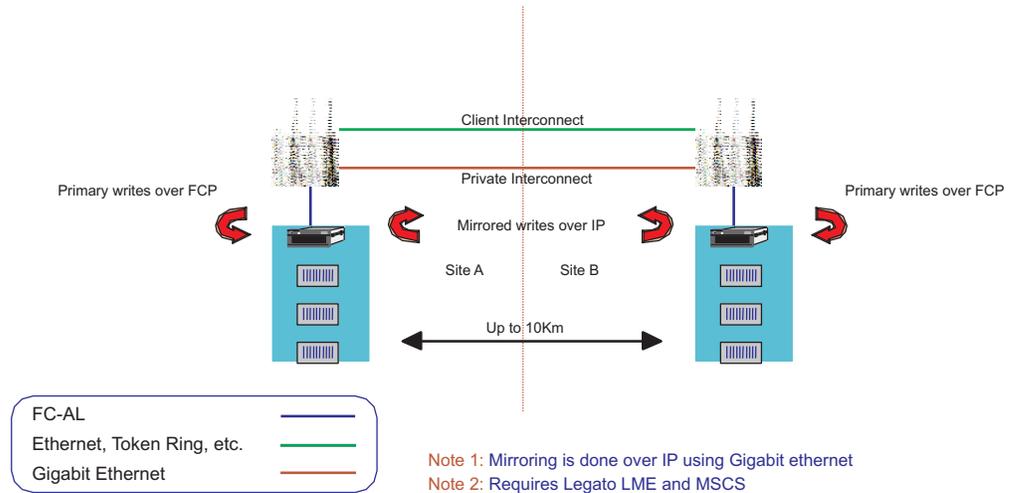
Figure 43. FAStT500 RAID controller Legato HA/replication for MS

Symptom-to-FRU index

The Symptom-to-FRU index (Table 21) lists symptoms and the possible causes. The most likely cause is listed first.

The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* also provide you with additional diagnostic aids.

Note: Do *not* look directly into any fiber cable or GBIC optical output. To view an optical signal, use a mirror to view the reflected light.

Table 21. Symptom-to-FRU index for FAStT500 RAID controller

Problem	Action/FRU
Controller LED (front cover) is on.	1. **Reseat Controller CRU.** 2. Place Controller online using DS4000 Storage Manager GUI. 3. If in passive mode, check Fibre path/GBIC. 4. Controller CRU
Software issued a controller error message.	1. **Check Controller Fan** 2. Controller CRU
Software errors occur when attempting to access controllers or drives.	1. **Check appropriate software and documentation to make sure the system is set up correctly and the proper command was run.** 2. Power to the Controller 3. Interface cables 4. ID settings 5. Controller 6. Drive 7. Controller backpanel

Table 21. Symptom-to-FRU index for FAStT500 RAID controller (continued)

Problem	Action/FRU
Fan LED (front cover) is on.	1. **Power supply fan CRU** 2. Controller fan CRU
Controller and Fan fault LEDs (front cover) are on.	1. **Check both Fan and Controller CRUs for fault LED and replace faulty CRU.**
Fault-A or Fault-B LED (battery CRU) is on.	1. **Battery CRU**
Full Charge-A or Full Charge-B LED (battery CRU) is off.	1. **Power-on Controller and allow batteries to charge for 24 hours until the Full Charge LEDs are on.** 2. Battery CRU 3. Both power supplies
No power to controller (all power LEDs off).	1. **Check power switches and power cords.** 2. Power supplies
Power Supply LED is off.	1. **Check and reseat power supply.** 2. Check for overheating. Wait ten minutes for the power supply CRU to cool down. 3. Power supply CRU
Power Supply CRUs LED are on, but all other CRU LEDs are off.	1. **DC power harness**
The Storage Manager client Enterprise Management window sees each storage server controller as an independent storage subsystem.	**No drives are present in the storage server.** Ensure that at least one drive is present in the storage server so that it can be configured properly. **One controller was replaced incorrectly. The controller firmware versions probably failed to synchronize correctly.** To recover, perform the following steps: 1. Remove and reinsert the controller blade. 2. Wait 5 minutes. 3. Delete the controller entry with the incorrect firmware version from the DS4000 Storage Manager Enterprise Management window. 4. Add the controller back to the DS4000 Storage Manager Enterprise Management window using the **Add Device** menu option in the Enterprise Management window. 5. If the Storage Manager client Enterprise Management window still shows each storage server controller as an independent storage subsystem or a partially managed device, repeat this procedure. If the problem still persists, contact IBM support.

Parts listing

Figure 44 on page 59 and the following table provide a parts listing for the FAStT500 RAID controller.
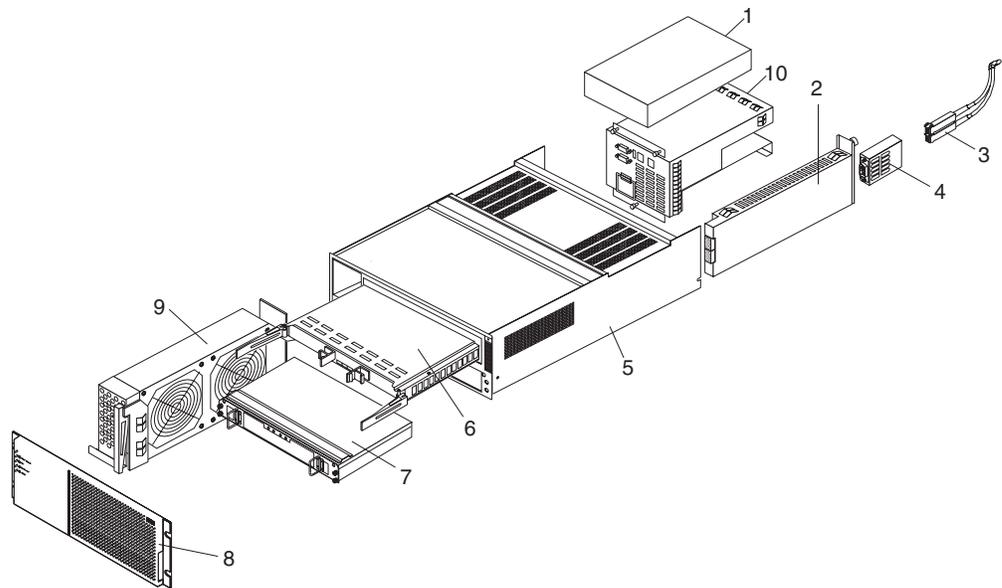
Figure 44. FAStT500 RAID controller parts listing

Index	FAStT500 RAID controller (Type 3552)	FRU
1	175-W Power Supply	01K6743
2	Mini Hub Card Assembly	37L0096
3	Optical Cable - 1 Meter	37L0083
3	Optical Cable - 5 Meters	03K9202
3	Optical Cable - 25 Meters	03K9204
4	Short Wave GBIC	03K9206
4	Long Wave GBIC	03K9208
5	Frame Assembly with Midplane	37L0093
6	RAID Controller	37L0098
7	Battery Backup Assembly	37L0099
8	Bezel Assembly	10L7043
9	Front Fan Assembly (Controller CRU Fan)	37L0094
10	Rear Fan Assembly	37L0102
	256 MB DIMM	37L0095
	Battery Cable	03K9285
	Blank Mini Hub Canister	37L0100
	Line Cord Jumper, High Voltage	36L8886
	Power Cable	37L0101
	Miscellaneous Hardware Kit	24P0954
	Rail Kit	37L0085
	Line Cord, US	6952300

Appendix A, "Power cords," on page 103 lists required power cords for the DS4000 storage components discussed in this document by country and region.

Chapter 9. Type 1742 DS4400 Storage Server

The IBM DS4400 storage server provides dual, redundant controllers with fibre channel interfaces to both the host and drive loops. The DS4400 storage server has redundant cooling, redundant power, and battery backup of the controller cache.

The DS4400 storage server is compatible with the following IBM products:

- IBM FAStT EXP500 (see Chapter 11 on page 79)
- IBM DS4000 EXP700 and DS4000 EXP710

  The DS4000 controller firmware must be upgraded to version 05.21.xx.xx or later to enable DS4400 storage server support for the DS4000 EXP700.

  The DS4000 controller firmware must be upgraded to version 06.11.xx.xx or later to enable DS4400 storage server support for the DS4000 EXP710.

- IBM DS4000 EXP100

  The DS4000 controller firmware must be upgraded to version 06.11.xx.xx or later to enable DS4400 storage server support for the DS4000 EXP100.

  Important: The DS4400 storage server currently supports the concurrent attachment, or intermixing, of fibre channel and Serial ATA storage expansion units in a single DS4400 storage server configuration. To enable FC/SATA intermixing with the DS4400 storage server, you must purchase the FC/SATA Intermix premium feature and perform the required DS4000 Storage Manager and firmware upgrades to support FC/SATA intermixing.

- DS4000 FC2-66 host bus adapter (FRU 19K1247)
- DS4000 FC2-133 host bus adapter (FRU 24P0962) (see Chapter 5 on page 17)
- Type 3534-F08 fibre channel switch
- Type 2109 Series fibre channel switches
- Type 2005 Series fibre channel switches

Designed to provide maximum host and drive-side redundancy, the DS4400 storage server supports direct attachment of up to four hosts that contain two host adapters each. Using external fibre channel managed hubs and switches in conjunction with the DS4400 storage server, you can attach up to 64 hosts with two adapters each to a DS4400 storage server.

General checkout

Use the indicator lights and the Symptom-to-FRU index to diagnose problems.

The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

Checking the indicator lights

The DS4400 storage server indicator lights display the status of the DS4400 storage server and its components. Green indicator lights mean normal operating status; amber indicator lights mean a possible failure.

It is important that you check all the indicator lights on the front and back of the controller unit after you turn on the power. After you turn on the power, the indicator lights might blink intermittently. Wait until the DS4400 storage server completes its power up before you check for faults. It can take up to 15 minutes for the battery to

complete its self-test and up to 24 hours to fully charge, particularly after an unexpected power loss of more than a few minutes.

The indicator lights for the components of the DS4400 storage server are described in the following sections.

Storage server indicator lights

The storage server has five indicator lights, as shown in Figure 45. To view the storage server indicator lights, you do not have to remove the DS4400 storage server bezel.

Power
Green light indicates power is on.
Normal status: On
Problem status: Off

Power suppl y
Amber light indicates a power supply fault.
Normal status: Off
Problem status: On

Fan
Amber light indicates a fan fault.
Normal status: Off
Problem status: On

Contr oller
Amber light indicates a controller fault.
Normal status: Off
Problem status: On

Fast Write Cac he
Green light indicates data in cache.

Figure 45. DS4400 storage server indicator lights

Table 22 describes the storage server indicator lights.

Table 22. DS4400 storage server indicator lights

Indicator light	Color	Normal operation	Problem indicator	Possible conditions suggested by the problem indicator[1]
Power	Green	On	Off	• No power to DS4400 storage server • No power to storage subsystem • Cables are loose or the switches are off • Power supply failed, is missing, or is not fully seated in DS4400 storage server • Overtemperature condition
Power supply fault	Amber	Off	On	• Power supply failed or if the Power supply is turned off, disconnected, or not fully seated in DS4400 storage server • Overtemperature • No power to DS4400 storage server or storage subsystem (all indicator lights are off)

Table 22. DS4400 storage server indicator lights (continued)

Indicator light	Color	Normal operation	Problem indicator	Possible conditions suggested by the problem indicator[1]
Storage server fan fault	Amber	Off	On	• Storage server fan failed. • Fan and communications module is missing, unplugged, or failed. • Circuitry failure • Overtemperature condition
Controller fault	Amber	Off	On	Controller failed; one or more memory modules failed (SIMMs or DIMMs).
Fast write cache	Green	Steady or blinking[2]	Software dependent[1]	Normal operation is off if: • Cache is not enabled • Battery is not ready

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

RAID controller indicator lights

Each RAID controller has ten indicator lights: one power, one fault, and eight status lights, as shown in Figure 46.

Note: To view the RAID controller indicator lights, remove the DS4400 storage server bezel.

Fault-B
Amber light indicates controller fault.
Normal status: Off
Problem status: On

Power
Green light indicates that power is on.
Normal status: On
Problem status: Off

Heartbeat
Green light indicates that the controller is working.
Normal status: On (blinking)
Problem status: On

Status
(8 lights including the Heartbeat)
Green lights indicate controller status.

Reset switch

Controller status indicator lights
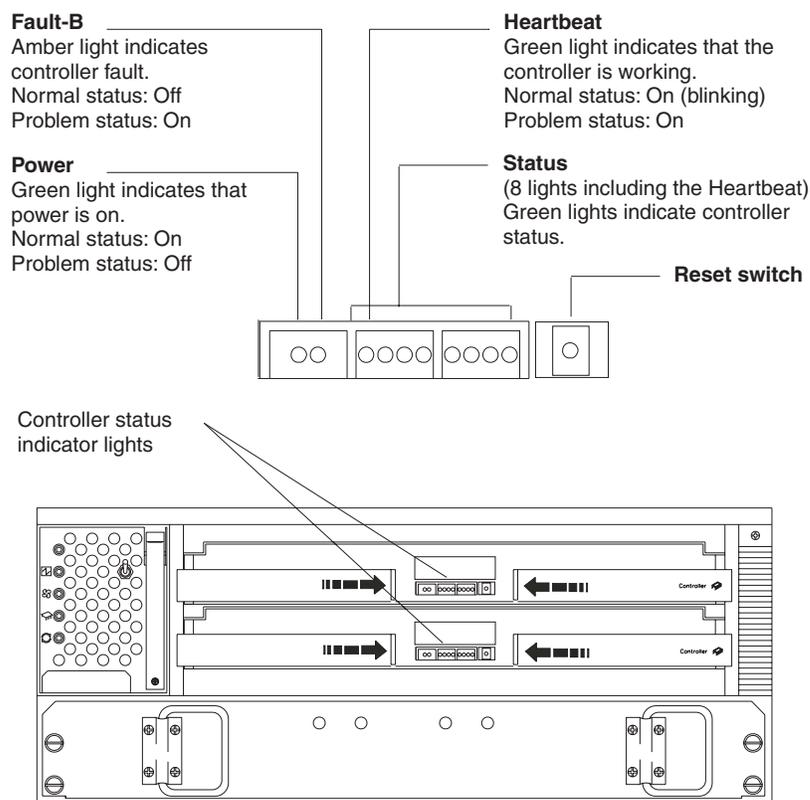
Figure 46. DS4400 storage server RAID controller indicator lights

Table 23 on page 64 describes the RAID controller indicator lights.

Table 23. DS4400 storage server RAID controller indicator lights

Indicator light	Color	Normal operation	Problem indicator	Possible conditions suggested by the problem indicator[1]
Power	Green	On	Off	• No power to storage subsystem • Cables are loose or the switches are off • Power supply failed, is missing, or is not fully seated • Overtemperature condition
Fault3	Amber	Off	On	Controller failure; controller fault condition
Heartbeat	Green	Blinking	Not blinking	No controller activity
Status3 (seven lights, not including Heartbeat)	Green	Various patterns depending on the condition[2]	Various patterns depending on the condition[2]	If any status indicator lights are lit and the controller is not offline, there is a memory fault that indicates that the controller CRU failed.

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

Battery indicator lights

The battery has four indicator lights as shown in Figure 47.

Note: To view the battery indicator lights, remove the DS4400 storage server bezel.

Fault-B
Amber light indicates a fault in the left battery bank.
Normal status: Off
Problem status: On

Full Charge-B
Green light indicates the left battery bank is fully charged.
Normal status: On
Problem status: Off
Changing status: Blinking

Full Charge-A
Green light indicates the right battery bank is fully charged.
Normal status: On
Problem status: Off
Changing status: Blinking

Fault-A
Amber light indicates a fault in the left battery bank.
Normal status: Off
Problem status: On

Figure 47. DS4400 storage server battery indicator lights

Table 24 on page 65 describes the battery indicator lights.

Table 24. DS4400 storage server battery indicator lights

Indicator light	Color	Normal operation	Problem indicator	Possible conditions suggested by the problem indicator[1]
Fault-A or Fault-B	Amber	Off	On	• Left or right battery bank failed • Battery is either discharged or defective
Full Charge-A or Full Charge-B	Green	On[2]	Off	• Left or right battery bank is not fully charged • Power has been off for an extended period and has drained battery power • Batteries are weak

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

Fan and communications module indicator light

The fan and communications module has one indicator light as shown in Figure 48.

Fault
Amber light indicates a fault in the fan and communications module.
Normal status: Off
Problem status: On
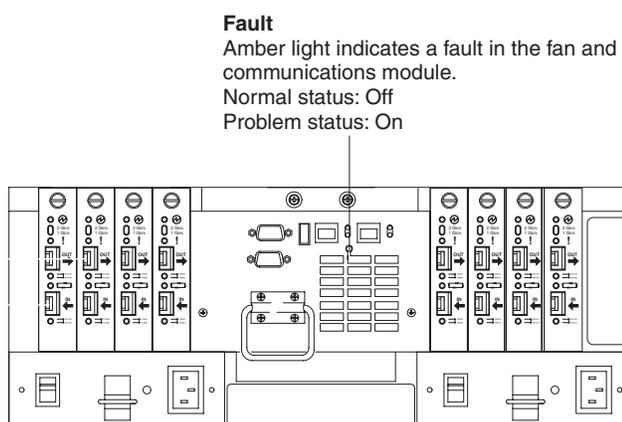
Figure 48. DS4400 storage server fan and communications module indicator light

Table 25 describes the fan and communications module indicator light.

Table 25. DS4400 storage server fan and communications module indicator light

Indicator light	Color	Normal operation	Problem indicator	Possible conditions suggested by the problem indicator[1]
Fan and communication fault	Amber	Off	On	• Fan and communications module failed or is installed incorrectly • Overtemperature condition

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

Power supply indicator light

The power supply has one indicator light, as shown in Figure 49 on page 66.
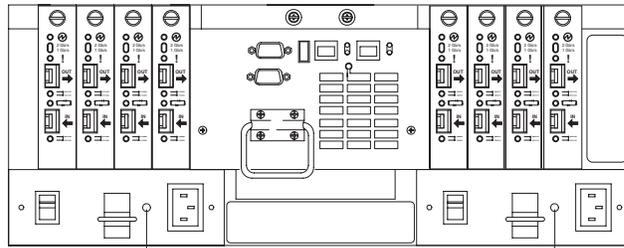
Power supply
Green light indicates
that the power supply
is operating properly.
Normal status: On
Problem status: Off

Power supply
Green light indicates
that the power supply
is operating properly.
Normal status: On
Problem status: Off

Figure 49. DS4400 storage server power supply indicator light

Table 26 describes the power supply indicator light.

Table 26. DS4400 storage server power supply indicator light

Indicator light	Color	Normal operation	Problem indicator	Possible conditions suggested by the problem indicator[1]
Power supply	Green	On	Off	• No power to DS4400 storage server • No power to storage subsystem • Power supply failed or is turned off • Overtemperature condition

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

Mini hub indicator lights

There are five host-side mini hub indicator lights and five drive-side mini hub indicator lights. Figure 50 shows the host-side indicator lights. The drive side indicator lights are the same; however, the possible conditions suggested by the problem indicators (described in Table 27 on page 67) might be different.
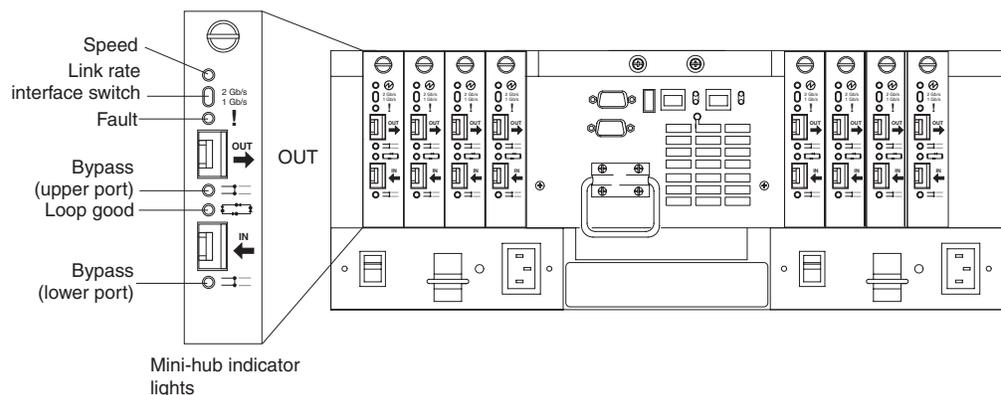
Figure 50. DS4400 storage server mini hub indicator lights

Table 27 on page 67 describes the indicator light status when there are fibre channel connections between host-side and drive-side mini hubs.

Table 27. DS4400 storage server host-side and drive-side mini hub indicator lights

Icon	Indicator light	Color	Normal operation	Problem indicator	Possible condition indicated by the problem indicator
	Speed	Green	On for 2 Gb Off for 1 Gb		Light on indicates data transfer rate of 2 Gb per second. Light off indicates data transfer rate of 1 Gb per second.
!	Fault	Amber	Off	On	Mini hub or SFP module failed **Note:** If a host-side mini hub is not connected to a controller, this fault light is always lit.
⊐⊏	Bypass (upper port)	Amber	Off	On	• Upper mini hub port is bypassed • Mini hub or SFP module failed, is loose, or is missing • Fiber-optic cables are damaged **Note:** When there are two functioning SFP modules installed into the mini hub ports and there are no fibre channel cables connected to them, the bypass indicator is lit. If there is only one functioning SFP module installed in a host-side mini hub port and there are no fibre channel cables connected to it, the indicator light will not be lit. However, the drive-side mini hub bypass indicator light will be lit when there is one SFP module installed in the mini hub and the mini hub has no fibre channel connection.

Table 27. DS4400 storage server host-side and drive-side mini hub indicator lights (continued)

Icon	Indicator light	Color	Normal operation	Problem indicator	Possible condition indicated by the problem indicator
	Loop good	Green	On	Off	• The loop is not operational, no devices are connected • Mini hub failed or a faulty device is connected to the mini hub • If there is no SFP module installed, the indicator will be lit • If one functioning SFP module is installed in the host-side mini hub port and there is no fibre channel cable connected to it, the loop good indicator light will not be lit. If one functioning SFP module is installed in the drive-side mini hub port and there is no fibre channel cable connected to it, the loop good indicator light will be lit. • Drive enclosure failed (drive-side mini hub only)
	Bypass (lower port)	Amber	Off	On	• Lower mini hub port is bypassed; there are no devices connected • Mini hub or SFP module failed or is loose • Fiber-optic cables are damaged **Note:** When there are two functioning SFP modules installed into the mini hub port and there are no fibre channel cables connected to them, the bypass indicator light is lit. If there is only one functioning SFP module installed in a host-side mini hub and there are no fibre channel cables connected to it, the indicator light is not lit. However, the drive-side mini hub bypass indicator light will be lit when there is one functioning SFP module installed in the mini hub port and the mini hub has no fibre channel cables connected to it.

Using the diagnostic hardware

The DS4400 storage server comes with a wrap-plug adapter and LC coupler. The wrap-plug adapter and LC coupler are used to identify Fibre channel path problems. The loopback and sendEcho tests are described in the *IBM TotalStorage DS4000 Problem Determination Guide.*

Symptom-to-FRU index

The Symptom-to-FRU index (Table 28) lists symptoms and the possible causes. The most likely cause is listed first.

The problem determination (PD) maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

Table 28. Symptom-to-FRU index for DS4400 storage server

Problem	Action/FRU
Controller LED (front cover) is on.	1. **Reseat Controller CRU.** 2. Place Controller online using DS4000 Storage Manager GUI. 3. If in passive mode, check Fibre path/GBIC. 4. Controller CRU
Software issued a controller error message.	1. **Check Controller Fan** 2. Controller CRU
Software errors occur when attempting to access controllers or drives.	1. **Check appropriate software and documentation to make sure the system is set up correctly and the proper command was run.** 2. Power to the Controller 3. Interface cables 4. ID settings 5. Controller 6. Drive 7. Controller backpanel
Fan LED (front cover) is on.	1. **Power supply fan CRU** 2. Controller fan CRU
Controller and Fan fault LEDs (front cover) are on.	1. **Check both Fan and Controller CRUs for fault LED and replace faulty CRU.**
Fault-A or Fault-B LED (battery CRU) is on.	1. **Battery CRU**
Full Charge-A or Full Charge-B LED (battery CRU) is off.	1. **Power-on Controller and allow batteries to charge for 24 hours until the Full Charge LEDs are on.** 2. Battery CRU 3. Both power supplies
No power to controller (all power LEDs off).	1. **Check power switches and power cords.** 2. Power supplies
Power Supply LED is off.	1. **Check and reseat power supply.** 2. Check for overheating. Wait ten minutes for the power supply CRU to cool down. 3. Power supply CRU

Table 28. Symptom-to-FRU index for DS4400 storage server (continued)

Problem	Action/FRU
Power Supply CRUs LED are on, but all other CRU LEDs are off.	1. **DC power harness**
The Storage Manager client Enterprise Management window sees each storage server controller as an independent storage subsystem.	**No drives are present in the storage server.** Ensure that at least one drive is present in the storage server so that it can be configured properly. **One controller was replaced incorrectly. The controller firmware versions probably failed to synchronize correctly.** To recover, perform the following steps: 1. Remove and reinsert the controller blade. 2. Wait 5 minutes. 3. Delete the controller entry with the incorrect firmware version from the DS4000 Storage Manager Enterprise Management window. 4. Add the controller back to the DS4000 Storage Manager Enterprise Management window using the **Add Device** menu option in the Enterprise Management window. 5. If the Storage Manager client Enterprise Management window still shows each storage server controller as an independent storage subsystem or a partially managed device, repeat this procedure. If the problem still persists, contact IBM support.

Parts listing

Figure 51 and the following table provide a parts listing for the type 1742 DS4400 storage server.
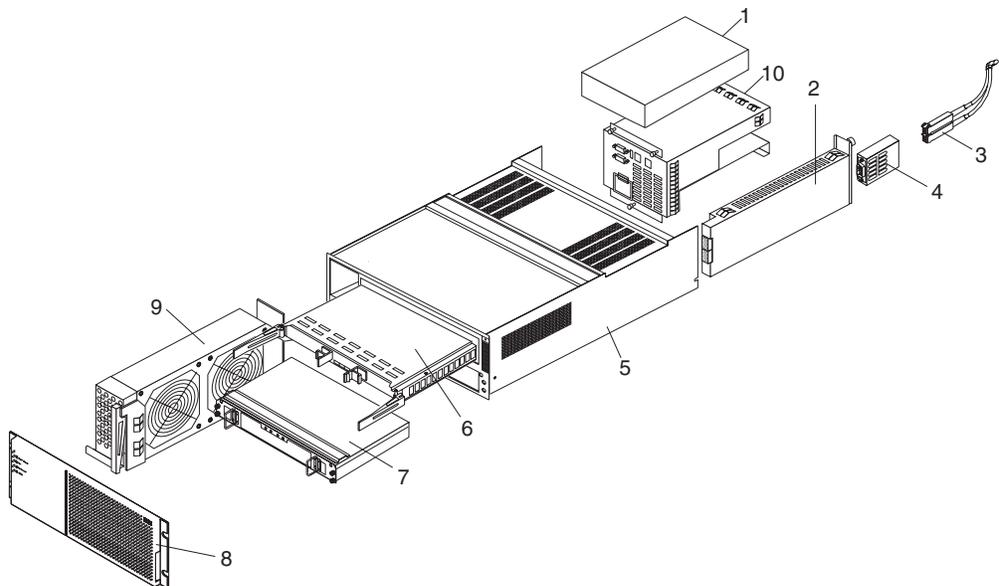
Figure 51. DS4400 storage server parts listing

Index	DS4400 storage server (Type 1742)	FRU
1	175-Watt Power Supply	01K6743
2	Mini hub Card Assembly	19K1270
3	Optical Cable - 1 Meter	19K1265
3	Optical Cable - 5 Meters	19K1266
3	Optical Cable - 25 Meters	19K1267
	LC-SC Adapter Cable	19K1268
4	Short Wave SFP Module	19K1280
4	Long Wave SFP Module	19K1281
5	Frame Assembly with Midplane	19K1277
6	RAID Card	19K1284
7	Battery Backup Assembly	24P0953
8	Bezel Assembly	19K1279
9	Front Fan Assembly (Controller CRU Fan)	37L0094
10	Rear Fan Assembly	37L0102
	Battery Cable	03K9285
	Blank Canister	37L0100
	Line Cord Jumper, High Voltage	36L8886
	Power Cable	37L0101
	Miscellaneous Hardware Kit	24P0954
	Rail Kit	37L0085
	Line Cord, US	6952300
	LC Wrap Plug ASM	24P0950

Appendix A, "Power cords," on page 103 lists required power cords for the DS4000 storage components discussed in this document by country and region.

Chapter 10. IBM TotalStorage FAStT EXP15 and EXP200 Storage Expansion Units

> **Note:** The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

The IBM TotalStorage FAStT EXP15 and EXP200 storage expansion units are compatible with the Type 3526 fibre channel RAID controller (see Chapter 6 on page 21).

This chapter contains the information for the FAStT EXP15 and EXP200 storage expansion units. Information that is common to both enclosures is given first. Information that is specific to each enclosure is given second.

Diagnostics and test information

> **Important**
>
> The service procedures are designed to help you isolate problems. They are written with the assumption that you have model-specific training on all computers, or that you are familiar with the computers, functions, terminology, and service-related information provided in this manual and the appropriate IBM PC/Netfinity Server Hardware Maintenance Manual.

You can use the following is a list of problems and references to diagnose the IBM FAStT EXP15 Type 3520 and FAStT IBM EXP200 Type 3530 storage expansion units.

Problem	Reference
Hard Disk Drive Numbering	See the IBM Product Installation Guide.
Error Codes/Error Messages	See the Symptom-to-FRU Index for the server that the storage expansion unit you are servicing is connected to.
Expansion Unit Options Switches	See the IBM Product Installation Guide.
Fan Controls and Indications	See the IBM Product Installation Guide.
Performing a Shutdown	See "Performing a shutdown" on page 74.
Power Supply Controls and Indicators	See the IBM Product Installation Guide.
Rear Controls and Indications	See the IBM Product Installation Guide.
Turning the Power On	See "Turning the power on" on page 74.

Additional service information

This section provides service information that is common to both the FAStT EXP15 and FAStT EXP200 storage expansion units:

- "Performing a shutdown" on page 74
- "Turning the power on" on page 74
- "Specifications" on page 74

Performing a shutdown

Note: If the expansion unit loses power unexpectedly, it might be due to a hardware failure in the power system or midplane (see "Symptom-to-FRU index" on page 76).

Perform the following steps to shut down your expansion unit:

1. Make sure that all I/O activity has stopped. If applicable, logically disconnect from the host controller.
2. Make sure that all amber Fault LEDs are off. If any Fault LEDs are lit (drives, power supplies, or fans), correct the problem before you turn off the power.
3. Turn off *both* power supply switches on the back of the expansion unit.

Turning the power on

Perform the following steps to power on the FAStT EXP15 and FAStT EXP200.

- **Initial start-up:**
    1. Verify that all communication and power cables are plugged into the back of the expansion unit.
        a. All hard disk drives are locked securely in place.
        b. **For FAStT EXP15:** The option ID switch on the expansion unit is set correctly.

           For FAStT EXP200: Option switches 1 through 5 and the tray number switch on the expansion unit are set correctly.
        c. The host controller and other SCSI bus devices are ready for the initial power-up.
        d. Power on the expansion unit before you power on the server.
    2. Turn on the power to each device, based on this power up sequence.
    3. Turn on *both* power supply switches on the back of the expansion unit.
    4. Only the green LEDs on the front and back should be on. If one or more of the amber Fault LEDs are on, see "Symptom-to-FRU index" on page 76.
- **Re-starting:**

    If you are re-starting after a normal shutdown, wait at least ten seconds before you attempt to turn on *either* power supply switch.

Specifications

Table 29. Specifications for FAStT EXP15 and FAStT EXP200

Specification	FAStT EXP15 Type 3520	FAStT EXP200 Type 3530
Size (with front panel)	Depth: 57.9 cm (22.8 in.)	Depth: 56.3 cm (22.2 in.)
	Height: 13.2 cm (5.2 in.)	Height: 12.8 cm (5 in.)
	Width: 48.2 mm (18.97 in.)	Width: 44.7 mm (17.6 in.)
Weight	Typical expansion unit as shipped: 39 kg (86 lb)	Typical expansion unit as shipped: 22.5 kg (49.5 lb)

Table 29. Specifications for FAStT EXP15 and FAStT EXP200 (continued)

Specification	FAStT EXP15 Type 3520	FAStT EXP200 Type 3530
Electrical Input:	Sign-wave input (50 to 60 Hz) • Low range: Minimum: 90 V ac / Maximum: 127 V ac • High range: Minimum: 198 V ac / Maximum: 257 V ac	
	Input Kilovolt-amperes (kVA) approximately • Minimum configuration: 0.06 kVA • Maximum configuration: 0.39 kVA	
Environment	**Air Flow:** Air flow is from front to back	

	Air temperature:
	 • Expansion unit on:
	     10° to 35° C (50° to 95° F)
	     Altitude: 0 to 914 m (3000 ft.)
	 • Expansion unit on:
	     10° to 32 °C (50° to 90° F)
	     Altitude: 914 m (3000 ft.) to 2133 m (7000 ft.)	

	Humidity: 10% to 80%	
Heat Output	Approximate heat output in British Thermal Units (BTU) per hour: • Minimum configuration: 205.2 BTU (60 watts) • Maximum configuration: 1333.8 BTU (390 watts)	
Acoustical Noise Emissions Values	For open bay (0 hard disk drives installed) and typical system configurations (8 hard disk drives installed).	

	• Sound Power (idling):
	   – 6.2 bels (open bay)
	   – 6.4 bels (typical)
	 • Sound Power (operating):
	   – 6.2 bels (open bay)
	   – 6.5 bels (typical)
	 • Sound Pressure (idling):
	   – 47 dBA (open bay)
	   – 49 dBA (typical)
	 • Sound Pressure (operating):
	   – 47 dBA (open bay)
	   – 50 dBA (typical)
		• Sound Power (idling):
		   – 6.3 bels (open bay)
		   – 6.5 bels (typical)
		 • Sound Power (operating):
		   – 6.3 bels (open bay)
		   – 6.6 bels (typical)
		 • Sound Pressure (idling):
		   – 47 dBA (open bay)
		   – 49 dBA (typical)
		 • Sound Pressure (operating):
		   – 47 dBA (open bay)
		   – 50 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.	

Symptom-to-FRU index

Note: The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

Use Table 30 to find solutions to problems that have definite symptoms.

Table 30. Symptom-to-FRU index for FAStT EXP15 and FAStT EXP200 storage expansion units

Problem Indicator	Action/FRU
FAStT EXP200 only: Amber LED On (Front Panel)	1. **General Machine Fault** Check for amber LED on expansion unit
FAStT EXP15 only: Amber and Green LEDs flashing (Drive)	1. **Host issued a drive rebuild command**
FAStT EXP15 only: Amber and Green LEDs Off (Power supply)	1. **Reseat hard disk drive** 2. Hard disk drive
Amber LED On (Drive)	1. **Hard Disk Drive**
Amber LED On (Fan)	1. **Fan**
Amber LED On (ESM board)	1. **ESM board** 2. Check for fan fault LED 3. Unit is overheating. Check temperature.
Amber LED On, Green LED Off (Power supply)	1. **Turn Power Switch On** 2. Power cord 3. Reseat Power Supply 4. Power Supply
Amber and Green LEDs On (Power supply)	1. **Power Supply**
All Green LEDs Off (Power supply)	1. **Check AC voltage cabinet AC voltage line inputs** 2. Power Supplies 3. Midplane board
Intermittent power loss to expansion unit	1. **Check AC voltage line inputs and cabinet power components** 2. Power Supplies 3. Midplane board
One or more Green LEDs Off (All)	1. **Turn Power Switch On** 2. Power cord 3. Reseat Power Supply 4. Power Supply
One or more Green LEDs Off (Drive)	1. **No activity to the drive** 2. This can be normal activity
One or more Green LEDs Off (All Hard Disk Drives or those on one Bus)	1. **Use SCSI RAID Manager to check drive status** 2. SCSI Cables 3. ESM Board 4. Midplane board

Table 30. Symptom-to-FRU index for FAStT EXP15 and FAStT EXP200 storage expansion units (continued)

Problem Indicator	Action/FRU
FAStT EXP15: Unable to access drives on one or both SCSI buses	1. **Check SCSI cables and connections** 2. Option switch 2 must be set to off 3. ESM board
FAStT EXP200: Unable to access drives on one or both SCSI buses	1. **Check SCSI cables and connections** 2. Check the drive SCSI ID setting 3. ESM board 4. Ensure that option switches 1 and 5 are set to the appropriate position (change the switch position only when the expansion unit is powered off).
Intermittent Power Loss	1. **AC power or plug** 2. Power supply 3. Midplane
Random errors	1. **Midplane board** 2. **(For FAStT EXP15 only)** Make sure option switches 1 and 2 are set to Off

Note: If you cannot find the problem using this Symptom-to-FRU Index, test the entire system.

Chapter 11. IBM TotalStorage FAStT EXP500 Storage Expansion Unit

> **Note:** The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

The IBM TotalStorage FAStT EXP500 storage expansion unit is compatible with the following IBM products:

- Type 3552 FAStT500 RAID controller (see Chapter 8 on page 47)
- Type 1742 DS4400 storage server (see Chapter 9 on page 61)
- FAStT200 type 3542 and FAStT200 HA type 3542 (see Chapter 7 on page 35)

Diagnostics and test information

The following list of problems and references is for diagnosing the IBM FAStT EXP500 Type 3530 storage expansion unit.

Problem	Reference
Hard Disk Drive Numbering	IBM Product Installation Guide
Error Codes/Error Messages	Symptom-to-FRU Index for the server that the storage expansion unit you are servicing is connected to
Expansion Unit Options Switches	IBM Product Installation Guide
Front Controls and Indications	IBM Product Installation Guide
Rear Controls and Indications	IBM Product Installation Guide

Additional service information

This section provides information on the following topics:

- "Turning the expansion unit on and off"
- "Performing an emergency shutdown" on page 81
- "Restoring power after an emergency" on page 81
- "Specifications" on page 81

Turning the expansion unit on and off

This section contains instructions for turning the expansion unit on and off under normal and emergency circumstances.

If you are turning on the expansion unit after an emergency shutdown or power outage, see "Restoring power after an emergency" on page 81.

Turning on the expansion unit

Perform the following steps to turn on the power for the initial startup of the expansion unit:

1. Verify that:
   a. All communication and power cables are plugged into the back of the expansion unit and an ac power outlet.
   b. All hard disk drives are locked securely in place.
   c. The tray number switches on the expansion unit are set correctly. (See the IBM Product Installation Guide for more information.)

2. Check the system documentation for all the hardware devices you intend to turn on and determine the proper startup sequence.

   Note: Be sure to turn on the IBM FAStT EXP500 before you turn on the server.
3. Turn on the power to each device, based on the startup sequence.

   Attention: If you are restarting the system after a normal shutdown, wait at least 10 seconds before you turn on the power supply switches.
4. Turn on both power supply switches on the back of the unit.

   The expansion unit might take a few seconds to power up. During this time, you might see the amber and green LEDs on the expansion unit turn on and off intermittently. When the startup sequence is complete, only the green LEDs on the front and back and the amber Bypass LEDs for unconnected GBIC ports should remain on. If other amber LEDs remain lit, see "Symptom-to-FRU index" on page 83.

Turning off the expansion unit

Attention: Except in an emergency, never turn off the power if any Fault LEDs are lit on the expansion unit. Correct the fault before you turn off the power, using the proper troubleshooting or servicing procedure. This action ensures that the expansion unit will power up correctly later. For guidance, see "Symptom-to-FRU index" on page 83.

The expansion unit is designed to run continuously, 24 hours a day. After you turn on the expansion unit, 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 81).

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

Perform the following steps to turn off the power:

1. Check the system documentation for all hardware devices you intend to turn off and determine the proper power-down sequence.
2. Make sure that all I/O activity has stopped.
3. Make sure that all amber Fault LEDs are off. If any Fault LEDs are lit (drives, power supplies, or fans), correct the problem before you turn off the power. For guidance, see "Symptom-to-FRU index" on page 83.
4. Turn off both power supply switches on the back on the expansion unit.

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 action helps safeguard your equipment from potential damage due to electrical surges when power is restored. If the expansion unit loses power unexpectedly, it might be due to a hardware failure in the power system or midplane (see "Symptom-to-FRU index" on page 83).

Perform the following steps to shut down during an emergency:

1. If you have time, stop all activity and check the LEDs (front and back). Make note of any Fault LEDs that are lit so that you can correct the problem when you turn on the power again.
2. Turn off all power supply switches; then, unplug the power cords from the expansion unit.

Restoring power after an emergency

Perform the following steps to restart the expansion unit if you turned off the power supply switches during an emergency shut down, or if a power failure or a power outage occurred:

1. After the emergency situation is over or power is restored, check the expansion unit 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 switches are in the off position; then, plug in the expansion unit power cords.
3. Check the system documentation for the hardware devices you intend to power up and determine the proper startup sequence.

   Note: Be sure to turn on the FAStT EXP500 before you turn on the server.
4. Turn on the power to each device, based on the startup sequence.
5. Turn on both power supply switches on the back of the FAStT EXP500.
6. Only the green LEDs on the front and back and the amber Bypass LEDs for unconnected GBIC ports should remain on. If other amber Fault LEDs are on, see "Symptom-to-FRU index" on page 83 for instructions.
7. Use your installed software application as appropriate to check the status of the expansion unit.

Specifications

The following gives the operating specifications of the FAStT EXP500.

Size (with front panel and without mounting rails)
- Depth: 56.3 cm (22.2 in)
- Height: 12.8 cm (5 in)
- Width: 44.7 cm (17.6 in)

Weight
- Standard expansion unit as shipped: 25 kg (54.5 lbs)
- Typical expansion unit fully loaded: 35.5 kg (78 lbs)

Electrical input
- Sine-wave input (50 to 60 Hz) is required

- Input Voltage:
  - Low range:
    - Minimum: 90 V ac
    - Maximum: 127 V ac
  - High range:
    - Minimum: 198 V ac
    - Maximum: 257 V ac
  - Input kilovolt-amperes (kVA) approximately:
    - Minimum configuration: 0.06 kVA
    - Maximum configuration: 0.36 kVA

Environment
- Air temperature:
  - Expansion unit on:
    - 10° to 35° C
    - (50° to 95° F)
    - Altitude: 0 to 914 m (3000 ft.)
  - Expansion unit on:
    - 10° to 32° C
    - (50° to 90° F)
    - Altitude: 914 m (3000 ft.) to 2133 m (7000 ft.)
- Humidity:
  - 8% to 80%

Acoustical noise emissions values
For open bay (0 drives installed) and typical system configurations (8 hard drives installed).
- Sound Power (idling):
  - 6.3 bels (open bay)
  - 6.5 bels (typical)
- Sound Power (operating):
  - 6.3 bels (open bay)
  - 6.6 bels (typical)
- Sound Pressure (idling):
  - 47 dBA (open bay)
  - 49 dBA (typical)
- Sound Pressure (operating):
  - 47 dBA (open bay)
  - 50 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.

Symptom-to-FRU index

Note: The PD maps found in the *IBM TotalStorage DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

Use Table 31 to find solutions to problems that have definite symptoms.

Table 31. Symptom-to-FRU index for FAStT EXP500 storage expansion unit

Problem Indicator	Action/FRU
Amber LED On (Front Panel)	1. **General Machine Fault** Check for amber LED on expansion unit. Use the RAID manager software to check the status.
Amber LED On (Hard Disk Drive)	1. **Hard Disk Drive**
Amber LED On (Fan)	1. **Fan**
Amber LED On	1. **ESM board**
Amber LED On, Green LED Off (Power Supply)	1. **Turn Power Switch On** 2. Power cord 3. Reseat Power Supply 4. Power Supply
Amber and Green LEDs On (Power Supply)	1. **Power Supply**
All Green LEDs Off	1. **Check AC voltage cabinet AC voltage line inputs** 2. Power Supplies 3. Midplane board
Intermittent power loss to expansion unit	1. **Check AC voltage line inputs, and cabinet power components** 2. Power Supplies 3. Midplane board
One or more Green LEDs Off (Power Supply)	1. **Turn Power Switch On** 2. Power cord 3. Reseat Power Supply 4. Power Supply
One or more Green LEDs On (Drives)	1. **No activity to the drive** 2. This can be normal activity
Intermittent Power Loss	1. **AC power or plug** 2. Power supply 3. Midplane
Random errors	1. **Midplane board**
One or more Green LEDs blinking slowly. (All hard disk drives.)	1. **Check cabling scheme** 2. FC Cable 3. GBIC
Hard disk drive not visible in RAID management software.	1. **Hard Disk Drive** 2. Midplane Board

Problem Indicator	Action/FRU
Amber temperature LED enabled in RAID management software. (ESM Board)	1. **Check for fan fault LED** 2. Unit is overheating; check temperature. 3. ESM Board
Amber conflict LED on. (ESM Board)	1. **Tray numbers of ESM boards within a single FAStT EXP500 do not match**

GBIC bypass LED.
 	
Note:
 	
It is normal for the LED to be on when no GBIC or cable is installed.
	1. **Check ESM fault LED**
	2. GBIC does not detect an incoming signal
	   a. FC Cable
	   b. GBIC or other end on the FC cable
	   c. GBIC adjacent to amber LEDC cable

Note: If you cannot find the problem using this Symptom-to-FRU Index, test the entire system. See the server documentation for detailed information on testing and diagnostic tools.

Parts listing

Figure 52 and the following table provide a parts listing for the FAStT EXP500 storage expansion unit.
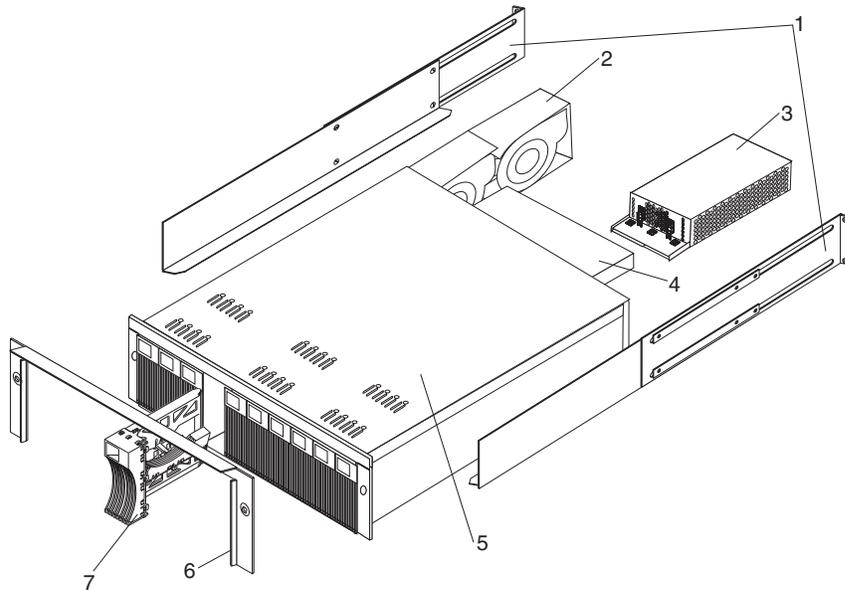
Figure 52. FAStT EXP500 storage expansion unit parts list

Index	System (IBM FAStT EXP500 storage expansion unit - Type 3560, Model 1RU)	FRU No.
1	Rail Kit Left/Right (Model 1RU)	37L0067
2	Blower Assembly (Model 1RU)	09N7285
3	350-W Power Supply Assembly (Model 1RU)	37L0059
4	Electronic Module (ESM, LVD/LVD) (Model 1RU)	37L0103

Index	System (IBM FAStT EXP500 storage expansion unit - Type 3560, Model 1RU)	FRU No.
5	Midplane/Frame (Model 1RU) **Note:** The midplane board and frame are replaced as a unit. If either part is needed, order the above FRU.	37L0104
6	Decorative Bezel (Model 1RU)	37L0074
7	Blank Tray Assembly (Model 1RU)	37L6708
	Miscellaneous Hardware Kit (Model 1RU)	09N7288
	Line Cord, 9 Foot (Model 1RU)	6952300
	Line Cord Jumper, High Voltage (Model 1RU)	36L8886

Appendix A, "Power cords," on page 103 lists required power cords for the DS4000 storage components discussed in this document by country and region.

Chapter 12. IBM Storage Area Network Data Gateway Router (2108-R03)

> **Note:** The PD maps found in the *IBM System DS4000 Problem Determination Guide* provide you with additional diagnostic aids.

Service Aids

The SAN Data Gateway (SDG) Router service capabilities include the following:

- LED indicators
- Power-on–self-test (POST)
- Health Check
- Event Log
- Service Port commands
- Diagnostics

LED indicators

Shown in Figure 53, the LEDs on the front panel provide a visual indication of the status and activity of the SDG and its interfaces. The LEDs are refreshed automatically about 5 times per second.
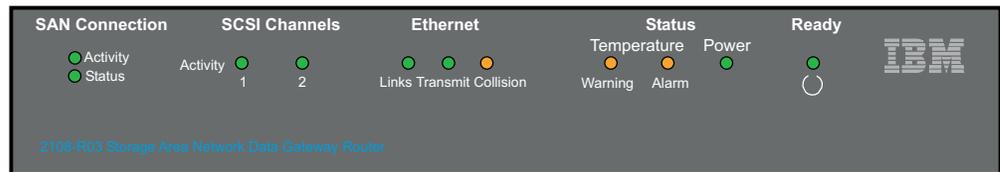
Figure 53. SDG Router front panel LEDs

Table 32 describes the SDG Router LED indicators.

Table 32. SDG Router LED indicators

LEDs (G=Green) (A=Amber)	Function	On	Off	Flash
SAN Connection				
Activity (G)	Link traffic			SAN interface activity
Status (G)	Link status	Link Active	No transmission (Link down)	
SCSI (G)				
Activity (1 and 2)	SCSI Activity	SCSI traffic	No SCSI traffic	SCSI Interface activity
ETHERNET				
Link (G)	Status	Link active	Link down	
Transmit (G)	Status	Transmission in progress		

Table 32. SDG Router LED indicators (continued)

LEDs (G=Green) (A=Amber)	Function	On	Off	Flash
Collision (A)	Status	Collision occurred		
TEMPERATURE				
WARNING (A)	Preventive failure indicator	Temperature Warning	No temperature problem	N/A
Alarm (A)	Information	Temperature exceeded	No temperature problem	N/A
Power Main (G)	Information	Power applied	No power	N/A
Ready (G)	Information	SDG Failure if on for more than 2 sec.	SDG Failure	Flashes during Startup cycle and once every second thereafter (normal)

POST

POST is divided into two functionally distinct parts: the initial-POST (IPOST) and the secondary-POST (SPOST)

IPOST is the first stage of POST and it thoroughly tests the on-board, dynamic random-access memory (DRAM) arrays. IPOST runs from the on-board flash memory. Upon successful completion, IPOST locates SPOST, copies it to the DRAM, and then transfers program control to SPOST.

SPOST is the second stage of post. SPOST configures the SDG Router's PCI bus. SPOST then locates, loads, and runs the licensed internal code.

Health Check

The health check program queries all subsystems for their operational status. The health check has four levels. A level 1 health check is the most basic, and health check level 4 is the most complete check.

Event Log

The SDG Router maintains an event log within its on-board flash file system. You can query these logs from the SDG Router service port. Event codes and messages that the SDG Router subsystems generate are recorded in this log file.

Service Port Commands

An extensive command set is available to manage the SDG Router, obtain Status, and run Diagnostics. The commands described in Table 33 have been extracted from the *SDG Service Guide*. They provide you with some basic tools to determine the functional status of the SDG Router. See Appendixes A and B of the *SDG Service Guide* for a description of all the commands.

Table 33. SDG Router service port commands

Group	Description	Page
diagBoot	Used to transition the SDG Router from normal operation to Diagnostic mode (see normalBoot below)	89

Table 33. SDG Router service port commands (continued)

Group	Description	Page
diagHelp	Displays a list of diagnostic commands	90
fcShow	Displays the status of the fibre channel interface	90
fcShowDevs	Displays information about the devices that are accessible from the fibre channel interface	91
fcShowNames	Displays the node and port names (addresses) of the fibre channel	91
hardwareConfig	**Diagnostic mode only**. Stores FRU VPD information in the SDG non-volatile memory (see sysVpdShow below)	92
help	Displays a list of the commands	92
hlthChkHelp	Displays the list of health check commands	93
hlthChkNow	Initiates the health check for the SDG. Results display.	93
loggerDump	Dumps records from the system event log to the terminal console	94
loggerDumpCurrent	Dumps only the records that were logged since the system was last started.	94
macShow	Displays the Media Access Control address for the Ethernet interface	95
mapShowDatabase	Device database listing the connected devices	95
mapShowDevs	Displays the cross-reference map of device addresses	95
normalBoot	Restores the SDG to normal operating conditions. Used only to transition from diagnostic mode to normal mode.	96
reboot	Preferred method for restarting the SDG Router	96
scsiRescan	Performs a rescan of the SCSI channel(s) to look for new devices	96
scsiShow	Lists all SCSI channels and the attached devices for each channel	97
showBox	Displays a picture of the SDG that shows the components present	98
sysConfigShow	Displays current parameter settings.	98
sysVpdShow or sysVpdShowAll	Displays Vital Product Data (VPD) information	98
targets	Lists and describes each device currently attached	100
version	Lists the firmware version level	100

The following descriptions are from *Storage Area Network Data Gateway Router Installation and User's Guide*; they also are listed in the *Storage Area Network Data Gateway Router Service Guide*.

diagBoot

Use the **diagBoot** command only to transition the SDG Router from normal operation to the special diagnostic mode. The command first ensures that the ffs0:mt directory exists, then it verifies that the files diagnstk.o and diagnstk.rc are in the flash file system. If they are in the root directory, it moves them to the ffs0:mt directory.

The **diagBoot** command copies the existing boot parameters to a file in the ffs0:mt directory on the SDG Router. It then installs the new boot parameters that direct the SDG Router to start using the special diagnostic startup script, ffs0:mt/diagnstk.rc. It renames the persistent map file config/device.map as config/device.bak. Finally, **diagBoot** issues a reboot command to put the changes into effect.

Note: Power cycling the SDG Router does not re-instate it to normal mode if previously set to diagnostic mode. Use **normalBoot** command (page 96) to re-initialize the router to normal mode.

diagHelp

The **diagHelp** command displays a list of the diagnostic commands.

Router > diagHelp .

The following commands are available in diagnostic mode only.

```
ddfTest: Test DDF Memory
elTest: Test Ethernet port w/loop-back cable
fcSlotTest <portnum> : Test specified fibre channel port w/loop-back cable
hardwareConfig: Re-inventory FRUs and update Vital Product Data
normalBoot: Shutdown and restart in normal mode
scsiChannelTest <x,y>: Test specified SCSI Channels w/loop-back cable
```

fcShow

The **fcShow** command displays the channel status for the fibre channel interface.

The following example is for an SDG Router single-port fibre channel PMC card (ISP2200 controller). The firmware state for interfaces that have a live connection to a fibre channel device are shown as Ready. An interface that has no live connection shows as Sync Lost.

```
Router > fcShow
----------------------------------------------------------
Fibre Channel Controllers
-------------------------------------------------------------------
Ctlr : PCI Addr : ISP : Firmware : FW : Ctrl : Nvram : Loop
 Id : Bs Dv Fn : Type : State : Version : Addr : Addr : ID}
-------------------------------------------------------------------
1 : 00 06 00 : 2200 : Ready : 2.01.2 : c0d98700 : 90001100 : 2 1
-------------------------------------------------------------------
value = 80 = 0x50 = ©P©
Router >
```

The following list describes the example fields:

Ctlr ID The channel number for this interface

PCI Addr The PCI address of the interface, showing bus, device ID, and function number

ISPType The type of fibre channel controller, ISP2100 or ISP2200

Firmware State The current state of the interface as reported by the fibre channel PMC adapter firmware. The firmware states are:

- **Configuration Wait**: Firmware is not initialized.
- **Waiting for AL_PA** : Firmware is performing or waiting to perform loop initialization.
- **Waiting for login**: Firmware is attempting port and process logins with all loop ports.
- **Ready**: Indicates that the interface is connected, operational and ready to process SCSI commands. Any other value indicates intermediate states or interface failure.

- **Sync Lost**: The firmware has detected a loss-of-sync condition and is resynchronizing the serial link receiver. This is the state reported when the fibre channel link does not detect a connection to a fibre channel device.
- **Error**: The firmware detected an unrecoverable error condition.
- **Nonparticipating**: The firmware is not participating on the loop because it did not acquire an arbitrated loop physical address (AL_PA) during initialization.
- **Failed**: The firmware is not responding to commands.

FW Version The version of firmware on the fibre channel PMC adapter

Ctrl Addr A pointer to an internal data structure that is used for some diagnostic operations

Nvram Addr The memory address of the parameter RAM for this interface

Loop ID The fibre channel loop ID for this interface

fcShowDevs

The **fcShowDevs** command displays information about the devices that are accessible from each fibre channel interface, as the following example shows. The display shows the LUN that the SDG Router has assigned to each device, the SCSI Channel that the device is attached to, the actual SCSI ID and LUN of the device, the vendor, product, revision, and serial number of the device.

```
Router > fcShowDevs
FC 1:
LUN Chan Id Lun Vendor Product Rev SN
--------------------------------------------------------------------
0 0 0 0PATHLIGHT SAN Router Local 0252 00000060450d00c0
2 3 4 0IBM 03570c11 5324 000000000260
3 3 4 1IBM 03570c11 5324 000000000260
value = 3 = 0x3
Router > Router > fcShowDevs
FC 1:
LUN Chan Id Lun Vendor Product Rev SN
 -----------------------------------------------------
0 0 0 0PATHLGHT SAN Router 0339 00000060451600db
1 1 0 0 ATL L500 6320000 001E JF91101163
2 1 1 0QUANTUM DLT7000 2150 CX921S1423
4 1 2 0QUANTUM DLT7000 2150 CX905S4607
6 2 0 0QUANTUM Powerstor L200 001E JW81477118
8 2 1 0QUANTUM DLT7000 2150 CX919S5223
LUN Chan Id Lun Vendor Product Rev SN
FC 4:
0 0 0 0PATHLGHT SAN Router 0339 00000060451600db
-----------------------------------------------------
1 1 0 0 ATL L500 6320000 001E JF91101163
2 1 1 0QUANTUM DLT7000 2150 CX921S1423
4 1 2 0QUANTUM DLT7000 2150 CX905S4607
6 2 0 0QUANTUM Powerstor L200 001E JW81477118
8 2 1 0QUANTUM DLT7000 2150 CX919S5223
value =6 =0x6
Router >
```

fcShowNames

The **fcShowNames** command displays the node and port names (addresses) of the fibre channels.

```
Router > fcShowNames
-----------------------------------------------------------------
Ctlr : PCI Addr : ISP : Node : Port
Id : Bs Dv Fn : Type : Name : Name
-----------------------------------------------------------------
1 : 00 06 00 : 2200 : 10000060.451603bb :  20010060.451603bb
4 : 00 07 00 : 2200 : 10000060.451603bb :  20020060.451603bb
-----------------------------------------------------------------
value = 64 = 0x40 = ©@©
Router >
```

The following list describes the example fields:

Ctlr id The channel number for the interface

PCI Addr The PCI address of the interface, showing bus, device ID, and function number

ISPType The type of fibre channel controller, ISP2100 or ISP2200

Node Name The fibre channel node name for the SDG Router

Port Name The fibre channel port name for the interface

hardwareConfig

In order to use this command, the SDG Router must be in diagnostic mode. The **hardwareConfig** command records the configurations of installed FRUs by copying them to the nonvolatile vital product data (VPD) stored on the SDG Router base. See the following example.

The fields that are updated are the SCSI channel types and PMC type. The service representative enters the **hardwareConfig** command after replacing any FRUs, which causes the SDG Router to update the VPD.

```
Router> hardwareConfig
==== Recording Hardware Configuration ====
Scanning PMC option slots...
Scanning SCSI IO Modules...
Checking memory sizes...
MemSize PCI-0 is 64 Mbytes ...Done
value = 0 = 0x0
Router >
```

help

The **help** command displays a list of the shell commands, as the following example shows.

```
Router > help
help Print this list
cleHelp Print Command Log Entry info
diagHelp Print Diagnostic Help info
hlthChkHelp Print Health Check Help info
mapHelp Print Device Map Help info
netHelp Print Network Help info
snmpHelp Print SNMP Help info
userHelp Print User account info
cd "path" Set current working path
copy ["in"][,"out"] Copy in file to out file (0 = std in/out)
h [n] Print (or set) shell history
ls ["path"[,long]] List contents of directory
ll ["path"] List contents of directory - long format
pwd Print working path
rename "old","new" Change name of file
rm ["name"] Remove (delete) a file
shellLock Lock or unlock shell command interface
version Print Version info
whoami Print user name
clearReservation [devId] Clear reservation on a target (may reset target)
diagBoot Shutdown and restart in diagnostic mode
initializeBox Delete all device maps, restore factory defaults, reboot
ridTag ["value"] Display and set serial number of replaced base unit
disableCC [option] Disable Command and Control Interface
option 1 - Report as Invalid (AIX mode)
option 2 - Fully disabled
enableCC Enable Command and Control Interface
scsiRescan [chan] Rescan SCSI Channel (all if chan not specified)
scsiShow Display info for SCSI Channels
fcShow Display info for fibre channels
fcShowDevs Display devices available on each fibre channel
fcShowNames Display Node and Port names for fibre channels
hostTypeShow Display Default Host Type settings
loggerDump [count] Display Logger Dump Records
loggerDumpCurrent [level] Display Logger Dump Records for current boot
reboot Shut down and restart
reset Restart without shut down
setFcScsiChanMask [chan],[scsi],[allow] Set Channel Access Control
setFcFrameSize [chan],[size] Set FC Frame Size
setFcHardId [chan],[id] Set FC Loop ID
setHost [chan],["OS"] Set default host type for FC Channel
OS may be "aix", "nt", "solaris", "hpux"
setSnaCCLun Set LUN for Controller Device (typically zero)
showBox Display graphic of current hardware configuration
sysConfigShow Display System Config Parameters
sysVpdShow Display Vital Product Data
sysVpdShowAll Display Vital Product Data for all subsystems
targets List all known target devices
uptime Display time since last boot
```

hlthChkHelp

The **hlthChkHelp** command displays a list of the health check commands, as the following example shows.

```
Router > hlthChkHelp
hlthChkIntervalGet - Show Check Interval
hlthChkIntervalSet <interval> - Set Check Interval
hlthChkLevelGet - Show Check Level
hlthChkLevelSet <level> - Set Check Level
hlthChkNow - Run Health Check Now
```

hlthChkNow

The command causes the SDG Router to run an immediate, level 4 health check. Results display that indicate which devices or subsystems failed the check.

```
Router> hlthChkNow
```

loggerDump [number]

The **loggerDump** command dumps records from the system event log to the console. You can use a numeric parameter to indicate the number of events to display. With no parameter specified, all events in the log file display starting with the most recent events, as the following example shows.

```
Router > loggerDump 4
*** Dumping 4 (1018 through 1021) of 1021 records ***
000008 1018 0d:00h:00m:07s:22t -- SCSI 2: Bus RESET
000009 1019 0d:00h:00m:07s:22t -- Target device added: index 0, handle 0xc0ec2600
000010 1020 0d:00h:00m:08s:18t -- Target device added: index 10, handle 0xc0ad2590
000011 1021 0d:00h:00m:08s:28t -- SCSI 2: New Device at Id 6, Lun 0
Router >
```

loggerDumpCurrent [level]

The **loggerDumpCurrent** command dumps records from the system event log to the console. Only the records that were logged since the system was last started are dumped. Level specifies the event log level for the events as shown in Table 34.

Table 34. SDG Router event log levels

Level	Name	Explanation
0	Private	Events that are never shown by the remote event viewer but are recorded in the SDG Router event log
1	Notice	Conditions that should always be reported, such as temperature alarms and device removals
2	Warning	Events that might result in a later problem
3	Information	Events that are not errors or warnings

The following example shows a dump after a typical start sequence with four target devices added (one additional device shows, which is the command and control LUN of the SDG Router itself).

```
Router > loggerDumpCurrent 1
*** Dumping 9 (1010 through 1018) current records with level >= 0 ***
000001 0d:00h:00m:05s:56t -- NOTICE: CS and LOGGING STARTED
000002 0d:00h:00m:07s:19t -- FCAL 1: LIP occurred
000003 0d:00h:00m:07s:19t -- FCAL 1: Loop up
000004 0d:00h:00m:07s:22t -- SCSI 1: Bus RESET
000005 0d:00h:00m:07s:22t -- SCSI 2: Bus RESET
000006 0d:00h:00m:07s:22t -- Target device added:index 0, handle 0xc0ec2600
000007 0d:00h:00m:08s:18t -- Target device added: index 9, handle 0xc1f9e090
000008 0d:00h:00m:08s:18t -- Target device added: index 10, handle 0xc0ad2590
000009 0d:00h:00m:08s:28t -- SCSI 2: New Device at Id 6, Lun 0
value = 0 = 0x0
Router >
```

macShow

The **macShow** command displays the media access control (MAC) address for the Ethernet interface, as the following example shows.

```
Router > macShow
Enet MAC Address: 0.60.45.d.0.80
value = 33 = 0x21 = ©!©
Router >
```

mapShowDatabase

The SDG Router maintains a database of attached devices to ensure that each time a host attaches to the SDG Router, the target devices are seen at a consistent address. The database lists not only the devices presently connected, but also devices that were previously connected. If a previously attached device is later reattached, it is assigned its previous address. Use the **mapShowDatabase** command to display the persistent device map table.

```
Router > mapShowDatabase
devId Type Chan tId tLun UID
----------------------------------------------
000 SNA 127 127 127 00000060:450d00c0
001 SCSI 001 003 000 00000060:450d00c0
002 SCSI 001 002 000 00000060:450d00c0
003 SCSI 001 001 000 00000060:450d00c0
004 SCSI 002 002 000 00000060:450d00c0
005 SCSI 002 000 000 00000060:450d00c0
006 SCSI 002 006 000 00000060:450d00c0
007 SCSI 002 009 000 00000060:450d00c0
008 SCSI 002 002 001 00000060:450d00c0
009 SCSI 002 005 000 00000060:450d00c0
010 SCSI 002 005 001 00000060:450d00c0
011 SCSI 001 000 000 00000060:450d00c0
012 SCSI 001 006 000 00000060:450d00c0
value = 0 = 0x0
Router >
```

The following list describes the example fields:

devId The index of the device in the database

Type The type of interface where the device is connected. SNA indicates an internal device. SCSI or fibre channel indicate I/O interfaces.

Chan The channel number of the interface where the device is attached

tId Target ID mapping for SCSI initiators

tLun Target LUN mapping for SCSI initiators

UID For a fibre channel interface, the unique ID of the device. For SCSI interface, the unique ID of the SDG Router.

mapShowDevs

The SDG Router maintains a cross-reference map of device addresses. You can display Information about the presently attached and available devices in the map by using the **mapShowDevs** command.

```
Router > mapShowDevs
devId Type Chan iId iLun UID tId tLun Handle Itl
------------------------------------------------------------------
000 SNA 127 127 127 00000060.450d00c0 001 000 c0ec2600h 00000000h
009 SCSI 002 005 000 09000060.450d00c0 255 255 c1f9e090h 00000000h
010 SCSI 002 005 001 0a000060.450d00c0 255 255 c0ad2590h 00000000h
012 SCSI 001 006 000 0c000060.450d00c0 255 255 c1ffdf10h c1ffdc80h
value = 0 = 0x0
Router >
```

The following list describes the example fields:

devId The index of the device in the database

Type The type of interface where the device is attached to the SDG Router

Chan The channel number of the interface

iId For a SCSI interface only, device ID of the device

tLun For a SCSI interface only, the LUN of the device

UID For a fibre channel interface, unique ID of the device. For SCSI interface, a constructed unique ID based on the unique ID of SDG Router.

tId Target ID mapping for SCSI initiators

tLun Target LUN mapping for SCSI initiators

Handle An internal pointer used for some diagnostic operations

Itl An internal pointer used for some diagnostic operations

normalBoot

Certain commands and tests are only available in diagnostic mode. Switching to diagnostic mode saves all configuration parameters so that they are restored before returning to normal operation. Use the **normalBoot** command to restore the SDG Router to normal operating conditions.

This command is used only to transition a SDG Router from the special diagnostic mode to normal operations. It restores the boot parameters that were copied by **diagBoot**. The new persistent device map is erased, and the original map file is renamed config/device.map restoring it for use when the SDG Router restarts. The **normalBoot** command then restarts the SDG Router.

reboot

The **reboot** command requests that the SDG Router shut down existing operations and then restart. This is the preferred method of restarting the SDG Router. There are processes running within the SDG Router that might have writes pending to files within the SDG Router's flash file system. Following a **reboot** command, these processes flush their data to the flash file system, and the flash file system writes all pending data out to the flash memory. The SDG Router starts a reset cycle only after all pending data has been successfully written to the flash file system.

```
Router > reboot
```

scsiRescan [channel]

The **scsiRescan** command requests a SCSIrescan to look for new devices. If channel is specified (1 or 2), then only that channel is scanned. If channel is not specified or if channel is 0, then all channels are scanned.

Notes:

1. Rescanning a SCSI bus can delay I/O commands pending on that bus for several seconds. Do not rescan SCSI buses when this delay cannot be tolerated. If possible, scan only the bus where a new device has been added.

2. If a channel is specified, that channel is scanned and the prompt is returned on completion. If no channel is specified (or 0 is specified), SCSI channels 1 and 2 are scanned in sequence and the prompt is returned on completion.

3. When a device is discovered, there can be further device specific initialization that continues after the scan has completed. In this case, the device might not show up immediately when you issue the **fcShowDevs** command. (Tape and changer devices that indicate a ready status are available after the scan is completed.)

4. If a SCSI target device requires replacement, remove the old device. Set the new device to the same SCSI bus ID as the old device and attach it to the same channel. Rescan the channel to update the configuration data. The new device should be available to host systems with the same LUN as the old device.

scsiShow

The **scsiShow** command lists all SCSI channels and the attached devices for each channel.

```
Router > scsiShow
SCSI Initiator Channel 1: 0xc195e670
ID LUN Vendor Product Rev | Sync/Off Width
--------------------------|------------
0 0 IBMAS400 DFHSS4W 4545 | 12/15 16 S W Q
SCSI Initiator Channel 2: 0xc0ed3900
ID LUN Vendor Product Rev | Sync/Off Width
--------------------------|------------
  4 0 IBM 0357011 5324 | 25/15 16 S W
4 1 IBM 0357011 5324 |
value = 0 = 0x0
 Router >
```

The following list describes the example fields:

ID The SCSI ID of the target device

LUN The SCSI LUN of the target device

Vendor The content of the Vendor ID field from the SCSI inquiry data

Product The content of the Product ID field from the SCSI inquiry data

Rev The content of the Revision ID field from the SCSI inquiry data

Sync/Off The negotiated synchronous transfer period and offset. The period is the negotiated transfer period. Multiply the period times 4 ns. to determine the actual period. However, if the period is negotiated to 12, then 50 ns. is used. The offset indicates the request/acknowledge (REQ/ACK) offset that was negotiated. A zero in these fields indicates that asynchronous transfer is in use.

Width The negotiated transfer width in bits, either 8 or 16

showBox

The **showBox** command displays the components currently in the SDG Router using characters to form a picture of the unit, as viewed from the rear. Figure 54 demonstrates how the **showBox** command displays a SDG Router that has a single-port fibre channel PMC installed.

Note: For SAN connection port-number assignments, see the *Storage Area Network Data Gateway Router Service Guide*.

```
 Front //|                                    //|
      // /----------------------------------// |
     // /                                  //   |
    // /                                  //    |
   // /                         /-----///     /
  ///====/                     /  1  ///     /
 /====================================/     /
 |  [SET=]                          |   /
 |                          [FCOSW]  |  /
 |  [SET=]                          | /
 |_____|/  Back
SET = SCSI Single Ended - Terminated
FCOSW = FibreChannel Optical Short Wave

SCSI-1 requires Single Ended cable
SCSI-2 requires Single Ended cable
FCOSW-1 slot-1 requires FibreChannel Multi-Mode (SW) cable
```

Figure 54. SDG Router showBox command output

sysConfigShow

The **sysConfigShow** command displays the current system parameter settings.

The display shows whether the SDG Router command and control interface is enabled or disabled. It also shows the LUN that is assigned to it, whether enhanced tape performance features are enabled, the MAC address of the Ethernet port, and the SDG Router fibre channel node address.

```
Router > sysConfigShow
Current System Parameter Settings:
Command and Control Device (CC) : 0 Enabled
 LUN : 0
Allow Early Write Status for Tape : 1 Enabled
Allow R/W Acceleration for Tape : 1 Enabled
Enet MAC Address: 0.60.45.16.1.4
FC Node WWN: 10000060.45160104
value =0 =0x0 Router >
```

sysVpdShow or sysVpdShowAll

The **sysVpdShow** command displays vital product data (VPD) information. The VPD for the SDG Router includes such items as serial numbers and installed memory sizes.

```
Router > sysVpdShow
====== VPD ======
name SAN Router
uid 00:60:45:16:01:04
s/n 100111
mfg Pathlight Tech
board OntarioII 1.1
" s/n 08357659
flash 2Mbyte
dram 32Mbyte
slot1 10772100 FCOSW
scsi 1: DET 2: DET
EC OTA08000H
RID Tag
value =0 =0x0
Router >
```

The following list describes the example fields:

name Product name: up to 16 characters

uid Unique Ethernet MAC address of the product: 32 characters displayed as hexadecimal bytes separated by colons

s/n Product serial number: up to 16 characters

mfg Product manufacturer: up to 16 characters

board Name of the system board contained in the base unit: up to 16 characters

″ **s/n** System board serial number: up to 16 characters

flash Size of the flash memory on the system board

dram Size of the DRAM on the system board

slot1 Card type installed in SAN connection slot one

scsi 1 SCSI type for each of the two channels, DET for ″differential, terminated″ and SET for ″single-ended, terminated″

EC Engineering change (EC) level for the system board: up to 16 characters

RID RID tag identifier: up to 16 characters

The **sysVpdShowAll** command shows more information and includes product data for the fibre channel PMC card, as the following example shows.

```
Router > sysVpdShowAll
 ===[ Vital Product Data ]===
 -=[ Base Assembly ]-------
Name SAN Data Gateway Router
Mfg Pathlight Tech
UID 00:60:45:16:01:04
S/N 100111Assy HCO OTA08000H
Assy HCO OTA08000H
Board OntarioII 1.1
" S/N 08357659
Flash 2 Mbyte
Dram 32 Mbyte
RID Tag 100111
-=[ Slot 1 ]=-------------
 Type 10772100 FCOSW
S/N 123456
UID 0060.45160065
HCO SC004120H
value =0 =0x0
Router >
```

targets

> The SDG Router maintains a list of target devices that are attached to the
> I/O channels. The **targets** command lists each device that is currently
> attached and provides a description of each device.

```
 Router > targets
Idx Tdev Vendor Product Rev | Type Specific
------------------------------|-----------------------------------
0 0xc194a400 PATHLGHT SAN Router Local 0252 | Cmd/Cntrl Status 0h
2 0xc1ffc390 IBM 03570C11 5324 | Tape: Blk Size  32768 , flags 7h
3 0xc1ffc290 IBM 03570C11 5324 | Changer: flags 7h
 value =4 =0x4
Router >
```

> The following list describes the example fields:
>
> **Idx** Device Index in the target list
>
> **Tdev** An internal pointer, used for some diagnostic operations
>
> **Vendor** Content of the Vendor ID field from the SCSI Inquiry Data
>
> **Product** Content of the Product ID field from the SCSI Inquiry Data
>
> **Rev** Content of the Revision ID field from the SCSI Inquiry Data
>
> **Type Specific** For each device type, information pertinent to the device

version

> The SDG Router has software that controls all functions. The **version**
> command displays the revision of that operating software. The first line
> displayed is the SDG Router firmware version. The lines that follow pertain
> to the operating system software version.

```
Router > version
SAN Data Gateway Router Version 0339.11 Built Dec 13 1999, 15:14:14
VxWorks (for Pathlight (i960RD)) version 5.3.1.
Kernel: WIND version 2.5.
value = 26 = 0x1a
Router >|
```

Diagnostics

The diagnostic suite is a subset of the manufacturing test program. When enabled, the diagnostic suite is capable of performing external loopback testing of all major hardware interfaces (SCSI, fibre channel, and Ethernet).

Toolkit P/N 34L2606 (supplied with the Router) contains the necessary loopback plugs to run the Diagnostics. It includes the following hardware:

- Service port cable: One RS-232 null-modem cable with 9-pin connectors
- SCSI loopback cable: One short wide-Ultra cable with 68-pin connectors
- Fibre channel: One fibre channel short-wavelength or long-wavelenh
  fiber-optic loopback plug
- Ethernet: One 10BASE-T Ethernet loopback cable
- Fuses: Two 250 V, 4 A time-lag fuses (type F4AL)

Diagnostic tests

To verify proper operation of the SDG or whenever a FRU has been replaced, a complete diagnostic check of the router can be performed. It is recommended that you perform these tests prior to returning the SDG Router to the customer.

Diagnostic test preparation

Perform the following steps to verify proper operation of the SDG or a replaced FRU:

1. Attach the service terminal to the SDG Router.
2. Turn on the SDG Router and wait until it has finished the startup cycle.
3. From the service terminal, type **diagBoot**.
4. Wait until the SDG Router has finished the startup cycle. The Shell prompt should be **diagmode>**.
5. From the service terminal, type **showBox**.
6. Verify that the SDG Router is configured according to the customer's requirements:
   a. If all installed FRUs are shown, go to "Fibre channel tests".
   b. If all installed FRUs are not shown, see Chapter 3 of the *2108 Model R03 Service Guide (MAP)*.

Fibre channel tests

Perform the following steps to verify proper fibre channel operation:

1. Attach the fibre channel loopback plug to the card in PMC slot 1. (You can also use the plug from FAStT MSJ).

   Note: This test works only if the card is an ISP2200. If the card is an ISP 2100, the following error displays: `Card in slot 0 is not fibre channel.` You can also run FAStT MSJ to verify if the SDG Router is being detected. However, you cannot run the diagnostics (Loopback and Read/Write Buffer test) on the SDG Router.

2. From the service terminal, type **fcSlotTest 1**

a. If the **fcSlotTest** test completes successfully, remove the loopback plug and go to ″SCSI test″.

b. If not, see Chapter 3 of the *2108 Model R03 Service Guide (MAP)*.

SCSI test

Perform the following steps to verify proper SCSI operation:

1. If there is only one SCSI interface installed, proceed to ″Ethernet Test″.

2. Attach the SCSI loopback cable to SCSI channels 1 and 2.

3. From the service terminal, type **scsiChannelTest 1, 2**.

   a. If the test completes successfully, go to step 4.

   b. If not, see Chapter 3 of the *2108 Model R03 Service Guide (MAP)*.

4. Remove the SCSI loopback cable.

5. Proceed to ″Ethernet Test″.

Ethernet test

Perform the following steps to verify proper Ethernet operation:

1. Obtain the SDG Router Ethernet network parameters from the customer. Configure the Ethernet port host name, address, routes, and enable the Ethernet. See the IBM DS4000 product installation uide.

2. Attach the Ethernet loopback plug to the Ethernet port.

3. From the service terminal, type **elTest**.

4. If the test completes successfully, go to step 5. If not, see Chapter 3 of the *2108 Model R03 Service Guide (MAP)*.

5. Remove the Ethernet loopback plug.

Verifying SDG Router operation

Perform the following steps to verify proper SDG operation:

1. From the service terminal, type **normalBoot**.

2. Wait until the SDG Router has finished the startup cycle. The Ready light should be blinking once every second, indicating the SDG Router POST was successful. If the light remains on or is off, see Chapter 3 of the *2108 Model R03 Service Guide (MAP)*.

Appendix A. 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	Cord specifics	Used in these countries or regions
13F9940	250V/10A 2.8M	Australia, Fiji, Kiribati, Nauru, New Zealand, Papua New Guinea
13F9979	250V/10A 2.8M	Afghanistan, Albania, Algeria, Andorra, Angola, Armenia, Austria, Azerbaijan, Belarus, Belgium, Benin, Bosnia and Herzegovina, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo (Democratic Republic of), Congo (Republic of), Cote D'Ivoire (Ivory Coast), Croatia (Republic of), Czech Rep, Dahomey, Djibouti, Egypt, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Finland, France, French Guyana, French Polynesia, Gabon, Georgia, Germany, Greece, Guadeloupe, Guinea, Guinea Bissau, Hungary, Iceland, Indonesia, Iran, Kazakhstan, Kyrgyzstan, Laos (Peoples Democratic Republic of), Latvia, Lebanon, Lithuania, Luxembourg, Macedonia (former Yugoslav Republic of), Madagascar, Mali, Martinique, Mauritania, Mauritius, Mayotte, Moldova (Republic of), Monaco, Mongolia, Morocco, Mozambique, Netherlands, New Caledonia, Niger, Norway, Poland, Portugal, Reunion, Romania, Russian Federation Rwanda, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Slovakia, Slovenia (Republic of), Somalia, Spain, Suriname, Sweden, SSyrian Arab Replublic, Tajikistan, Tahiti, Togo, Tunisia, Turkey, Turkmenistan, Ukraine, Upper Volta, Uzbekistan, Vanuatu, Vietnam, Wallis and Futuna, Yugoslavia (Federal Republic of), Zaire
13F9997	250V/10A 2.8M	Denmark

IBM power cord part number	Cord specifics	Used in these countries or regions
14F0015	250V/10A 2.8M	Bangladesh, Lesotho, Maceo, Maldives, Namibia, Nepal, Pakistan, Samoa, South Africa, Sri Lanka, Swaziland, Uganda
14F0033	250V/10A 2.8M	Abu Dhabi, Bahrain, Botswana, Brunei Darussalam, Channel Islands, Cyprus, Dominica, Gambia, Ghana, Grenada, Guyana, Hong Kong S.A.R. of China, Iraq, Ireland, Jordan, Kenya, Kuwait, Liberia, Malawi, Malaysia, Malta, Myanmar (Burma), Nigeria, Oman, Qatar, Saint Kitts & Nevis, Saint Lucia, Saint Vincent and the Grenadines, Seychelles, Sierra Leone, Singapore, Sudan, Tanzania (United Republic of), Trinidad & Tobago, United Arab Emirates (Dubai), United Kingdom, Yemen, Zambia, Zimbabwe
14F0051	250V/10A 2.8M	Liechtenstein, Switzerland
14F0069	250V/10A 2.8M	Chile, Italy, Libyan Arab Jamahiriya
14F0087	250V/10A 2.8M	Israel
1838574	250V/10A 2.8M	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Caicos Islands, Canada, Cayman Islands, Costa Rica, Columbia, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Japan, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Taiwan, United States, Venezuela
36L8880	250V/10A 2.8M	Argentina, Paraguay, Uruguay
02K0546	250V/6A 2.8M	PRC (China)
6952300	125V/10A 2.8M	Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Cayman Islands, Costa Rica, Columbia, Cuba, Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Mexico, Micronesia (Federal States of), Netherlands Antilles, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Taiwan, Thailand, Turks and Caicos Islands, United States, Venezuela
6952301	125V/10A 1.8M	

Appendix B. Additional DS4000 documentation

The following tables present an overview of the IBM System Storage DS4000 Storage Manager, Storage Subsystem, and Storage Expansion Enclosure product libraries, as well as other related documents. Each table lists documents that are included in the libraries and what common tasks they address.

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

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

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

DS4000 Storage Manager Version 9 library

Table 35 associates each document in the DS4000 Storage Manager Version 9 library with its related common user tasks.

Table 35. DS4000 Storage Manager Version 9.1 titles by user tasks

Title	User tasks					
	Planning	**Hardware installation**	**Software installation**	**Configuration**	**Operation and administration**	**Diagnosis and maintenance**
IBM System Storage DS4000 Storage Manager Version 9 Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux	✔		✔	✔		
IBM System Storage DS4000 Storage Manager Version 9 Installation and Support Guide for AIX, UNIX, Solaris and Linux on POWER	✔		✔	✔		
IBM System Storage DS4000 Storage Manager Version 9 Copy Services User's Guide	✔		✔	✔	✔	
IBM TotalStorage DS4000 Storage Manager Version 9 Concepts Guide	✔	✔	✔	✔	✔	✔

DS4800 Storage Subsystem library

Table 36 associates each document in the DS4800 Storage Subsystem library with its related common user tasks.

Table 36. DS4800 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
IBM System Storage DS4800 Installation, User's and Maintenance Guide	✔	✔		✔	✔	✔
IBM System Storage DS4800 Installation and Cabling Overview		✔				
IBM TotalStorage DS4800 Controller Cache Upgrade Kit Instructions	✔	✔		✔		

DS4700 Storage Subsystem library

Table 37 associates each document in the DS4700 Storage Subsystem library with its related common user tasks.

Table 37. DS4700 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
IBM System Storage DS4700 Installation, User's and Maintenance Guide	✔	✔		✔	✔	✔
IBM System Storage DS4700 Storage Subsystem Fibre Channel Cabling Guide		✔				

DS4500 Fibre Channel Storage Server library

Table 38 associates each document in the DS4500 (previously FAStT900) Fibre Channel Storage Server library with its related common user tasks.

Table 38. DS4500 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4500 Installation and Support Guide	✔	✔		✔		
IBM TotalStorage DS4500 Fibre Channel Cabling Instructions	✔	✔				
IBM TotalStorage DS4500 Storage Server User's Guide				✔	✔	✔
IBM TotalStorage DS4500 Rack Mounting Instructions	✔	✔				

DS4400 Fibre Channel Storage Server library

Table 39 associates each document in the DS4400 (previously FAStT700) Fibre Channel Storage Server library with its related common user tasks.

Table 39. DS4400 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4400 Fibre Channel Storage Server User's Guide	✔	✔		✔	✔	✔
IBM TotalStorage DS4400 Fibre Channel Storage Server Installation and Support Guide	✔	✔		✔	✔	
IBM TotalStorage DS4400 Fibre Channel Cabling Instructions	✔	✔				

DS4300 Fibre Channel Storage Server library

Table 40 associates each document in the DS4300 (previously FAStT600) Fibre Channel Storage Server library with its related common user tasks.

Table 40. DS4300 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4300 Fibre Channel Storage Server Installation and User's Guide	✔	✔		✔		
IBM TotalStorage DS4300 Rack Mounting Instructions	✔	✔				
IBM TotalStorage DS4300 Fibre Channel Cabling Instructions	✔	✔				
IBM TotalStorage DS4300 SCU Base Upgrade Kit		✔	✔			
IBM TotalStorage DS4300 SCU Turbo Upgrade Kit		✔	✔			
IBM TotalStorage DS4300 Turbo Models 6LU/6LX Upgrade Kit		✔	✔			

DS4200 Express Storage Subsystem library

Table 41 associates each document in the DS4200 Express Storage Subsystem library with its related common user tasks.

Table 41. DS4200 Express Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM System Storage DS4200 Express Installation, User's and Maintenance Guide	✔	✔		✔	✔	✔
IBM System Storage DS4200 Express Storage Subsystem Fibre Channel Cabling Guide		✔				

DS4100 SATA Storage Server library

Table 42 associates each document in the DS4100 (previously FAStT100) SATA Storage Server library with its related common user tasks.

Table 42. DS4100 SATA Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4100 Installation, User's and Maintenance Guide	✔	✔		✔	✔	✔
IBM TotalStorage DS4100 Cabling Guide		✔				

DS4000 Storage Expansion Enclosure documents

Table 43 associates each of the following documents with its related common user tasks.

Table 43. DS4000 Storage Expansion Enclosure document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM System Storage DS4000 EXP810 Storage Expansion Enclosures Installation, User's, and Maintenance Guide	✔	✔		✔	✔	✔
IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide	✔	✔		✔	✔	✔
Fibre Channel Solutions - IBM DS4000 EXP500 Installation and User's Guide	✔	✔		✔	✔	✔
IBM System Storage DS4000 EXP420 Storage Expansion Enclosures Installation, User's, and Maintenance Guide	✔	✔		✔	✔	✔
IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosures Installation and Migration Guide	✔	✔				

Other DS4000 and DS4000-related documents

Table 44 associates each of the following documents with its related common user tasks.

Table 44. DS4000 and DS4000–related document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM Safety Information					✔	
IBM TotalStorage DS4000 Quick Start Guide	✔	✔				
IBM TotalStorage DS4000 Hardware Maintenance Manual						✔
IBM System Storage DS4000 Problem Determination Guide						✔
IBM Fibre Channel Planning and Integration: User's Guide and Service Information	✔	✔			✔	✔
IBM TotalStorage DS4000 FC2-133 Host Bus Adapter Installation and User's Guide		✔			✔	
IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide		✔			✔	
IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview	✔	✔	✔	✔		
IBM Netfinity® Fibre Channel Cabling Instructions		✔				
IBM Fibre Channel SAN Configuration Setup Guide	✔		✔	✔	✔	

Appendix C. Product Recycling and Disposal

This unit must be recycled or discarded according to applicable local and national regulations. IBM encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. IBM offers a variety of product return programs and services in several countries to assist equipment owners in recycling their IT products. Information on IBM product recycling offerings can be found on IBM's Internet site at www.ibm.com/ibm/ environment/products/prp.shtml.

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Appliances are labeled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to various products to indicate that the product is not to be thrown away, but rather reclaimed upon end of life per this Directive.

In accordance with the European WEEE Directive, electrical and electronic equipment (EEE) is to be collected separately and to be reused, recycled, or recovered at end of life. Users of EEE with the WEEE marking per Annex IV of the WEEE Directive, as shown above, must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to customers for the return, recycling and recovery of WEEE. Customer participation is important to minimize any potential effects of EEE on the environment and human health due to the potential presence of hazardous substances in EEE. For proper collection and treatment, contact your local IBM representative.

Appendix D. Battery Return Program

This product may contain sealed lead acid, nickel cadmium, nickel metal hydride, lithium, or a lithium ion battery. Consult your user manual or service manual for specific battery information. The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, go to `www.ibm.com/ibm/environment/products/batteryrecycle.shtml` or contact your local waste disposal facility.

In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used IBM sealed lead acid, nickel cadmium, nickel metal hydride, and other battery packs from IBM Equipment. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.
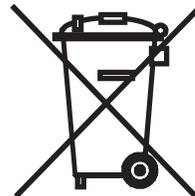
For Taiwan:

Please recycle batteries

廢電池請回收

For the European Union:

For California:

Perchlorate Material - special handling may apply. See `www.dtsc.ca.gov/hazardouswaste/perchlorate`.

The foregoing notice is provided in accordance with California Code of Regulations Title 22, Division 4.5 Chapter 33. Best Management Practices for Perchlorate Materials. This product/part may include a lithium manganese dioxide battery which contains a perchlorate substance.

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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 1000000 bytes, and GB stands for approximately 1000000000 bytes.

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

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

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Some software may differ from its retail version (if available), and may not include user manuals or all program functionality.

Electronic emission notices

Federal Communications Commission (FCC) statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates,

uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Chinese class A compliance statement

Attention: This is a class A statement. In a domestic environment, this product might cause radio interference in which case the user might be required to take adequate measures.

中华人民共和国 "A类" 警告声明

```
声 明
 此为A级产品, 在生活环境中, 该产品可能会造成无线电干扰。在这种情况下,
可能需要用户对其干扰采取切实可行的措施。
```

Industry Canada Class A emission compliance statement

This Class A digital apparatus complies with Canadian ICES-003.

Avis de conformité à la réglementation d'Industrie Canada

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Australia and New Zealand Class A statement

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

United Kingdom telecommunications safety requirement

Notice to Customers

This apparatus is approved under approval number NS/G/1234/J/100003 for indirect connection to public telecommunication systems in the United Kingdom.

European Union EMC Directive conformance statement

This product is in conformity with the protection requirements of EU Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any

failure to satisfy the protection requirements resulting from a nonrecommended modification of the product, including the fitting of non-IBM option cards.

This product has been tested and found to comply with the limits for Class A Information Technology Equipment according to CISPR 22/European Standard EN 55022. The Limits for Class A equipment were derived for commercial and industrial environments to provide reasonable protection against interference with licensed communication equipment.

Attention: This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Taiwan electrical emission statement

警告使用者:
這是甲類的資訊產品，在
居住的環境中使用時，可
能會造成射頻干擾，在這
種情況下，使用者會被要
求採取某些適當的對策。

Japanese Voluntary Control Council for Interference (VCCI) statement

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されることがあります。

Glossary

This glossary provides definitions for the terminology and abbreviations used in IBM TotalStorage DS4000 publications.

If you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* located at the following Web site:

www.ibm.com/ibm/terminology

This glossary also includes terms and definitions from:

- *Information Technology Vocabulary* by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.
- *IBM Glossary of Computing Terms*. New York: McGraw-Hill, 1994.

The following cross-reference conventions are used in this glossary:

See   Refers you to (a) a term that is the expanded form of an abbreviation or acronym, or (b) a synonym or more preferred term.

See also
         Refers you to a related term.

Abstract Windowing Toolkit (AWT).   A Java graphical user interface (GUI).

accelerated graphics port (AGP).   A bus specification that gives low-cost 3D graphics cards faster access to main memory on personal computers than the usual peripheral component interconnect (PCI) bus. AGP reduces the overall cost of creating high-end graphics subsystems by using existing system memory.

access volume.   A special logical drive that allows the host-agent to communicate with the controllers in the storage subsystem.

adapter.   A printed circuit assembly that transmits user data input/output (I/O) between the internal bus of the host system and the external fibre-channel (FC) link and vice versa. Also called an I/O adapter, host adapter, or FC adapter.

advanced technology (AT) bus architecture.   A bus standard for IBM compatibles. It extends the XT bus architecture to 16 bits and also allows for bus mastering, although only the first 16 MB of main memory are available for direct access.

agent.   A server program that receives virtual connections from the network manager (the client program) in a Simple Network Management Protocol-Transmission Control Protocol/Internet Protocol (SNMP-TCP/IP) network-managing environment.

AGP.   See *accelerated graphics port*.

AL_PA.   See *arbitrated loop physical address*.

arbitrated loop.   One of three existing fibre-channel topologies, in which 2 - 126 ports are interconnected serially in a single loop circuit. Access to the Fibre Channel-Arbitrated Loop (FC-AL) is controlled by an arbitration scheme. The FC-AL topology supports all classes of service and guarantees in-order delivery of FC frames when the originator and responder are on the same FC-AL. The default topology for the disk array is arbitrated loop. An arbitrated loop is sometimes referred to as a Stealth Mode.

arbitrated loop physical address (AL_PA).   An 8-bit value that is used to uniquely identify an individual port within a loop. A loop can have one or more AL_PAs.

array.   A collection of fibre-channel or SATA hard drives that are logically grouped together. All the drives in the array are assigned the same RAID level. An array is sometimes referred to as a ″RAID set.″ See also *redundant array of independent disks (RAID)*, *RAID level*.

asynchronous write mode.   In remote mirroring, an option that allows the primary controller to return a write I/O request completion to the host server before data has been successfully written by the secondary controller. See also *synchronous write mode*, *remote mirroring*, *Global Copy*, *Global Mirroring*.

AT.   See *advanced technology (AT) bus architecture*.

ATA.   See *AT-attached*.

AT-attached.   Peripheral devices that are compatible with the original IBM AT computer standard in which signals on a 40-pin AT-attached (ATA) ribbon cable followed the timings and constraints of the Industry Standard Architecture (ISA) system bus on the IBM PC AT computer. Equivalent to integrated drive electronics (IDE).

auto-volume transfer/auto-disk transfer (AVT/ADT). A function that provides automatic failover in case of controller failure on a storage subsystem.

AVT/ADT. See *auto-volume transfer/auto-disk transfer*.

AWT. See *Abstract Windowing Toolkit*.

basic input/output system (BIOS). The personal computer code that controls basic hardware operations, such as interactions with diskette drives, hard disk drives, and the keyboard.

BIOS. See *basic input/output system*.

BOOTP. See *bootstrap protocol*.

bootstrap protocol (BOOTP). In Transmission Control Protocol/Internet Protocol (TCP/IP) networking, an alternative protocol by which a diskless machine can obtain its Internet Protocol (IP) address and such configuration information as IP addresses of various servers from a BOOTP server.

bridge. A storage area network (SAN) device that provides physical and transport conversion, such as Fibre Channel to small computer system interface (SCSI) bridge.

bridge group. A bridge and the collection of devices connected to it.

broadcast. The simultaneous transmission of data to more than one destination.

cathode ray tube (CRT). A display device in which controlled electron beams are used to display alphanumeric or graphical data on an electroluminescent screen.

client. A computer system or process that requests a service of another computer system or process that is typically referred to as a server. Multiple clients can share access to a common server.

command. A statement used to initiate an action or start a service. A command consists of the command name abbreviation, and its parameters and flags if applicable. A command can be issued by typing it on a command line or selecting it from a menu.

community string. The name of a community contained in each Simple Network Management Protocol (SNMP) message.

concurrent download. A method of downloading and installing firmware that does not require the user to stop I/O to the controllers during the process.

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

CRU. See *customer replaceable unit*.

customer replaceable unit (CRU). An assembly or part that a customer can replace in its entirety when any of its components fail. Contrast with *field replaceable unit (FRU)*.

cyclic redundancy check (CRC). (1) A redundancy check in which the check key is generated by a cyclic algorithm. (2) An error detection technique performed at both the sending and receiving stations.

dac. See *disk array controller*.

dar. See *disk array router*.

DASD. See *direct access storage device*.

data striping. See *striping*.

default host group. A logical collection of discovered host ports, defined host computers, and defined host groups in the storage-partition topology that fulfill the following requirements:
- Are not involved in specific logical drive-to-LUN mappings
- Share access to logical drives with default logical drive-to-LUN mappings

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

DHCP. See *Dynamic Host Configuration Protocol*.

direct access storage device (DASD). A device in which access time is effectively independent of the location of the data. Information is entered and retrieved without reference to previously accessed data. (For example, a disk drive is a DASD, in contrast with a tape drive, which stores data as a linear sequence.) DASDs include both fixed and removable storage devices.

direct memory access (DMA). The transfer of data between memory and an input/output (I/O) device without processor intervention.

disk array controller (dac). A disk array controller device that represents the two controllers of an array. See also *disk array router*.

disk array router (dar). A disk array router that represents an entire array, including current and deferred paths to all logical unit numbers (LUNs) (hdisks on AIX). See also *disk array controller*.

DMA. See *direct memory access*.

domain. The most significant byte in the node port (N_port) identifier for the fibre-channel (FC) device. It is not used in the Fibre Channel-small computer system interface (FC-SCSI) hardware path ID. It is required to be the same for all SCSI targets logically connected to an FC adapter.

drive channels. The DS4200, DS4700, and DS4800 subsystems use dual-port drive channels that, from the physical point of view, are connected in the same way as two drive loops. However, from the point of view of the number of drives and enclosures, they are treated as a single drive loop instead of two different drive loops. A group of storage expansion enclosures are connected to the DS4000 storage subsystems using a drive channel from each controller. This pair of drive channels is referred to as a redundant drive channel pair.

drive loops. A drive loop consists of one channel from each controller combined to form one pair of redundant drive channels or a redundant drive loop. Each drive loop is associated with two ports. (There are two drive channels and four associated ports per controller.) For the DS4800, drive loops are more commonly referred to as drive channels. See *drive channels*.

DRAM. See *dynamic random access memory*.

Dynamic Host Configuration Protocol (DHCP). A protocol defined by the Internet Engineering Task Force that is used for dynamically assigning Internet Protocol (IP) addresses to computers in a network.

dynamic random access memory (DRAM). A storage in which the cells require repetitive application of control signals to retain stored data.

ECC. See *error correction coding*.

EEPROM. See *electrically erasable programmable read-only memory*.

EISA. See *Extended Industry Standard Architecture*.

electrically erasable programmable read-only memory (EEPROM). A type of memory chip which can retain its contents without consistent electrical power. Unlike the PROM which can be programmed only once, the EEPROM can be erased electrically. Because it can only be reprogrammed a limited number of times before it wears out, it is appropriate for storing small amounts of data that are changed infrequently.

electrostatic discharge (ESD). The flow of current that results when objects that have a static charge come into close enough proximity to discharge.

environmental service module (ESM) canister. A component in a storage expansion enclosure that monitors the environmental condition of the components in that enclosure. Not all storage subsystems have ESM canisters.

E_port. See *expansion port*.

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

ESD. See *electrostatic discharge*.

ESM canister. See *environmental service module canister*.

automatic ESM firmware synchronization. When you install a new ESM into an existing storage expansion enclosure in a DS4000 storage subsystem that supports automatic ESM firmware synchronization, the firmware in the new ESM is automatically synchronized with the firmware in the existing ESM.

EXP. See *storage expansion enclosure*.

expansion port (E_port). A port that connects the switches for two fabrics.

Extended Industry Standard Architecture (EISA). A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to 32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

fabric. A Fibre Channel entity which interconnects and facilitates logins of N_ports attached to it. The fabric is responsible for routing frames between source and destination N_ports using address information in the frame header. A fabric can be as simple as a point-to-point channel between two N-ports, or as complex as a frame-routing switch that provides multiple and redundant internal pathways within the fabric between F_ports.

fabric port (F_port). In a fabric, an access point for connecting a user's N_port. An F_port facilitates N_port logins to the fabric from nodes connected to the fabric. An F_port is addressable by the N_port connected to it. See also *fabric*.

FC. See *Fibre Channel*.

FC-AL. See *arbitrated loop*.

feature enable identifier. A unique identifier for the storage subsystem, which is used in the process of generating a premium feature key. See also *premium feature key*.

Fibre Channel (FC). A set of standards for a serial input/output (I/O) bus capable of transferring data between two ports at up to 100 Mbps, with standards proposals to go to higher speeds. FC supports point-to-point, arbitrated loop, and switched topologies.

Fibre Channel-Arbitrated Loop (FC-AL). See *arbitrated loop*.

Fibre Channel Protocol (FCP) for small computer system interface (SCSI). A high-level fibre-channel mapping layer (FC-4) that uses lower-level fibre-channel

(FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

field replaceable unit (FRU). An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit might contain other field replaceable units. Contrast with *customer replaceable unit (CRU)*.

FlashCopy. A premium feature for DS4000 that can make an instantaneous copy of the data in a volume.

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

gigabit interface converter (GBIC). A transceiver that performs serial, optical-to-electrical, and electrical-to-optical signal conversions for high-speed networking. A GBIC can be hot swapped. See also *small form-factor pluggable*.

Global Copy. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode without the write consistency group option. This is also referred to as ″Asynchronous Mirroring without Consistency Group.″ Global Copy does not ensure that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives. If it is critical that writes to the primary logical drives are carried out in the same order in the appropriate secondary logical drives, Global Mirroring should be used instead of Global Copy. See also *asynchronous write mode*, *Global Mirroring*, *remote mirroring*, *Metro Mirroring*.

Global Mirroring. Refers to a remote logical drive mirror pair that is set up using asynchronous write mode with the write consistency group option. This is also referred to as ″Asynchronous Mirroring with Consistency Group.″ Global Mirroring ensures that write requests to multiple primary logical drives are carried out in the same order on the secondary logical drives as they are on the primary logical drives, preventing data on the secondary logical drives from becoming inconsistent with the data on the primary logical drives. See also *asynchronous write mode*, *Global Copy*, *remote mirroring*, *Metro Mirroring*.

graphical user interface (GUI). A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons, and the object-action relationship.

GUI. See *graphical user interface.*

HBA. See *host bus adapter*.

hdisk. An AIX term representing a logical unit number (LUN) on an array.

heterogeneous host environment. A host system in which multiple host servers, which use different operating systems with their own unique disk storage subsystem settings, connect to the same DS4000 storage subsystem at the same time. See also *host*.

host. A system that is directly attached to the storage subsystem through a fibre-channel input/output (I/O) path. This system is used to serve data (typically in the form of files) from the storage subsystem. A system can be both a storage management station and a host simultaneously.

host bus adapter (HBA). An interface between the fibre-channel network and a workstation or server.

host computer. See *host*.

host group. An entity in the storage partition topology that defines a logical collection of host computers that require shared access to one or more logical drives.

host port. Ports that physically reside on the host adapters and are automatically discovered by the DS4000 Storage Manager software. To give a host computer access to a partition, its associated host ports must be defined.

hot swap. To replace a hardware component without turning off the system.

hub. In a network, a point at which circuits are either connected or switched. For example, in a star network, the hub is the central node; in a star/ring network, it is the location of wiring concentrators.

IBMSAN driver. The device driver that is used in a Novell NetWare environment to provide multipath input/output (I/O) support to the storage controller.

IC. See *integrated circuit*.

IDE. See *integrated drive electronics*.

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

Industry Standard Architecture (ISA). Unofficial name for the bus architecture of the IBM PC/XT personal computer. This bus design included expansion slots for plugging in various adapter boards. Early versions had an 8-bit data path, later expanded to 16 bits. The ″Extended Industry Standard Architecture″ (EISA) further expanded the data path to 32 bits. See also *Extended Industry Standard Architecture*.

initial program load (IPL). The initialization procedure that causes an operating system to commence operation. Also referred to as a system restart, system startup, and boot.

integrated circuit (IC). A microelectronic semiconductor device that consists of many interconnected transistors and other components. ICs are constructed on a small rectangle cut from a silicon crystal or other semiconductor material. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. Also known as a *chip*.

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

Internet Protocol (IP). A protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network.

Internet Protocol (IP) address. The unique 32-bit address that specifies the location of each device or workstation on the Internet. For example, 9.67.97.103 is an IP address.

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

IP. See *Internet Protocol*.

IPL. See *initial program load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

Java Runtime Environment (JRE). A subset of the Java Development Kit (JDK) for end users and developers who want to redistribute the Java Runtime Environment (JRE). The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

JRE. See *Java Runtime Environment*.

label. A discovered or user entered property value that is displayed underneath each device in the Physical and Data Path maps.

LAN. See *local area network*.

LBA. See *logical block address*.

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

logical block address (LBA). The address of a logical block. Logical block addresses are typically used in hosts' I/O commands. The SCSI disk command protocol, for example, uses logical block addresses.

logical partition (LPAR). (1) A subset of a single system that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system. (2) A fixed-size portion of a logical volume. A logical partition is the same size as the physical partitions in its volume group. Unless the logical volume of which it is a part is mirrored, each logical partition corresponds to, and its contents are stored on, a single physical partition. (3) One to three physical partitions (copies). The number of logical partitions within a logical volume is variable.

logical unit number (LUN). An identifier used on a small computer system interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

loop address. The unique ID of a node in fibre-channel loop topology sometimes referred to as a loop ID.

loop group. A collection of storage area network (SAN) devices that are interconnected serially in a single loop circuit.

loop port. A node port (N_port) or fabric port (F_port) that supports arbitrated loop functions associated with an arbitrated loop topology.

LPAR. See *logical partition*.

LUN. See *logical unit number*.

MAC. See *medium access control*.

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

man pages. In UNIX-based operating systems, online documentation for operating system commands, subroutines, system calls, file formats, special files, stand-alone utilities, and miscellaneous facilities. Invoked by the **man** command.

MCA. See *micro channel architecture*.

media scan. A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all

logical drive data to verify that it can be accessed, and optionally scans the logical drive redundancy information.

medium access control (MAC).   In local area networks (LANs), the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. The MAC sublayer includes the method of determining when a device has access to the transmission medium.

Metro Mirroring.   This term is used to refer to a remote logical drive mirror pair which is set up with synchronous write mode. See also *remote mirroring*, *Global Mirroring*.

MIB.   See *management information base*.

micro channel architecture (MCA).   Hardware that is used for PS/2 Model 50 computers and above to provide better growth potential and performance characteristics when compared with the original personal computer design.

Microsoft Cluster Server (MSCS).   MSCS, a feature of Windows NT Server (Enterprise Edition), supports the connection of two servers into a cluster for higher availability and easier manageability. MSCS can automatically detect and recover from server or application failures. It can also be used to balance server workload and provide for planned maintenance.

mini hub.   An interface card or port device that receives short-wave fiber channel GBICs or SFPs. These devices enable redundant Fibre Channel connections from the host computers, either directly or through a Fibre Channel switch or managed hub, over optical fiber cables to the DS4000 Storage Server controllers. Each DS4000 controller is responsible for two mini hubs. Each mini hub has two ports. Four host ports (two on each controller) provide a cluster solution without use of a switch. Two host-side mini hubs are shipped as standard. See also *host port, gigabit interface converter (GBIC), small form-factor pluggable (SFP)*.

mirroring.   A fault-tolerance technique in which information on a hard disk is duplicated on additional hard disks. See also *remote mirroring*.

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

MSCS.   See *Microsoft Cluster Server*.

network management station (NMS).   In the Simple Network Management Protocol (SNMP), a station that runs management application programs that monitor and control network elements.

NMI.   See *non-maskable interrupt*.

NMS.   See *network management station*.

non-maskable interrupt (NMI).   A hardware interrupt that another service request cannot overrule (mask). An NMI bypasses and takes priority over interrupt requests generated by software, the keyboard, and other such devices and is issued to the microprocessor only in disastrous circumstances, such as severe memory errors or impending power failures.

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

node port (N_port).   A fibre-channel defined hardware entity that performs data communications over the fibre-channel link. It is identifiable by a unique worldwide name. It can act as an originator or a responder.

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

N_port.   See *node port*.

NVS.   See *nonvolatile storage*.

NVSRAM.   Nonvolatile storage random access memory. See *nonvolatile storage*.

Object Data Manager (ODM).   An AIX proprietary storage mechanism for ASCII stanza files that are edited as part of configuring a drive into the kernel.

ODM.   See *Object Data Manager*.

out-of-band.   Transmission of management protocols outside of the fibre-channel network, typically over Ethernet.

partitioning.   See *storage partition*.

parity check.   (1) A test to determine whether the number of ones (or zeros) in an array of binary digits is odd or even. (2) A mathematical operation on the numerical representation of the information communicated between two pieces. For example, if parity is odd, any character represented by an even number has a bit added to it, making it odd, and an information receiver checks that each unit of information has an odd value.

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

PDF.   See *portable document format*.

performance events.   Events related to thresholds set on storage area network (SAN) performance.

peripheral component interconnect local bus (PCI local bus).   A local bus for PCs, from Intel, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry

Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture*, *Extended Industry Standard Architecture*.

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

port.   A part of the system unit or remote controller to which cables for external devices (such as display stations, terminals, printers, switches, or external storage units) are attached. The port is an access point for data entry or exit. A device can contain one or more ports.

portable document format (PDF).   A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by e-mail, the Web, intranets, or CD-ROM; and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

premium feature key.   A file that the storage subsystem controller uses to enable an authorized premium feature. The file contains the feature enable identifier of the storage subsystem for which the premium feature is authorized, and data about the premium feature. See also *feature enable identifier*.

private loop.   A freestanding arbitrated loop with no fabric attachment. See also *arbitrated loop*.

program temporary fix (PTF).   A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

PTF.   See *program temporary fix*.

RAID.   See *redundant array of independent disks (RAID)*.

RAID level.   An array's RAID level is a number that refers to the method used to achieve redundancy and fault tolerance in the array. See also *array, redundant array of independent disks (RAID)*.

RAID set.   See *array*.

RAM.   See *random-access memory*.

random-access memory (RAM).   A temporary storage location in which the central processing unit (CPU) stores and executes its processes. Contrast with *DASD*.

RDAC.   See *redundant disk array controller*.

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

recoverable virtual shared disk (RVSD).   A virtual shared disk on a server node configured to provide continuous access to data and file systems in a cluster.

redundant array of independent disks (RAID).   A collection of disk drives (*array*) that appears as a single volume to the server, which is fault tolerant through an assigned method of data striping, mirroring, or parity checking. Each array is assigned a RAID level, which is a specific number that refers to the method used to achieve redundancy and fault tolerance. See also *array, parity check, mirroring, RAID level, striping*.

redundant disk array controller (RDAC).   (1) In hardware, a redundant set of controllers (either active/passive or active/active). (2) In software, a layer that manages the input/output (I/O) through the active controller during normal operation and transparently reroutes I/Os to the other controller in the redundant set if a controller or I/O path fails.

remote mirroring.   Online, real-time replication of data between storage subsystems that are maintained on separate media. The Enhanced Remote Mirror Option is a DS4000 premium feature that provides support for remote mirroring. See also *Global Mirroring*, *Metro Mirroring*.

ROM.   See *read-only memory*.

router.   A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses.

RVSD.   See *recoverable virtual shared disk*.

SAI.   See *Storage Array Identifier*.

SA Identifier.   See *Storage Array Identifier*.

SAN.   See *storage area network*.

SATA.   See *serial ATA*.

scope.   Defines a group of controllers by their Internet Protocol (IP) addresses. A scope must be created and defined so that dynamic IP addresses can be assigned to controllers on the network.

SCSI.   See *small computer system interface*.

segmented loop port (SL_port).   A port that allows division of a fibre-channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

sense data.   (1) Data sent with a negative response, indicating the reason for the response. (2) Data describing an I/O error. Sense data is presented to a host system in response to a sense request command.

serial ATA. The standard for a high-speed alternative to small computer system interface (SCSI) hard drives. The SATA-1 standard is equivalent in performance to a 10 000 RPM SCSI drive.

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

server. A functional hardware and software unit that delivers shared resources to workstation client units on a computer network.

server/device events. Events that occur on the server or a designated device that meet criteria that the user sets.

SFP. See *small form-factor pluggable*.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SL_port. See *segmented loop port*.

SMagent. The DS4000 Storage Manager optional Java-based host-agent software, which can be used on Microsoft Windows, Novell NetWare, HP-UX, and Solaris host systems to manage storage subsystems through the host fibre-channel connection.

SMclient. The DS4000 Storage Manager client software, which is a Java-based graphical user interface (GUI) that is used to configure, manage, and troubleshoot storage servers and storage expansion enclosures in a DS4000 storage subsystem. SMclient can be used on a host system or on a storage management station.

SMruntime. A Java compiler for the SMclient.

SMutil. The DS4000 Storage Manager utility software that is used on Microsoft Windows, HP-UX, and Solaris host systems to register and map new logical drives to the operating system. In Microsoft Windows, it also contains a utility to flush the cached data of the operating system for a particular drive before creating a FlashCopy.

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

small form-factor pluggable (SFP). An optical transceiver that is used to convert signals between

optical fiber cables and switches. An SFP is smaller than a gigabit interface converter (GBIC). See also *gigabit interface converter*.

SNMP. See *Simple Network Management Protocol* and *SNMPv1*.

SNMP trap event. (1) (2) An event notification sent by the SNMP agent that identifies conditions, such as thresholds, that exceed a predetermined value. See also *Simple Network Management Protocol*.

SNMPv1. The original standard for SNMP is now referred to as SNMPv1, as opposed to SNMPv2, a revision of SNMP. See also *Simple Network Management Protocol*.

SRAM. See *static random access memory*.

SSA. See *serial storage architecture*.

static random access memory (SRAM). Random access memory based on the logic circuit know as flip-flop. It is called static because it retains a value as long as power is supplied, unlike dynamic random access memory (DRAM), which must be regularly refreshed. It is however, still volatile, meaning that it can lose its contents when the power is turned off.

storage area network (SAN). A dedicated storage network tailored to a specific environment, combining servers, storage products, networking products, software, and services. See also *fabric*.

Storage Array Identifier (SAI or SA Identifier). The Storage Array Identifier is the identification value used by the DS4000 Storage Manager host software (SMClient) to uniquely identify each managed storage server. The DS4000 Storage Manager SMClient program maintains Storage Array Identifier records of previously-discovered storage servers in the host resident file, which allows it to retain discovery information in a persistent fashion.

storage expansion enclosure (EXP). A feature that can be connected to a system unit to provide additional storage and processing capacity.

storage management station. A system that is used to manage the storage subsystem. A storage management station does not need to be attached to the storage subsystem through the fibre-channel input/output (I/O) path.

storage partition. Storage subsystem logical drives that are visible to a host computer or are shared among host computers that are part of a host group.

storage partition topology. In the DS4000 Storage Manager client, the Topology view of the Mappings window displays the default host group, the defined host group, the host computer, and host-port nodes. The host port, host computer, and host group topological

elements must be defined to grant access to host computers and host groups using logical drive-to-LUN mappings.

striping. Splitting data to be written into equal blocks and writing blocks simultaneously to separate disk drives. Striping maximizes performance to the disks. Reading the data back is also scheduled in parallel, with a block being read concurrently from each disk then reassembled at the host.

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

sweep method. A method of sending Simple Network Management Protocol (SNMP) requests for information to all the devices on a subnet by sending the request to every device in the network.

switch. A fibre-channel device that provides full bandwidth per port and high-speed routing of data by using link-level addressing.

switch group. A switch and the collection of devices connected to it that are not in other groups.

switch zoning. See *zoning*.

synchronous write mode. In remote mirroring, an option that requires the primary controller to wait for the acknowledgment of a write operation from the secondary controller before returning a write I/O request completion to the host. See also *asynchronous write mode*, *remote mirroring*, *Metro Mirroring*.

system name. Device name assigned by the vendor's third-party software.

TCP. See *Transmission Control Protocol*.

TCP/IP. See *Transmission Control Protocol/Internet Protocol*.

terminate and stay resident program (TSR program). A program that installs part of itself as an extension of DOS when it is executed.

topology. The physical or logical arrangement of devices on a network. The three fibre-channel topologies are fabric, arbitrated loop, and point-to-point. The default topology for the disk array is arbitrated loop.

TL_port. See *translated loop port*.

transceiver. A device that is used to transmit and receive data. Transceiver is an abbreviation of transmitter-receiver.

translated loop port (TL_port). A port that connects to a private loop and allows connectivity between the private loop devices and off loop devices (devices not connected to that particular TL_port).

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

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

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

trap recipient. Receiver of a forwarded Simple Network Management Protocol (SNMP) trap. Specifically, a trap receiver is defined by an Internet Protocol (IP) address and port to which traps are sent. Presumably, the actual recipient is a software application running at the IP address and listening to the port.

TSR program. See *terminate and stay resident program*.

uninterruptible power supply. A source of power from a battery that is installed between a computer system and its power source. The uninterruptible power supply keeps the system running if a commercial power failure occurs, until an orderly shutdown of the system can be performed.

user action events. Actions that the user takes, such as changes in the storage area network (SAN), changed settings, and so on.

worldwide port name (WWPN). A unique identifier for a switch on local and global networks.

worldwide name (WWN). A globally unique 64-bit identifier assigned to each Fibre Channel port.

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

write-once read many (WORM). Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered.

WWN. See *worldwide name*.

zoning. (1) In Fibre Channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones. (2) A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

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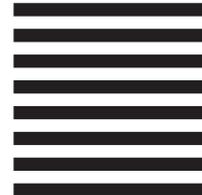
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