IBM System Storage DS4000

IBM

Problem Determination Guide

IBM System Storage DS4000

Problem Determination Guide

IBM

First Edition (August 2006)

Contents

Figures

Tables

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 and danger notices

The caution and danger statements that this document contains can be referenced in the multilingual *IBM Safety Information* document that is provided with your IBM System Storage Storage Subsystem. Each caution and danger statement is numbered for easy reference to the corresponding statements in the translated document.

- **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.
- **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.
- **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:
Handling the cord on this product or cords associated with accessories sold with product will expose you to lead, a chemical known to the State of California to cause cancer, birth defects, or other reproductive harm. *Wash hands after handling*.

The following Caution notices are printed in English throughout this document. For a translation of these notices, see *IBM Safety Information*.

Statement 1:

DANGER

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

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

Statement 2:

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

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

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

DANGER

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

Class 1 Laser statement

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

IEC 825-11993 CENELEC EN 60 825

Statement 3:

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

CAUTION:
Use safe practices when lifting.

Statement 4:

CAUTION:
The power control button on the device and the power switch on the power supply do not turn off the electrical current supplied to the device. The device also might have more than one power cord. To remove all electrical current from the device, ensure that all power cords are disconnected from the power source.
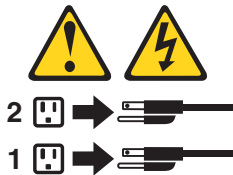
Statement 5:

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

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

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 problem determination for the IBM System Storage DS4000 product line. Use this document for the following tasks:

- Diagnose and troubleshoot system faults
- Configure and service hardware
- Determine system specifications
- Interpret system data

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
	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 System Storage DS4000 Problem Determination Guide* 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.

Attention: Beginning with the first edition of this document, the *IBM System Storage DS4000 Hardware Maintenance Manual* and the *IBM System Storage DS4000 Problem Determination Guide* are published as separate documents. In addition, the hardware maintenance information for new IBM DS4000 products released with or after this document is included in the Installation, User's, and Maintenance Guide for those products.

This document contains the following chapters:

Chapter 1, "About problem determination," on page 1 provides a starting point for the problem determination information found in this document.

Chapter 2, "Problem determination starting points," on page 3 provides an introduction to problem determination tools and techniques that are contained in this document.

Chapter 3, "Problem determination maps," on page 7 provides a series of flowcharts that help you to isolate and resolve hardware issues.

Chapter 4, "Introduction to the QLogic SANsurfer application," on page 35 introduces the IBM Fibre Array Storage Technology Management Suite Java (QLogic SANsurfer).

Chapter 5, "PD hints: Common path/single path configurations," on page 63 provides problem determination hints for common path or single path configurations.

Chapter 6, "PD hints: RAID controller errors in the Windows 2000, Windows 2003, or Windows NT event log," on page 65 provides problem determination hints for event log errors stemming from the RAID controller.

Chapter 7, "PD hints: Configuration types," on page 79 provides the various configuration types that can be encountered.

Chapter 8, "PD hints: Passive RAID controller," on page 87 provides instructions on how to isolate problems that occur in a passive RAID controller.

Chapter 9, "PD hints: Performing sendEcho tests," on page 91 contains information on how to perform loopback tests.

Chapter 10, "PD hints: Tool hints," on page 95 contains information on generalized tool usage.

Chapter 11, "PD hints: Drive side hints and RLS diagnostics," on page 111 contains problem determination information for the drive or device side as well as read link status diagnostics.

Chapter 12, "PD hints: Hubs and switches," on page 143 provides information on hub and switch problem determination.

Chapter 13, "PD hints: Wrap plug tests," on page 149 provides information about tests that you can perform with wrap plugs.

Chapter 14, "Heterogeneous configurations," on page 153 contains information about heterogeneous configurations.

Chapter 15, "Using the IBM Fast!UTIL utility," on page 157 provides detailed configuration information for advanced users who want to customize the configuration of the IBM fibre-channel PCI adapter (FRU 01K7354), the IBM DS4000 host adapter (FRU 09N7292), and the IBM DS4000 FC2-133 Adapter (FRU 24P0962).

Chapter 16, "Frequently asked questions about the DS4000 Storage Manager," on page 163 contains a list of the questions about the DS4000 Storage Manager that are most frequently asked.

Chapter 17, "pSeries supplemental problem determination information," on page 173 discusses fibre channel-specific problems and information that might be necessary to resolve them.

Appendix A, "Additional DS4000 documentation," on page 181 lists documentation for all of the DS4000 products.

Appendix B, "Accessibility," on page 191 provides information about DS4000 Storage Manager alternate keyboard navigation.

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 following Web site:

  www.ibm.com/servers/storage/support/disk/
- Use an IBM discussion forum on the IBM Web site to ask questions.

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

Using the documentation

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

Web sites

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

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

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

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

  - Diagnosing problems using the IBM Online Assistant
  - Downloading the latest device drivers and updates for your products
  - Viewing frequently asked questions (FAQ)
  - Viewing hints and tips to help you solve problems
  - Participating in IBM discussion forums

- Setting up e-mail notification of technical updates about your products
- You can order publications through the IBM Publications Ordering System at the following web site:

  www.elink.ibmlink.ibm.com/public/applications/publications/cgibin/pbi.cgi/
- For the latest information about IBM xSeries products, services, and support, go to the following Web site:

  www.ibm.com/eserver/xseries/
- For the latest information about IBM pSeries products, services, and support, go to the following Web site:
  www.ibm.com/eserver/pseries/
- For the latest information about the IBM IntelliStation information, go to the following Web site:

  www-132.ibm.com/content/home/store_IBMPublicUSA/en_US/
  IntelliStation_workstations.html
- For the latest information about operating system and HBA support, clustering support, SAN fabric support, and Storage Manager feature support, see the TotalStorage DS4000 Interoperability Matrix at the following Web site:

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

Software service and support

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

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

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

Hardware service and support

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

www.ibm.com/planetwide/

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

Fire suppression systems

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

How to send your comments

Your feedback is important in helping us to provide the most accurate and high-quality information. If you have comments or suggestions for improving this publication, you can send us comments electronically by using these addresses:

- Internet: starpubs@us.ibm.com
- IBMLink from U.S.A.: STARPUBS at SJEVM5
- IBMLink from Canada: STARPUBS at TORIBM
- IBM Mail Exchange: USIB3WD at IBMMAIL

You can also mail your comments by using the Reader Comment Form in the back of this manual or direct your mail to:

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

Chapter 1. About problem determination

The procedures in this document 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 document and the appropriate IBM server hardware maintenance manual.

This guide provides problem determination and resolution information for the issues most commonly encountered with IBM fibre channel devices and configurations. This manual contains useful component information, such as specifications, replacement and installation procedures, and basic symptom lists.

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.

Where to start

To use this document correctly, begin by identifying a particular problem area from the lists provided in "Starting points for problem determination" on page 5. The starting points direct you to the related PD maps, which provide graphical directions to help you identify and resolve problems. The problem determination maps in Chapter 2 might also refer you to other PD maps or to other chapters or appendices in this document. When you complete tasks that are required by the PD maps, it might be helpful to see the component information that is provided in the *IBM System Storage DS4000 Hardware Maintenance Manual*.

Related documents

For information about managed hubs and switches that might be in your network, 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 also be found at the following Web site:

www.ibm.com/storage/ibmsan/products.htm

For information about major event log data, see the *IBM System Storage DS4000 Event Log Specification*, GC26-7852-00.

Product updates

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

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

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

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

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

Perform the following steps to receive product updates:

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

   Note: During this process a check list displays. Do not check any of the items in the check list until you complete the selections in the pull-down menus.
5. When you finish selecting the menu topics, place a check in the box for the machine type of your DS4000 series product, as well as any other attached DS4000 series product(s) for which you would like to receive information, then click **Add products**. The My Support page opens again.
6. On the My Support page, click the **Edit profile** tab, then click **Subscribe to email**. A pull-down menu displays.
7. In the pull-down menu, select **Storage**. A check list displays.
8. Place a check in each of the following boxes:
   a. **Please send these documents by weekly email**
   b. **Downloads and drivers**
   c. **Flashes**
   d. Any other topics that you may be interested in

   Then, click **Update**.
9. Click **Sign out** to log out of My Support.

Chapter 2. Problem determination starting points

This chapter contains information to help you perform the tasks required when you follow PD procedures. Review this information before you attempt to isolate and resolve fibre channel problems. This chapter also provides summaries of the tools that might be useful in following the PD procedures provided in Chapter 3, "Problem determination maps," on page 7.

Note: The PD maps in this document are not to be used in order of appearance. *Always begin working with the PD maps from the starting points provided in this chapter* (see "Starting points for problem determination" on page 5). Do not use a PD map unless you are directed there from a particular symptom or problem area in one of the lists of starting points, or from another PD map.

Problem determination tools

The PD maps in Chapter 3, "Problem determination maps," on page 7 rely on numerous tools and diagnostic programs to isolate and fix the problems. You use the following tools when performing the tasks directed by the PD maps.

Loopback Data Test

> Host bus adapters type 2200 and above support loopback testing, which can be run from the QLogic SANsurfer diagnostics. (For more information on the SANsurfer application, see Chapter 4, "Introduction to the QLogic SANsurfer application," on page 35.)

Wrap plugs

> Wrap plugs are required to run the Loopback test at the host bus adapter or at the end of cables. There are two types of wrap plugs: SC and LC. SC wrap plugs are used for the larger connector cables. A coupler is provided for each respective form-factor to connect the wrap plugs to cables. The part numbers for the wrap plugs are:
> * SC: 75G2725 (wrap and coupler kit)
> * LC
>   - 24P0950 (wrap connector and coupler kit)
>   - 11P3847 (wrap connector packaged with DS4400 Storage Server)
>   - 05N6766 (coupler packaged with DS4400 Storage Server)
>
> **Note:** Many illustrations in this document depict the LC wrap plug. Substitute the LC wrap plug for the FAStT 200 (3254) and the FAStT 500 (3557).

QLogic SANsurfer Management Application

> The SANsurfer application is network-capable and can connect to and configure remote systems. With the SANsurfer application, you can perform loopback and read/write buffer tests to help isolate problems.
>
> See Chapter 4, "Introduction to the QLogic SANsurfer application," on page 35 for further details on the SANsurfer application.

IBM DS4000 Storage Manager

The DS4000 Storage Manager provides the capability to monitor events and manage storage in a heterogeneous environment. These diagnostic and storage management capabilities fulfill the requirements of a true SAN, but also increase complexity and the potential for problems. Chapter 14, "Heterogeneous configurations," on page 153 shows examples of heterogeneous configurations and the associated profiles from the DS4000 Storage Manager. These examples can help you identify improperly configured storage by comparing the customer's profile with those supplied (assuming similar configurations).

Event Monitoring has also been implemented in these versions of DS4000 Storage Manager. The Event Monitor handles notification functions (e-mail and SNMP traps) and monitors storage subsystems whenever the Enterprise Management window is not open. The Event Monitor is a separate program bundled with the DS4000 Storage Manager client software; it is a background task that runs independently of the Enterprise Management window.

The DS4000 Storage Manager implements controller runtime diagnostics.

The DS4000 Storage Manager also implements Read Link Status (RLS), which enables diagnostics to aid in troubleshooting drive-side problems. DS4000 Storage Manager establishes a time stamped "baseline" value for drive error counts and keeps track of drive error events. The end user receives deltas over time, as well as trends.

Considerations before starting PD maps

Because a wide variety of hardware and software combinations are possible, use the following information to assist you in problem determination. Before you use the PD maps, perform the following actions:

- Verify any recent hardware changes.
- Verify any recent software changes.
- Verify that the BIOS is at the latest level. See "File updates" on page 5 and specific server hardware maintenance manuals for details about this procedure.
- Verify that device drivers are at the latest levels. See the device driver installation information in the installation guide for your device.
- Verify that the configuration matches the hardware.
- Verify that the SANsurfer application is the most current version. For more information, see Chapter 4, "Introduction to the QLogic SANsurfer application," on page 35.

As you go through the problem determination procedures, consider the following questions:

- Do diagnostics fail?
- Is the failure repeatable?
- Has this configuration ever worked?
- If this configuration has been working, what changes were made prior to it failing?
- Is this the original reported failure? If not, try to isolate failures using the lists of indications (see "General symptoms" on page 5, "Specific problem areas" on page 5, and "PD maps and diagrams" on page 6).

Important
To eliminate confusion, systems are considered identical only if the following are *exactly* identical for *each* system: • Machine type and model   • BIOS level   • Adapters and attachments (in same locations)   • Address jumpers, terminators, and cabling   • Software versions and levels   Comparing the configuration and software setup between working and non-working systems will often resolve problems.

File updates

You can download diagnostic, BIOS flash, and device driver files from the following Web site:

www.ibm.com/servers/eserver/serverproven/compat/us/

Starting points for problem determination

The lists of indications contained in this section provide you with entry points to the problem determination maps found in this chapter. (Links to useful appendix materials are also provided.) Use the following lists of problem areas as a guide for determining which PD maps will be most helpful.

General symptoms

- **RAID controller passive**

  If you determine that a RAID controller is passive, go to "RAID Controller Passive PD map" on page 9.

- **Failed or moved cluster resource**

  If you determine that a cluster resource failed or has been moved, go to "Cluster Resource PD map" on page 10.

- **Start long delay**

  If the host experiences a long delay at startup (more than 10 minutes), go to "Start Delay PD map" on page 11.

- **Systems Management or DS4000 Storage Manager performance problems**

  If you discover a problem through the Systems Management or Storage Management tools, go to "Systems Management PD map" on page 12.

Specific problem areas

- **DS4000 Storage Manager**

  See "Systems Management PD map" on page 12.

  See also Chapter 16, "Frequently asked questions about the DS4000 Storage Manager," on page 163.

- **Port configuration (Linux)**

  See "Linux Port Configuration PD map 1" on page 24.

- **Microsoft Windows 2000, Windows 2003, or Windows NT Event Log**

  See Chapter 6, "PD hints: RAID controller errors in the Windows 2000, Windows 2003, or Windows NT event log," on page 65.

- **Fibre channel problems on the pSeries AIX system**

  See

- **Indicator lights on devices**

- **Major Event Log (MEL)**

  See the *IBM System Storage DS4000 Event Log Specification* (GC26-7852-00).

- **Control panel or SCSI adapters**

  See the driver installation information in the appropriate hardware chapter of the installation guide for your device.

- **Managed hub or switch logs**

- **Cluster Administrator**

- **IBM pSeries servers with 6228 and 6239 HBAs**

PD maps and diagrams

- **Configuration Type Determination**

- **Hub or Switch PD**

- **Fibre Path PD**

- **Device PD**

Chapter 3. Problem determination maps

This chapter contains a series of PD maps that guide you through problem isolation and resolution. Before you use any of the following PD maps, you should have reviewed the information in Chapter 2, "Problem determination starting points," on page 3.

The PD maps in this chapter are not to be used in order of appearance. *Always begin working with the PD maps from the starting points provided in the previous chapter* (see "Starting points for problem determination" on page 5). Do not use a PD map unless you are directed there from a particular symptom or problem area in one of the lists of starting points, or from another PD map.

Configuration Type PD map

To perform certain problem determination procedures, you need to determine whether your fibre configuration is Type 1 or Type 2. Use this map to make that determination. You will need this information for later PD procedures.

Configuration Type PD map

```
                           ┌────────┐
                           │ Entry  │
                           │ Point  │
                           └───┬────┘
                               │
                               ▼
                      ┌──────────────────┐
                      │ Logically break  │
                      │ large configura- │
                      │ tions into       │
                      │ sections         │
                      │ representing     │
                      │ Type 1 and 2     │
                      └────────┬─────────┘
                               │
                               ▼
                            ◇ Is MSCS ◇
         ┌─────────┐  Yes   ◇ being    ◇
         │ Type 2  │◄───────◇ used?    ◇
         └─────────┘         ◇        ◇
              ▲                 │ No
              │                 ▼
              │  Yes       ◇ Are external ◇
              │◄───────────◇ concentrators◇
              │            ◇ used?        ◇
          Yes │               │ No
              │               ▼
      ◇ Fully         No  ◇ 3526 or ◇
      ◇ redundant  ◄──────◇ 3542    ◇
      ◇ configura- ◇      ◇ unit?   ◇
      ◇ tion?      ◇         │ Yes
         │ No        ┌───────────┐
         └──────────►│  Type 1   │◄─── Yes
                     └─────┬─────┘
              ┌────────────┘
              ▼
      ┌──────────────┐
      │ Return to    │
      │ PD Starting  │
      │ Points       │
      └──────────────┘
```

Additional information: See Chapter 7, "PD hints: Configuration types," on page 79.

Note: Repeat this process for each section.

To return to the PD starting points, go to page 3.

RAID Controller Passive PD map

From: "General symptoms" on page 5; "Cluster Resource PD map" on page 10.

Controller Passive PD map

Entry Point

Controller Passive? — No → Return to PD entry

Yes

NT event 18? — No → **Any yellow lights on concentrator/minihubs?**

Yes

Save date/time and SRB info

No → **More nodes sharing RAID Controller?** — Yes

No

Find earliest event 18

Is SRB x0D, 0E, 0F?

Yes

To Fibre Path PD map 2

Additional information: See Chapter 8, "PD hints: Passive RAID controller," on page 87.

Additional information: Use MEL information to find the approximate fail time in the Windows® event log. *See the System Storage DS4000 Event Log Specification*.

Additional information: See Chapter 6, "PD hints: RAID controller errors in the Windows 2000, Windows 2003, or Windows NT event log," on page 65.

Additional information: See Chapter 6, "PD hints: RAID controller errors in the Windows 2000, Windows 2003, or Windows NT event log," on page 65.

To see Fibre Path PD map 2, go to "Fibre Path PD map 2" on page 17.

Cluster Resource PD map

From: "General symptoms" on page 5.

Cluster Resource PD map

Entry Point

Was Cluster Resource Moved?

No

Cluster Resource Failed?

Yes

Was resource moved by administrator?

Yes

Problem solved

No

Check RAID Controllers

Controller Passive?

No

Check SM, Indicator Lights, cluster log

Yes

To Controller Passive PD map

Yes

Check SM, Indicator Lights, cluster log

Debug one failure at a time

Additional information: This situation can occur only from multiple concurrent fails (if not moved by the administrator).

Additional information: This situation can occur only from multiple concurrent fails.

Start Delay PD map

From: "General symptoms" on page 5.

Boot-up Delay PD map

Operating System	Symptoms
Windows NT	Blue screen – no dot crawl activity
Windows 2000	Windows 2000 Starting Up progress bar
Linux	Startup sequence frozen: waiting for LIP to complete, kernel panic, no log-in dialog

Entry Point

Is the start-up screen hanging for long time? — No → Return to PD Starting Points

Yes

Unplug HBA(s) Fibre connection at device (concentrator, controller, etc.)

Did system come up quickly? — No → Not a fibre problem- Look at applications → Done

Yes

Have you been here already? — Yes → HBA Type 2100? — No → Insert wrap plug at the cable end. Start FAStT MSJ and run loopback data test

No

Replug fibre cables and restart

Yes (HBA Type 2100?)

Restart system and use FAStT MSJ to enable HBA(s)

To Fibre Path PD map 2

Loopback test Passes? — No → Insert wrap plug at HBA run loopback data test

Yes

Replug cables

Loopback test passes

Yes → Replace Cable

No → Replace HBA

See "Start delay" on page 97 and Chapter 6, "PD hints: RAID controller errors in the Windows 2000, Windows 2003, or Windows NT event log," on page 65.

See "Linux port configuration" on page 106.

Additional information: See Chapter 4, "Introduction to the QLogic SANsurfer application," on page 35.

To return to the options for PD entry, go to page 3.

To see Fibre Path PD map 2, go to "Fibre Path PD map 2" on page 17.

Systems Management PD map

From: "General symptoms" on page 5.

Systems Management

Entry
Point

Using SYS MGMT
alert info, look at
SM/Recovery
Guru

Is the
problem
fixed?

Done ◄— Yes

No

Call IBM Support

Additional information: See Chapter 16, "Frequently asked questions about the DS4000 Storage Manager," on page 163.
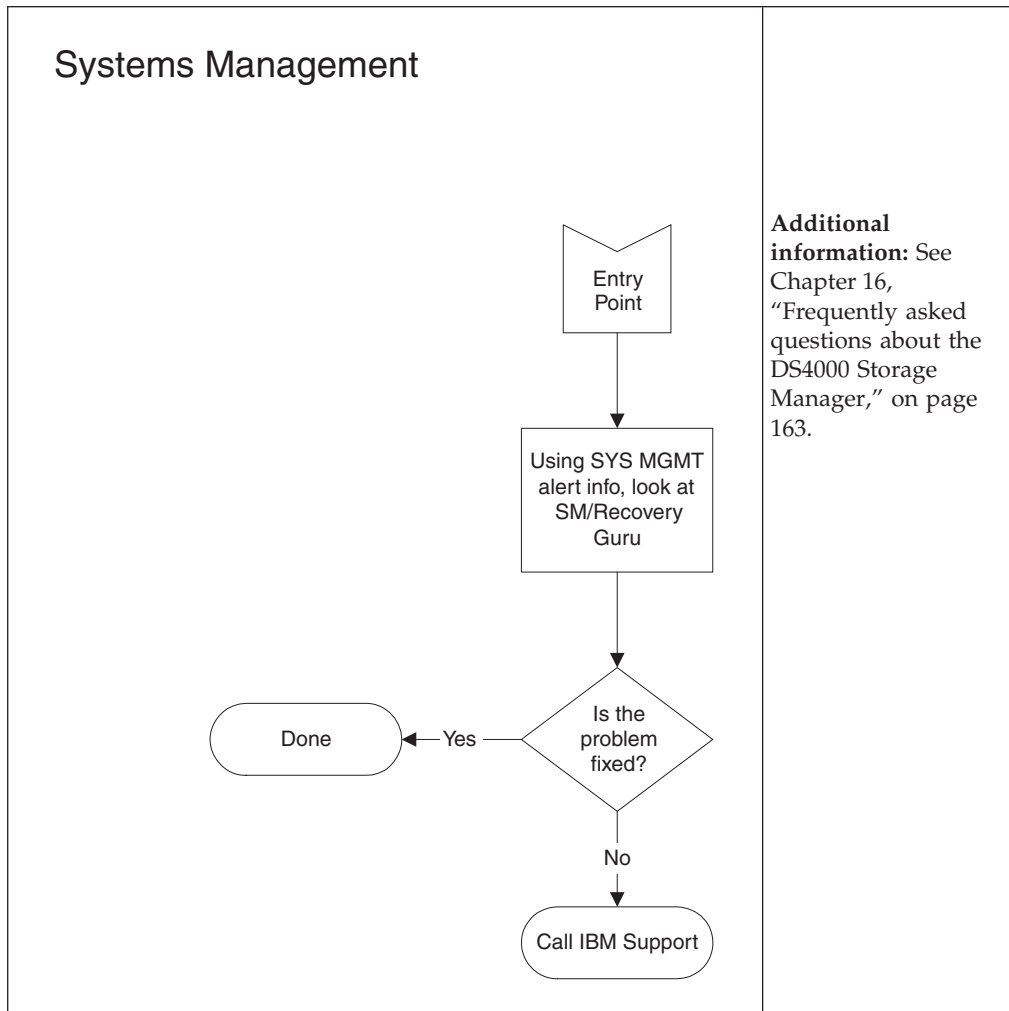
Hub/Switch PD map 1

From: "PD maps and diagrams" on page 6; "Single Path Fail PD map 2" on page 19.
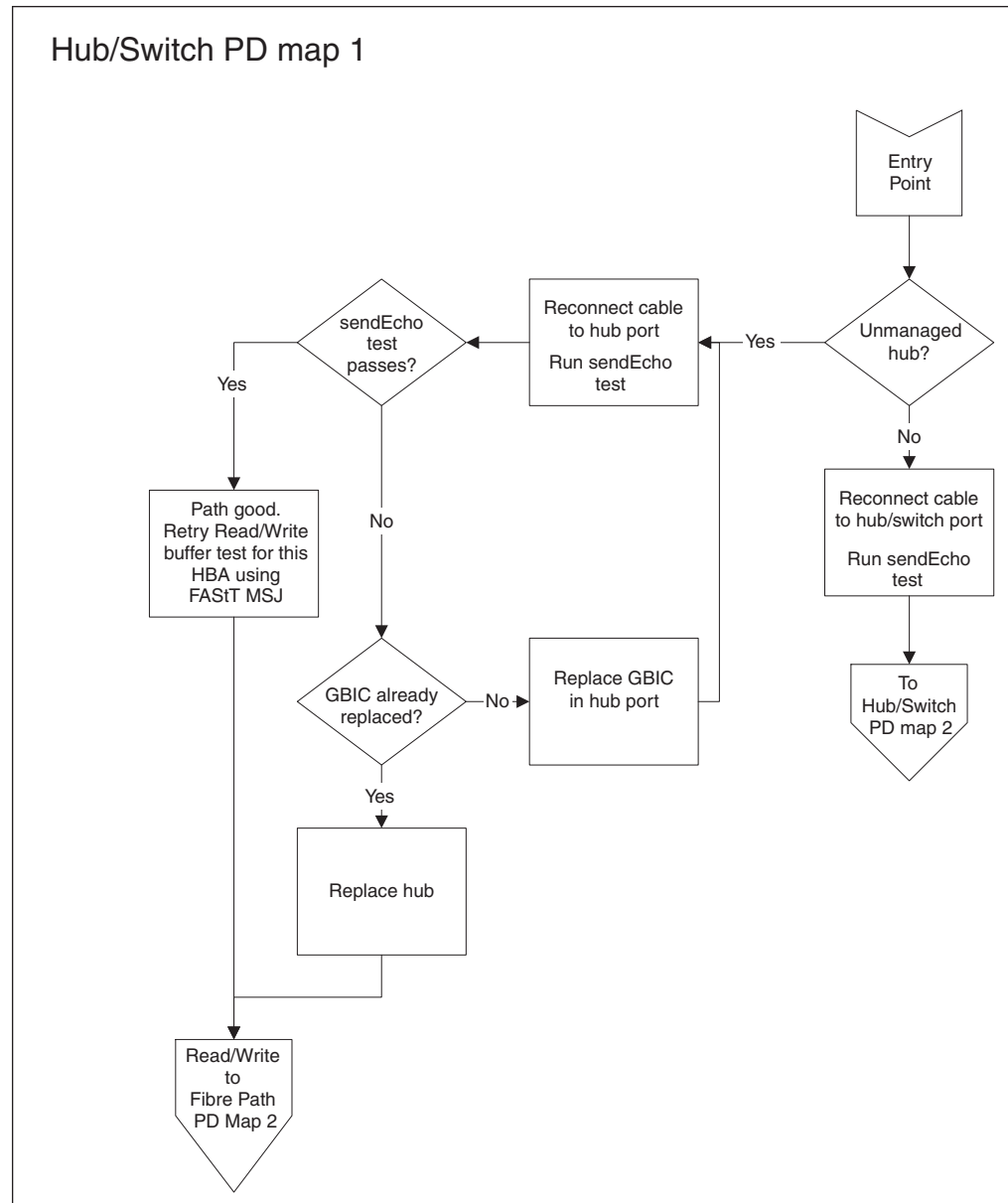
For information about sendEcho tests, see Chapter 9, "PD hints: Performing sendEcho tests," on page 91.

For information about Read/Write Buffer tests, see Chapter 4, "Introduction to the QLogic SANsurfer application," on page 35.

To see Hub/Switch PD map 2, go to "Hub/Switch PD map 2" on page 14.

To see Fibre Path PD map 2, go to "Fibre Path PD map 2" on page 17.

Hub/Switch PD map 2

From: "Hub/Switch PD map 1" on page 13.
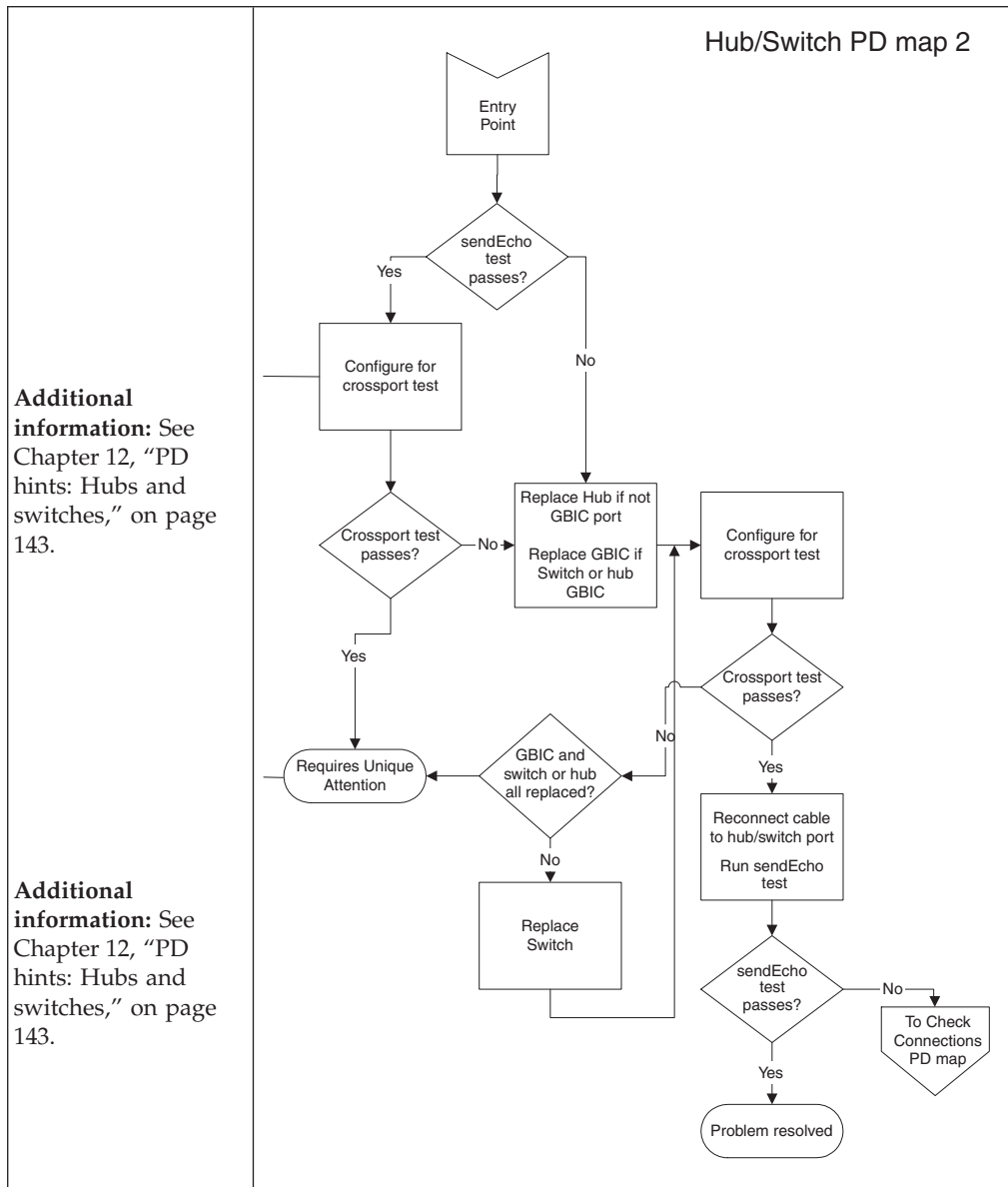
For information about sendEcho tests, see Chapter 9, "PD hints: Performing sendEcho tests," on page 91.

To see the Check Connections PD map, see "Check Connections PD map" on page 15.

Check Connections PD map

From: "Hub/Switch PD map 2" on page 14.

```
Check Connections PD map


                    ┌─────────┐
                    │  Entry  │
                    │  Point  │
                    └────┬────┘
                         │
                         ▼
                    ┌─────────────┐
                    │   Check     │
                    │ Connections │
                    │and replug last│
                    │  changed    │
                    └──────┬──────┘
                           │
                           ▼
                       ╱───────╲
                      ╱ Previous ╲         No        ┌──────────────┐
                      ╲ fail now ╱──────────────────▶│ To Fibre Path│
                       ╲  good? ╱                     │  PD map 2    │
                        ╲──┬──╱                       └──────────────┘
                         Yes
                          │
                          ▼
                    ( Problem resolved )
```
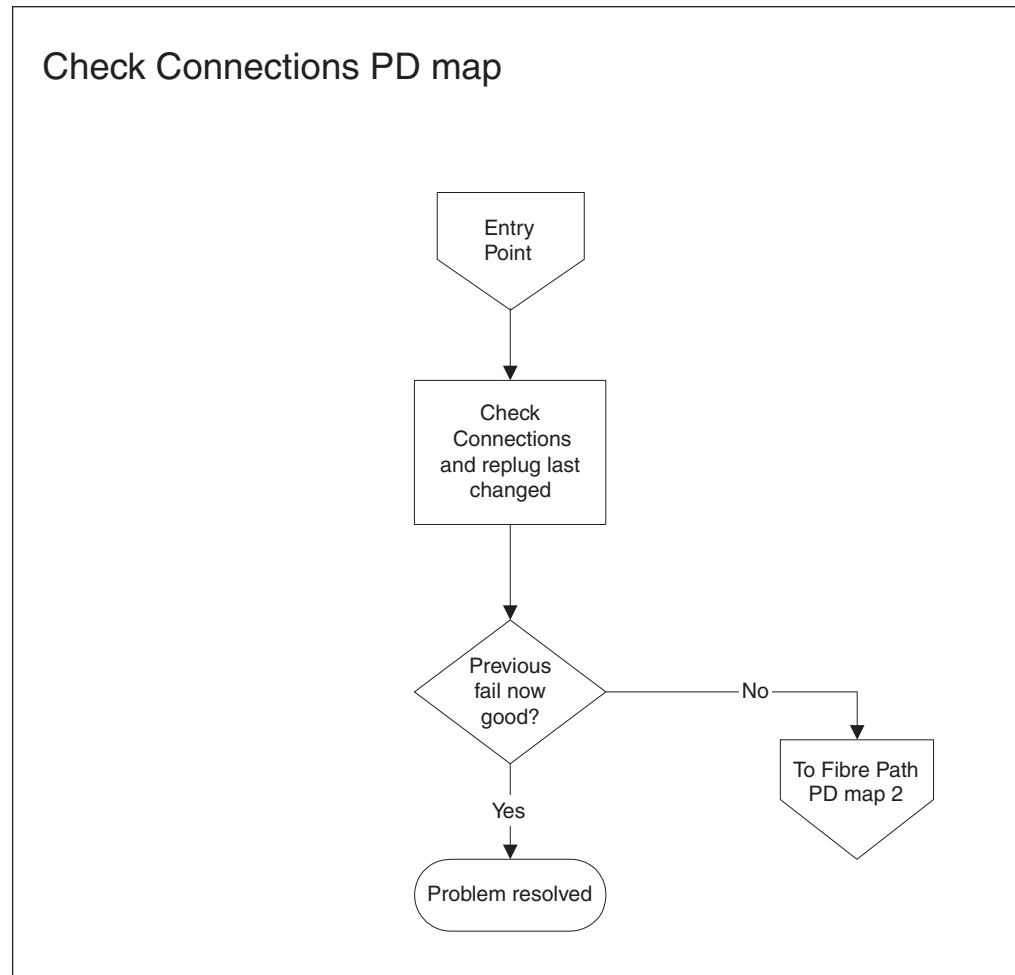
To see Fibre Path PD map 2, go to "Fibre Path PD map 2" on page 17.

Fibre Path PD map 1

From: "Common Path PD map 2" on page 21.
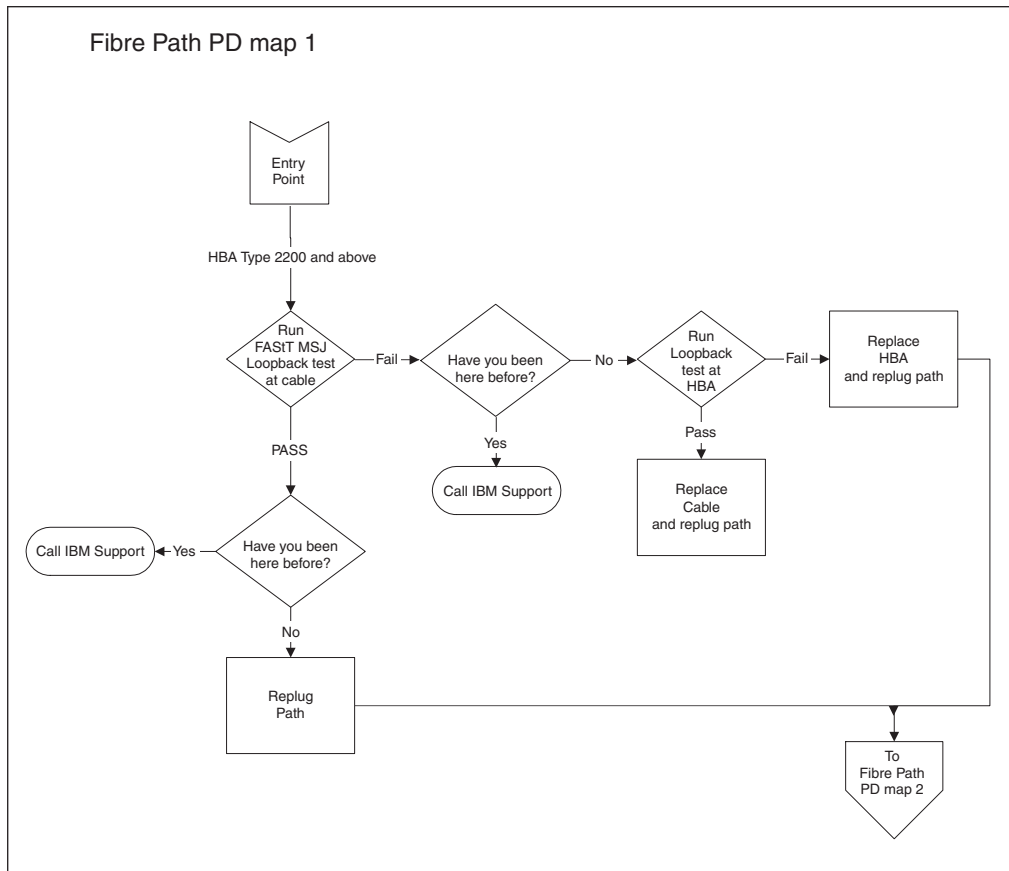
For information about how to run loopback tests, see Chapter 4, "Introduction to the QLogic SANsurfer application," on page 35.

To see Fibre Path PD map 2, go to "Fibre Path PD map 2" on page 17.

Fibre Path PD map 2

From: "Fibre Path PD map 1" on page 16; "Check Connections PD map" on page 15; "RAID Controller Passive PD map" on page 9; "Start Delay PD map" on page 11; "Hub/Switch PD map 1" on page 13.
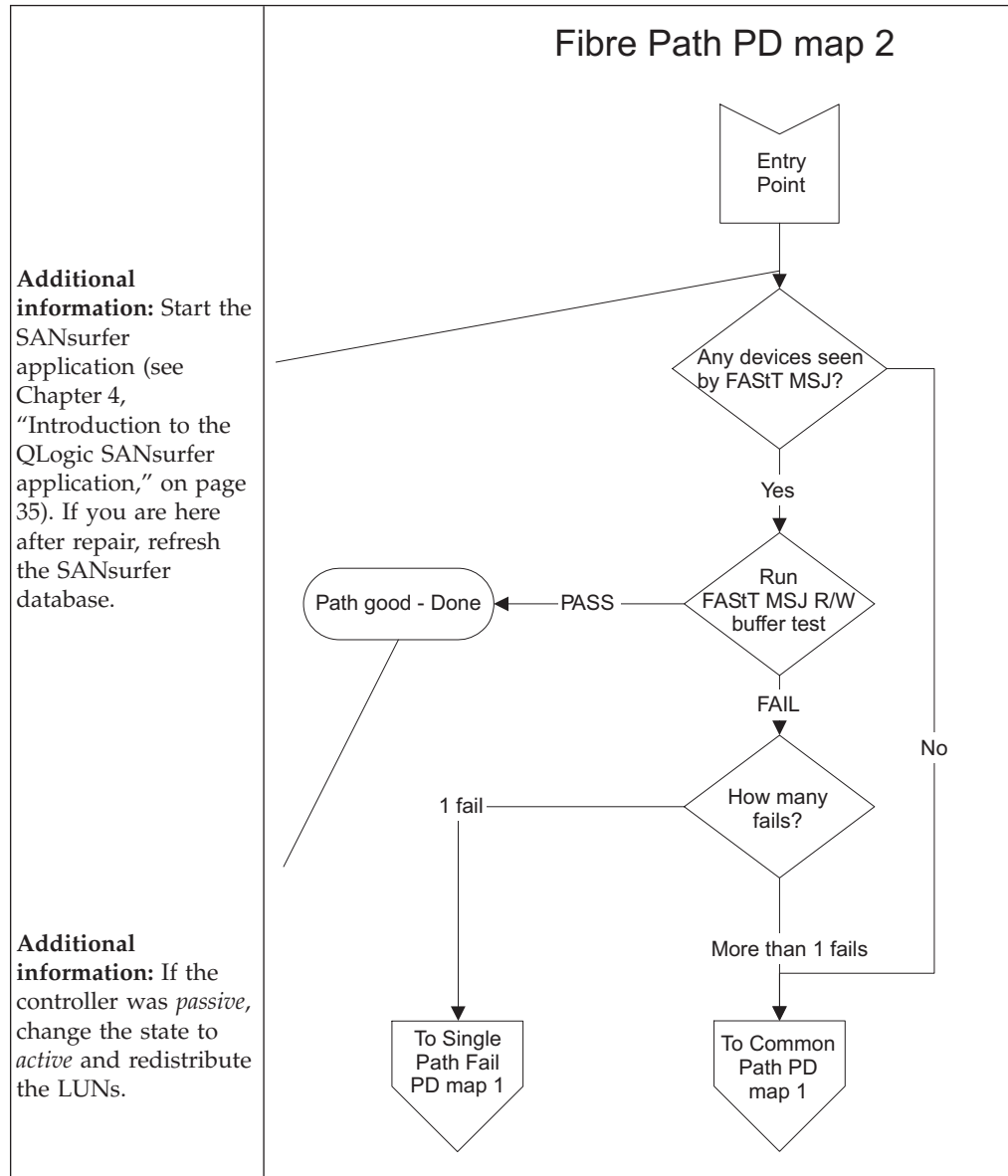
To see Single Path Fail PD map 1, go to "Single Path Fail PD map 1" on page 18.

To see Common Path PD map 1, go to "Common Path PD map 1" on page 20.

Single Path Fail PD map 1

From: "Fibre Path PD map 2" on page 17.
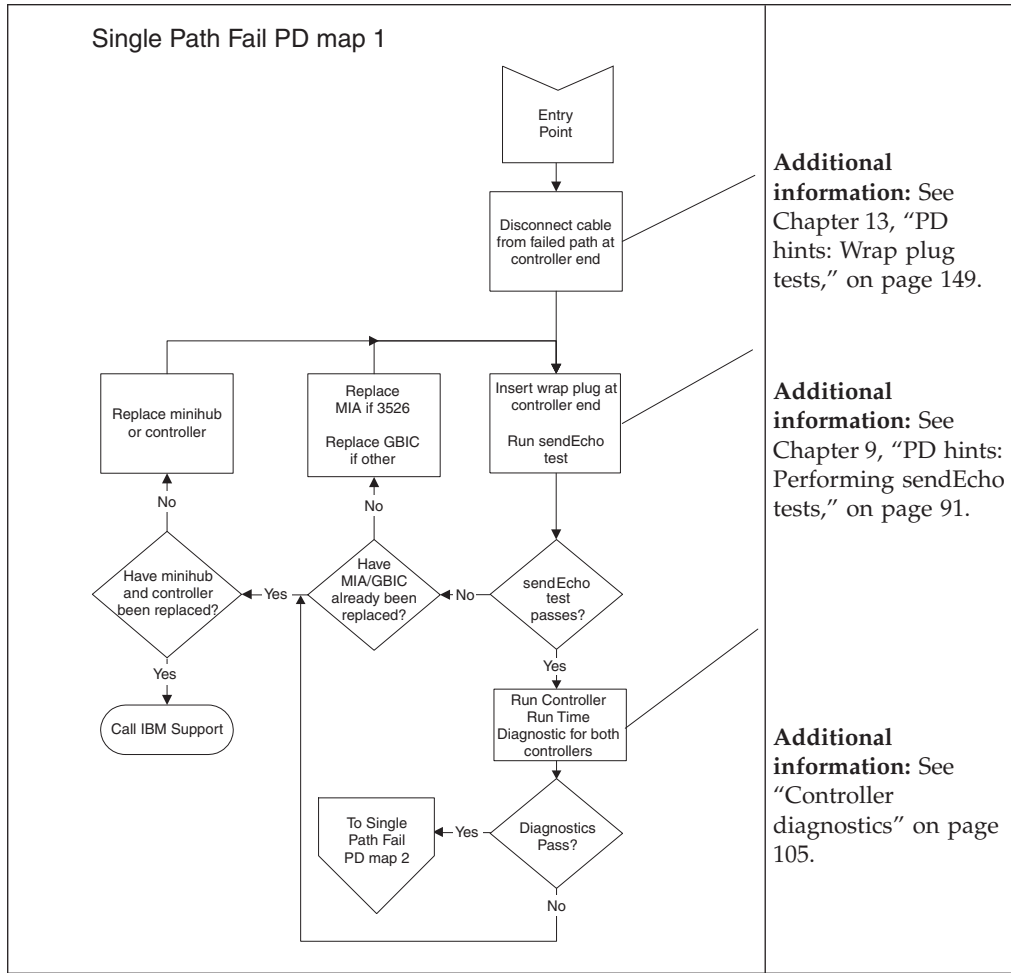
To see Single Path Fail PD map 2, go to "Single Path Fail PD map 2" on page 19.

Single Path Fail PD map 2

From: "Single Path Fail PD map 1" on page 18.
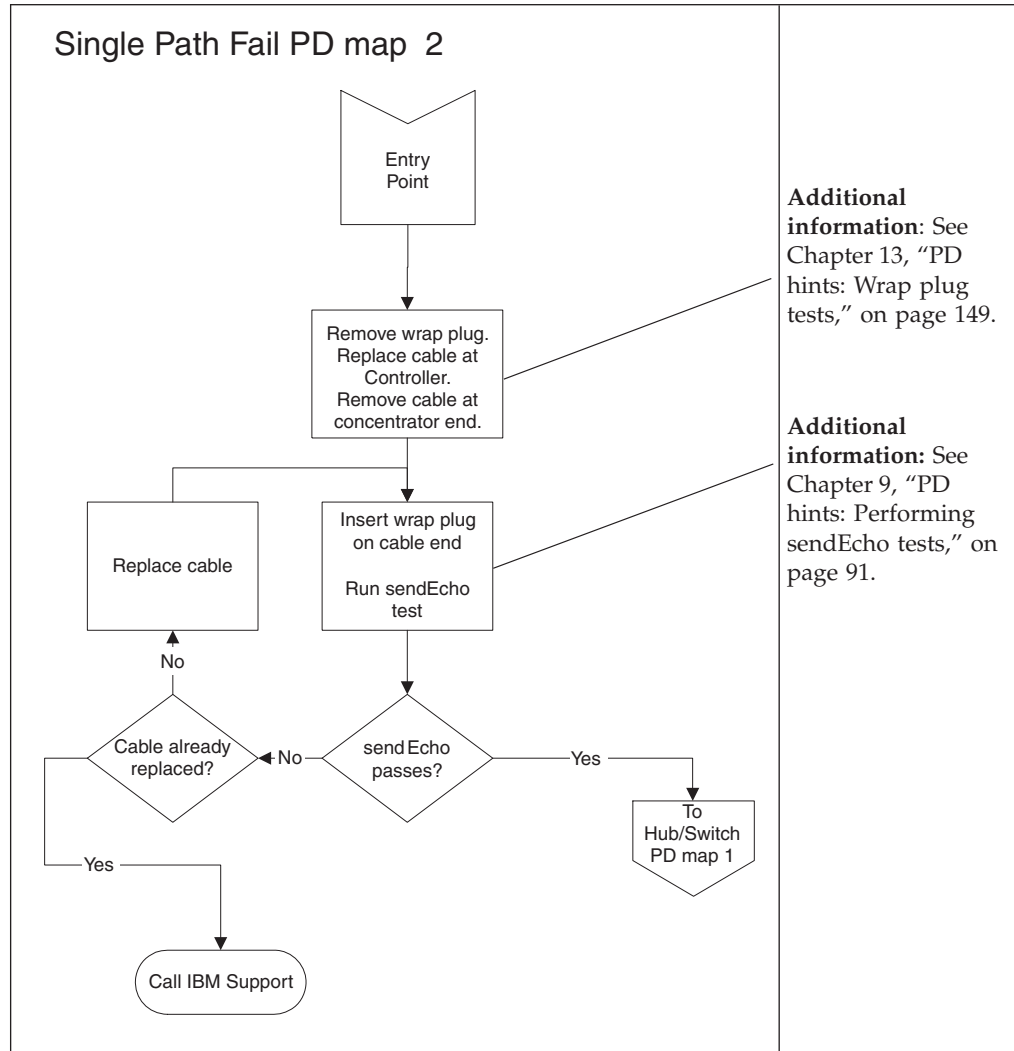
To see Hub/Switch PD map 1, go to "Hub/Switch PD map 1" on page 13.

Common Path PD map 1

From: "Fibre Path PD map 2" on page 17.

Common Path PD map 1

Entry Point

Unmanaged hub in path? — Yes → Are Both hub port lights off? — No → Is Yellow on- Green off? — No → Are Both hub port lights on? — No

Are Both hub port lights off? — Yes → Check GBIC seating in hub

Is Yellow on-Green off? — Yes → Replace GBIC

Are Both hub port lights on? — Yes → Check cable connections

Unmanaged hub in path? — No → Disconnect cable from common path at concentrator going to HBA

Is problem resolved? — Yes → Done. Return to main to check for other problems

Is problem resolved? — No → Replace hub

Replace Hub if not GBIC port
Replace GBIC if Switch or Hub GBIC

Insert wrap plug at concentrator port where cable was removed

Has GBIC/ concentrator already been replaced? — Yes → Call IBM Support

Has GBIC/ concentrator already been replaced? — No ← Is Green light on port?

Is Green light on port? — Yes → To Common Path PD map 2

Is problem resolved? — Yes → (loop)
Is problem resolved? — No → Call IBM Support

Additional information: See Chapter 5, "PD hints: Common path/single path configurations," on page 63.

To see Common Path PD map 2, go to "Common Path PD map 2" on page 21.

Common Path PD map 2

From: "Common Path PD map 1" on page 20.

Common Path PD map 2

Entry Point

HBA type 2100? —No→ (to Fibre Path PD map 1)

Yes

Configure for crossport test using cable disconnected at HBA end and wrap plug on cable

To Fibre Path PD map 1

Crossport test passes? —Yes→ Replace 2100- return to main

No

Replace cable- return to main

Additional information: See Chapter 12, "PD hints: Hubs and switches," on page 143.
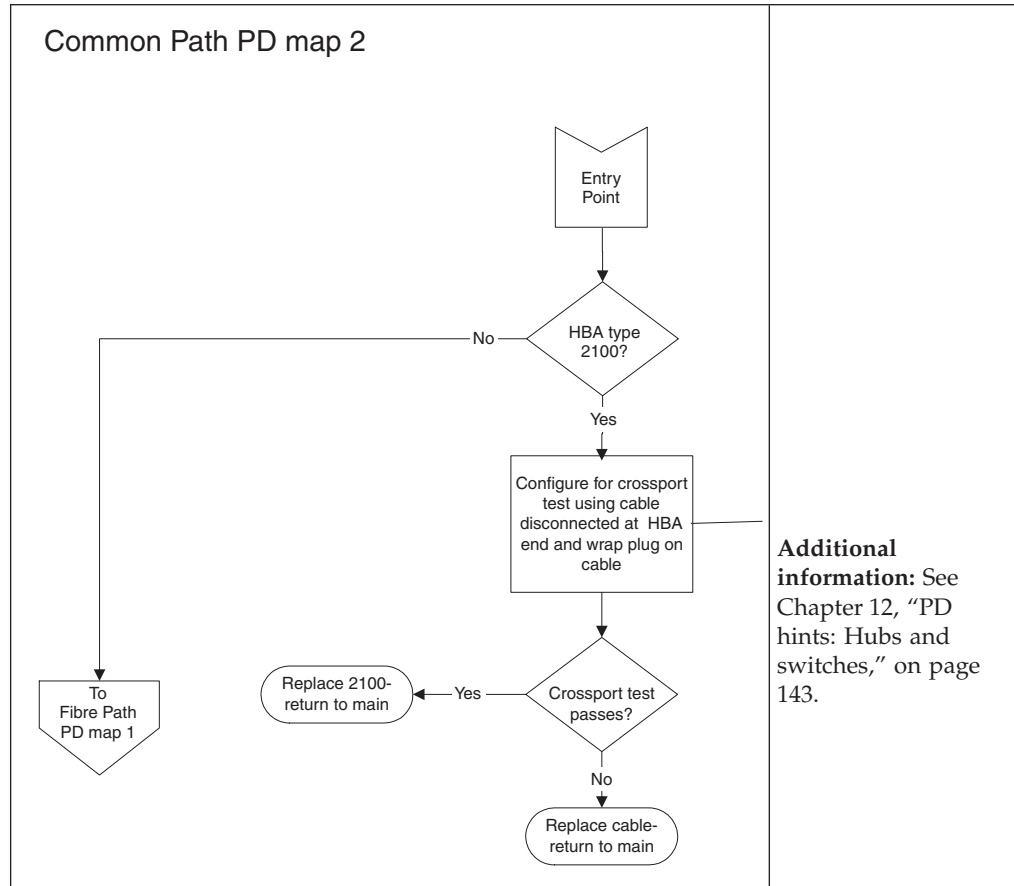
See

To see Fibre Path PD map 1, go to "Fibre Path PD map 1" on page 16.

Device PD map 1

From: "PD maps and diagrams" on page 6.
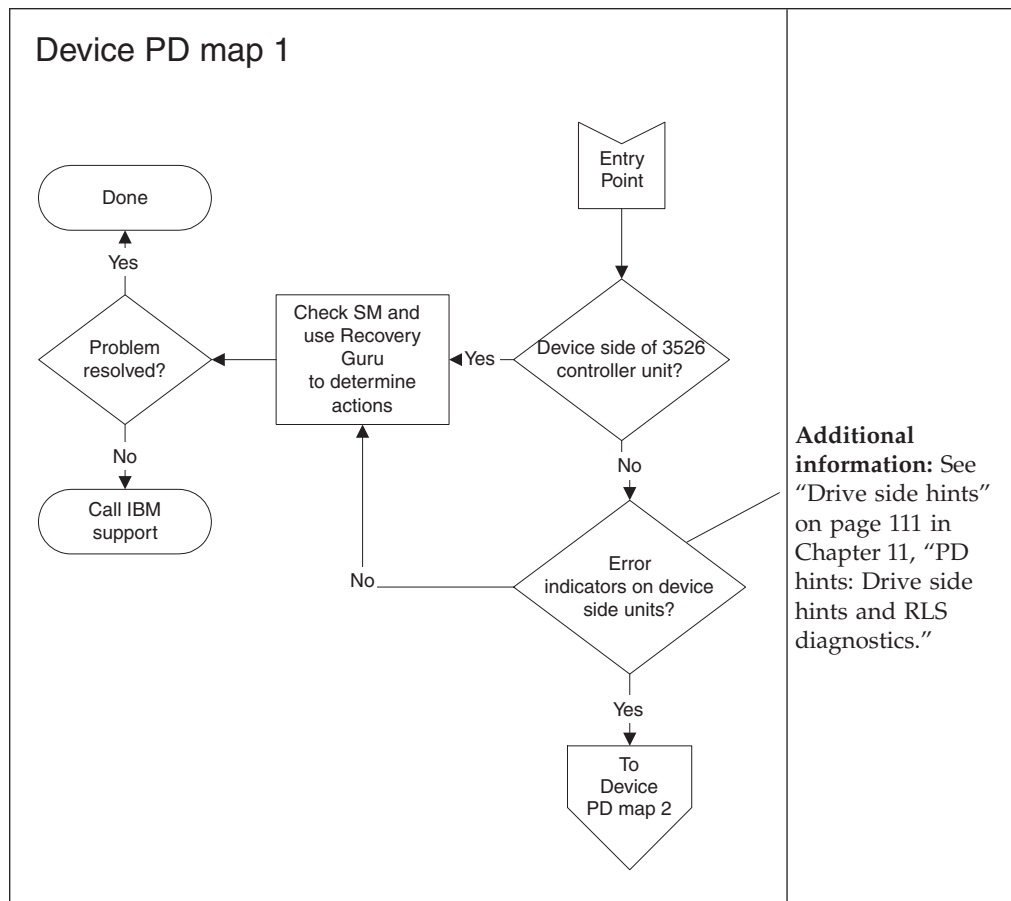
To see Device PD map 2, go to "Device PD map 2" on page 23.

Device PD map 2

Device PD map 2

Entry
Point

Fault indicator
On? — Yes

Here before at
same unit? — Yes → Call IBM
support

No

No

Replace GBIC

Yes — Fixed? — No → Replace unit that
shows fault

Any
Bypass light
On in device
path? — No

Yes

Problem solved

To
PD Hints-
Device
side

Additional information: See "Drive side hints" on page 111.	**Additional information:** If the faulty component causes an ESM in an EXP500 or EXP100 to fail, unplug and replug the ESM after the fix.
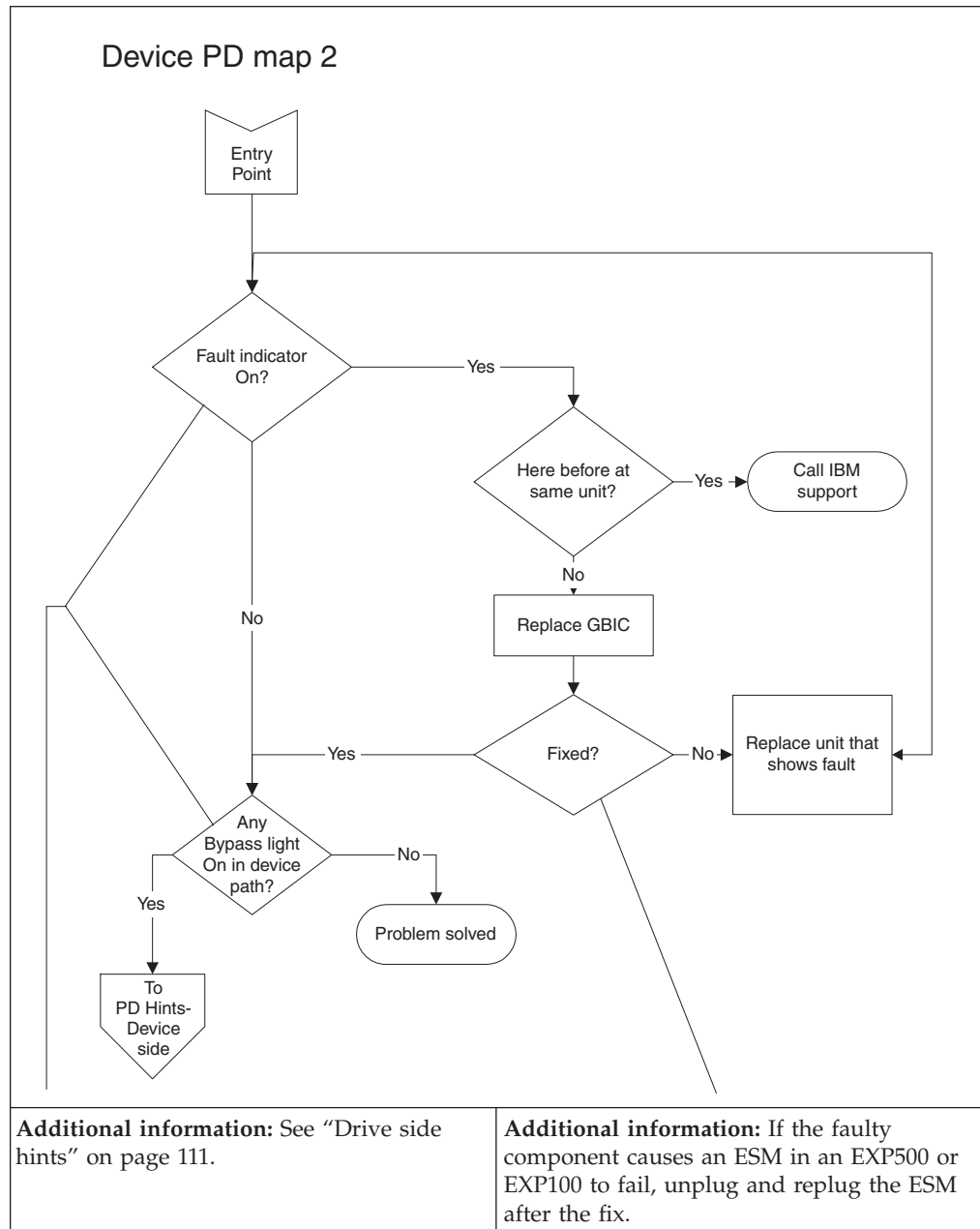
To see PD hints about troubleshooting the device (drive) side, go to "Drive side hints" on page 111.

Linux Port Configuration PD map 1

From: "Specific problem areas" on page 5.

Flowchart: Linux Port Configuration PD Map 1

Entry Point → Run FAStT MSJ connect to the host

Any devices seen by FAStT MSJ? — No → Expand HBA device tree

Yes → Run FAStT MSJ R/W buffer test — Pass → (Expand HBA device tree)

Fail → How many fails? — One fail → To Single Path Fail PD map 1

More than one fail → To Common Path PD map 1

Expand HBA device tree → Any LUN 3l in device tree? — Yes → Incorrect storage mapping

No → Are Luns sequential and starting with LUN 0? — No → (Incorrect storage mapping)

Yes → Configure device Luns (click on **configure**)

Invalid device and Lun configuration detected? — No

Yes → Do auto discovery → Any device node name split? — No → Configure devices and LUN See "Linux Port Configuration"

Yes → To Linux Port Configuration PD map 2

Note: The agent qlremote does not start automatically. Prior to connecting the host, open a terminal session and run qlremote. Stop all I/Os before starting qlremote.

See "Linux port configuration" on page 106.

Hint: If a Device node name is split, then two entries will appear for the same WWN name. (Only one entry should appear per controller WWN name.)

To see Single Path Fail PD map 1, see "Single Path Fail PD map 1" on page 18.

To see Common Path PD map 1, see "Common Path PD map 1" on page 20.

To see Linux® Port Configuration PD map 2, see "Linux Port Configuration PD map 2" on page 25.

Linux Port Configuration PD map 2

From: "Linux Port Configuration PD map 1" on page 24

Linux Port Configuration PD Map 2	
Entry Point → Right-click on split controller node name and select device information → Use Storage Manager to map the device/LUNs for Linux and reconfigure the ports using FAStT MSJ	**Hint**: Right-click the Host icon in the HBA Tree and select **Adapter Persistent Configuration Data ...** The Adapter(s) WWNN is displayed. Record this information as it will be required by the DS4000 Storage Manager to map your storage to the Linux OS. **Additional information:** See "Linux port configuration" on page 106.

pSeries PD map

Start with this pSeries® PD map if you are troubleshooting fibre channel network SANs with FC 6228 and 6239 HBAs and IBM® pSeries servers running an AIX® system.

AIX/pSeries main PD map

Begin pSeries PD map

Is the adapter available? → No → See Fibre Channel Adapter Not Available PD map

Yes

Is the SCSI I/O Protocol Device available? → No → See Fibre Channel SCSI I/O Controller Protocol Device Not Available PD map

Yes

Are the appropriate logical hard disks available? → No → See Logical Hard Disks Not Available PD map

Yes

Are the appropriate logical tape drives available? → No → See Logical Tape Drives Not Available PD map

Yes

Are there errors reported by or associated with a disk storage subsystem? → No → Are there errors reported by or associated with a tape subsystem? → No → Are there errors reported by or associated with a Fibre Channel Switch? → No → Are there errors reported by or associated with a SAN Data Gateway? → No → Are there errors reported by or associated with a Fibre Channel Storage Hub? → No → See Fiber Path Failures PD map

Yes: Refer to Service Manual for the disk storage subsystem

Yes: Refer to Service Manual for the tape subsystem

Yes: Refer to Service Manual for the Fibre Channel Switch

Yes: Refer to Service Manual for the SAN Data Gateway

Yes: Refer to Service Manual for the Fibre Channel Storage Hub

For more detailed information, including sample diagnostic information, see "Fibre Channel Adapter Not Available PD map" on page 28.

To see Logical Hard Disks Not Available PD map, see "Logical Hard Disks Not Available PD map" on page 30.

To see Logical Hard Tapes Not Available PD map, see "Logical Tape Drives Not Available PD map" on page 31.

To see Fiber Path Failures PD map, see "Fiber Path Failures PD map 1" on page 32.

Fibre Channel Adapter Not Available PD map
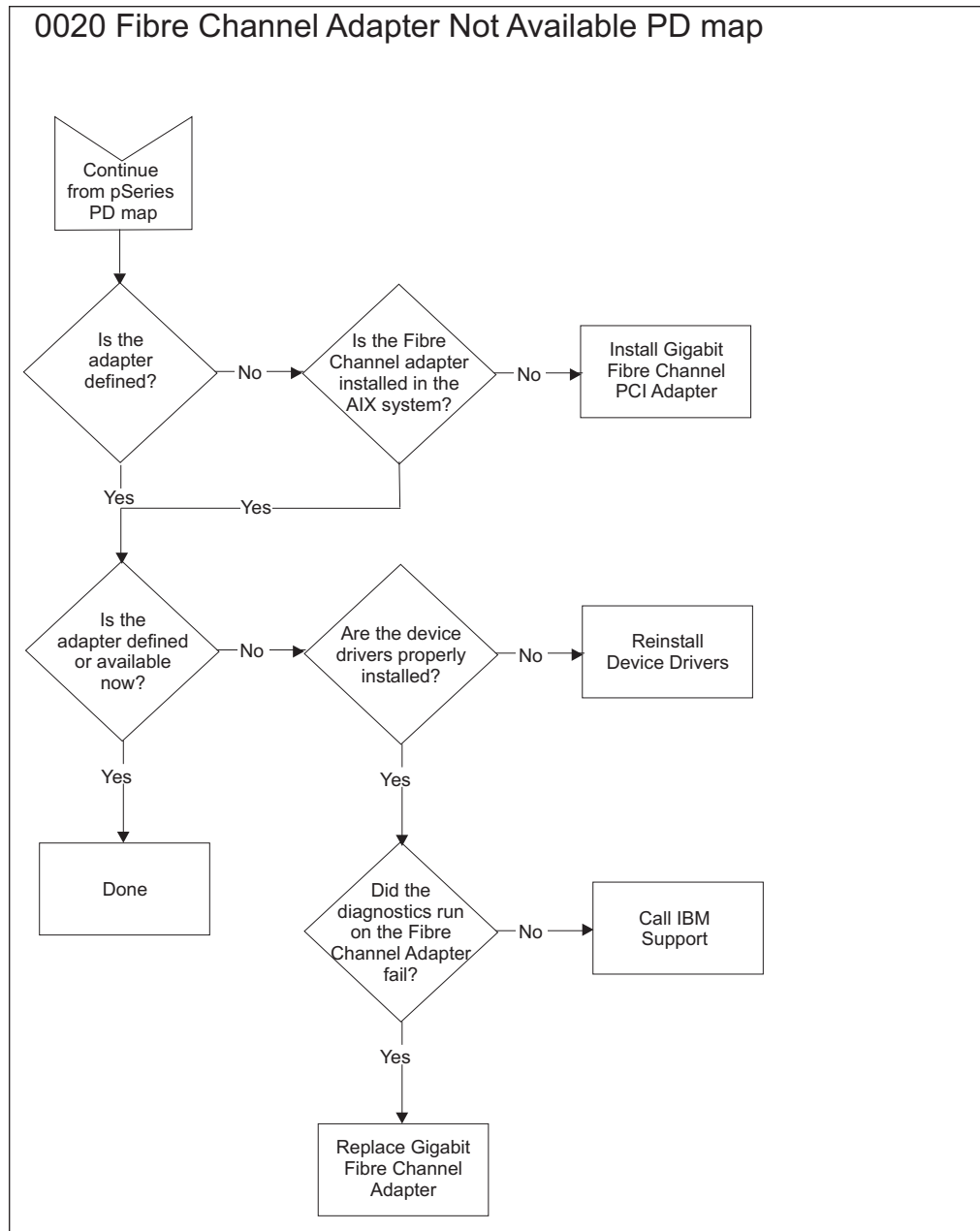
From: "pSeries PD map" on page 26

For more detailed information, including sample diagnostic information, see "Fibre Channel Adapter Not Available PD map."

Fibre Channel SCSI I/O Controller Protocol Device Not Available PD map

0030 Fibre Channel SCSI I/O Controller Protocol Device Not Available PD map

For more detailed information, including sample diagnostic information, see Chapter 17, "pSeries supplemental problem determination information," on page 173.

Logical Hard Disks Not Available PD map
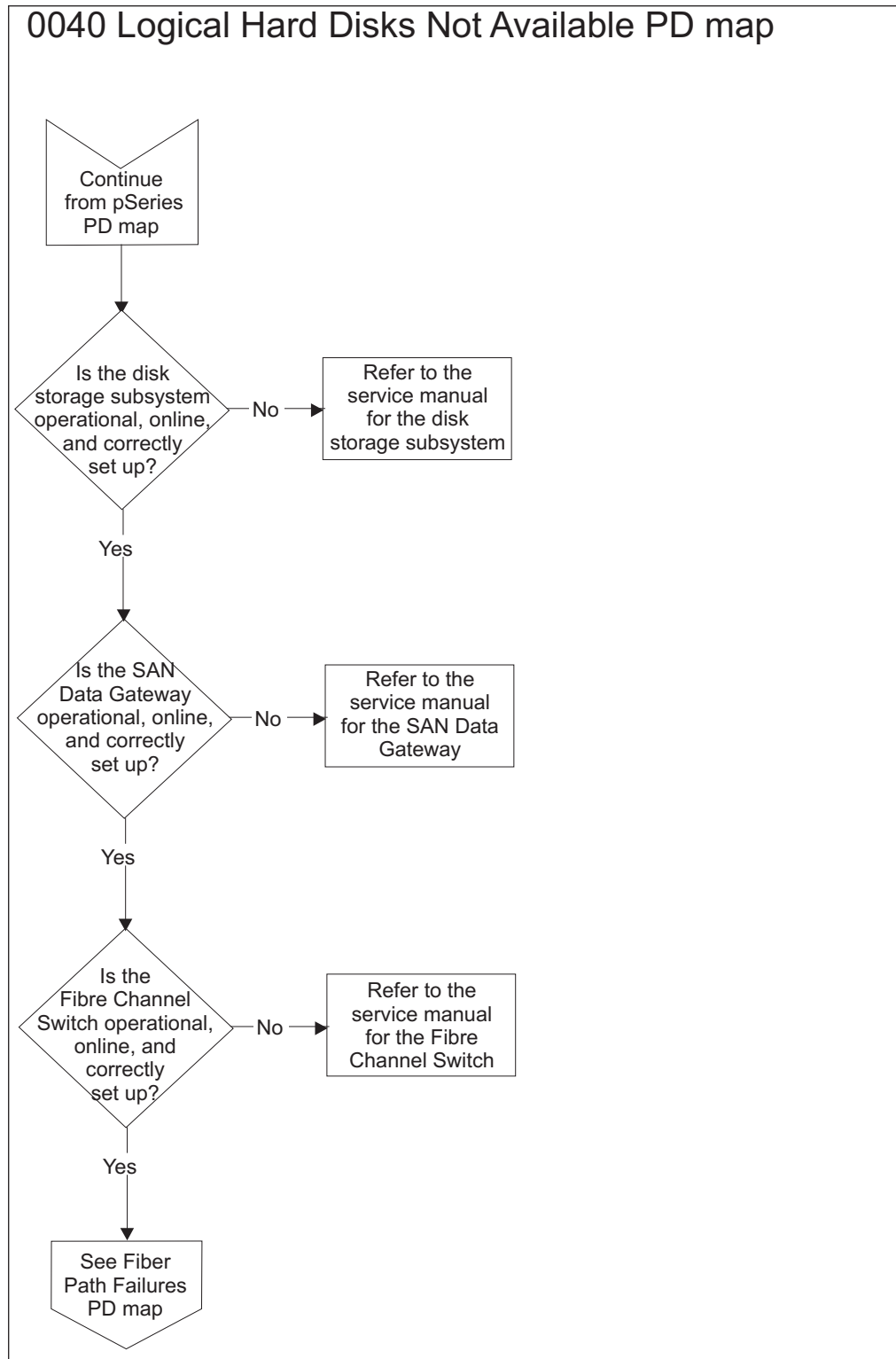
From: "pSeries PD map" on page 26

0040 Logical Hard Disks Not Available PD map

```
        ┌─────────────┐
        │  Continue   │
        │ from pSeries│
        │   PD map    │
        └──────┬──────┘
               │
               ▼
         ╱╲                              ┌──────────────┐
        ╱  ╲   Is the disk              │  Refer to the│
       ╱ storage subsystem ╲    No ───► │ service manual│
       ╲ operational, online,╱          │  for the disk│
        ╲ and correctly set up?╱        │storage subsystem│
         ╲╱                              └──────────────┘
          │ Yes
          ▼
         ╱╲                              ┌──────────────┐
        ╱  ╲   Is the SAN              │  Refer to the│
       ╱ Data Gateway      ╲    No ───► │ service manual│
       ╲ operational, online,╱          │ for the SAN Data│
        ╲ and correctly set up?╱        │   Gateway    │
         ╲╱                              └──────────────┘
          │ Yes
          ▼
         ╱╲                              ┌──────────────┐
        ╱  ╲   Is the                  │  Refer to the│
       ╱ Fibre Channel     ╲    No ───► │ service manual│
       ╲ Switch operational,╱           │  for the Fibre│
        ╲ online, and correctly set up?╱│Channel Switch│
         ╲╱                              └──────────────┘
          │ Yes
          ▼
     ┌─────────────┐
     │ See Fiber   │
     │ Path Failures│
     │   PD map    │
     └─────────────┘
```

For more detailed information, including sample diagnostic information, see "Fibre Channel Adapter Not Available PD map" on page 28.

To see Fiber Path Failures, see "Fiber Path Failures PD map 1" on page 32.

Logical Tape Drives Not Available PD map

From: "pSeries PD map" on page 26

0050 Logical Tape Drives Not Available PD map

```
       ┌──────────┐
       │ Continue │
       │ from     │
       │ pSeries  │
       │ PD map   │
       └────┬─────┘
            │
            ▼
       ╱───────────╲            ┌──────────────┐
      ╱   Are the   ╲           │  Refer to the│
     ╱  appropriate  ╲   No     │  installation│
     ╲ logical tape  ╱─────────▶│  manual for  │
      ╲drives defined?         │  the tape    │
       ╲───────────╱            │  drives      │
            │                   └──────────────┘
           Yes
            │
            ▼
       ╱───────────╲            ┌──────────────┐
      ╱   Are the   ╲           │  Refer to the│
     ╱  tape drives  ╲   No     │  service     │
     ╲ operational,  ╱─────────▶│  manual for  │
      ╲online, and   ╱          │  the logical │
       ╲correctly    ╱          │  tape drives │
        ╲set up?    ╱           └──────────────┘
            │
           Yes
            │
            ▼
       ╱───────────╲            ┌──────────────┐
      ╱ Is the SAN   ╲          │  Refer to the│
     ╱  Data Gateway  ╲  No     │  service     │
     ╲ operational,   ╱────────▶│  manual for  │
      ╲online, and    ╱         │  the SAN Data│
       ╲correctly     ╱         │  Gateway     │
        ╲set up?     ╱          └──────────────┘
            │
           Yes
            │
            ▼
       ┌──────────┐
       │ See Fiber│
       │ Path     │
       │ Failures │
       │ PD map   │
       └──────────┘
```

For more detailed information, including sample diagnostic information, see "Fibre Channel Adapter Not Available PD map" on page 28.

To see Fiber Path Failures, see "Fiber Path Failures PD map 1" on page 32.

Fiber Path Failures PD map 1

0060 Fiber Path Failures PD map 1

Begin Fiber Path Failures PDF Map

Is there any reason to suspect problems with fiber jumpers, trucks, patch panels, or other devices in this configuration? — No → Call IBM Support

Yes

Does the fiber jumper from the AIX System Fibre Channel Adapter provide a complete signal path to the disk storage subsystem, tape drive, patch panel, or other device to which it is connected? — No → Correct the Fault

Yes

Do the patch-panels and interconnecting trunk or jumper in this configuration provide a complete end-to-end signal path? — No → Correct the Fault

Yes

Do the fiber jumpers plugged into the Fiber Channel Switch in this configuration provide a complete signal through the switch? — No → Correct the Fault

Yes

See Fiber Path Failures PD map 2

For more detailed information, including sample diagnostic information, see "Fibre Channel Adapter Not Available PD map" on page 28.

Fibre Path Failures PD map 2

From: "Fiber Path Failures PD map 1" on page 32

```
0060-2 Fiber Path Failures PD map 2
```

Continue from
Fiber Path Failures
PD map 1

Do the fiber
jumper and SCSI
interface cables plugged
into the SAN Data Gateway in
this configuration provide
a complete signal
path through the
gateway? — No→ Correct the Fault

Yes

Do the
fiber jumpers
plugged into the hub
in this configuration
provide a complete
signal path through
the hub? — No→ Correct the Fault

Yes

Do the
fiber jumpers
plugged into any
other device provide
a complete signal
path through
this device? — No→ Correct the Fault

Yes

Does the fiber
jumper plugged
into this device
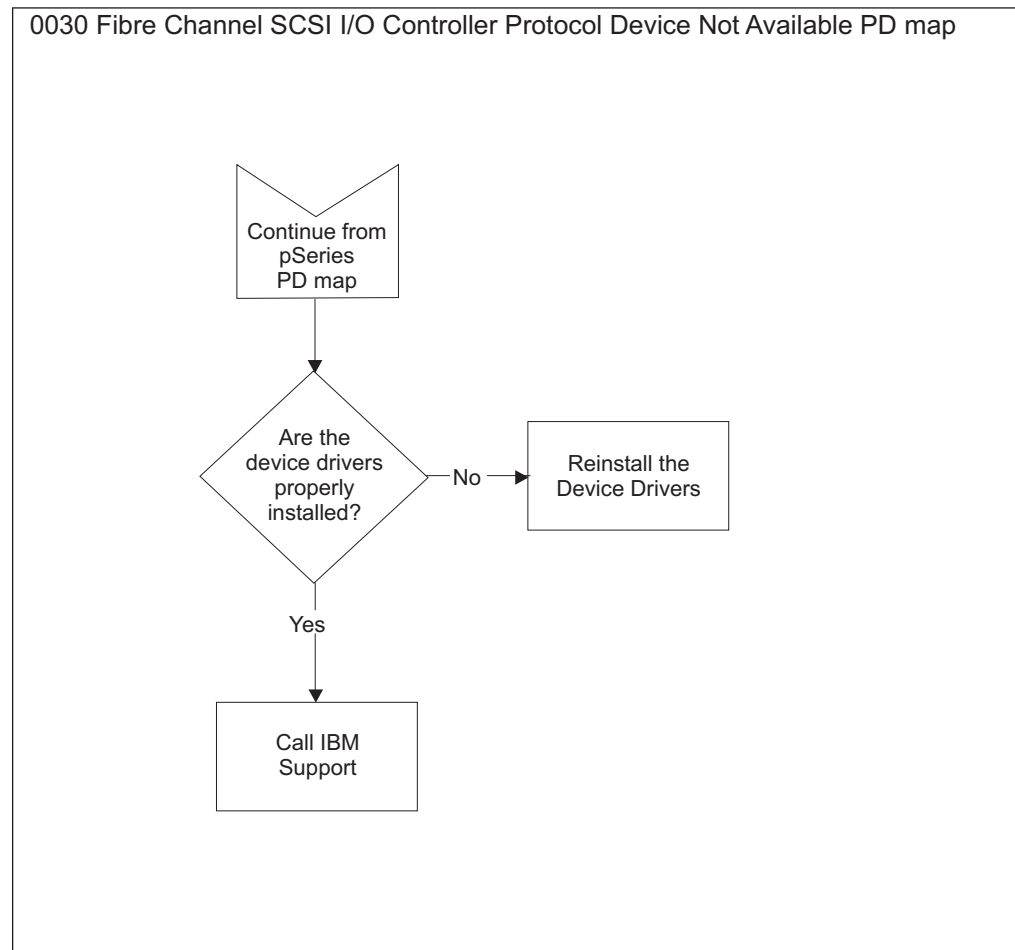provide a complete
signal path to it? — No→ Correct the Fault

Yes

Call IBM
Support

For more detailed information, including sample diagnostic information, see "Fibre Channel Adapter Not Available PD map" on page 28.
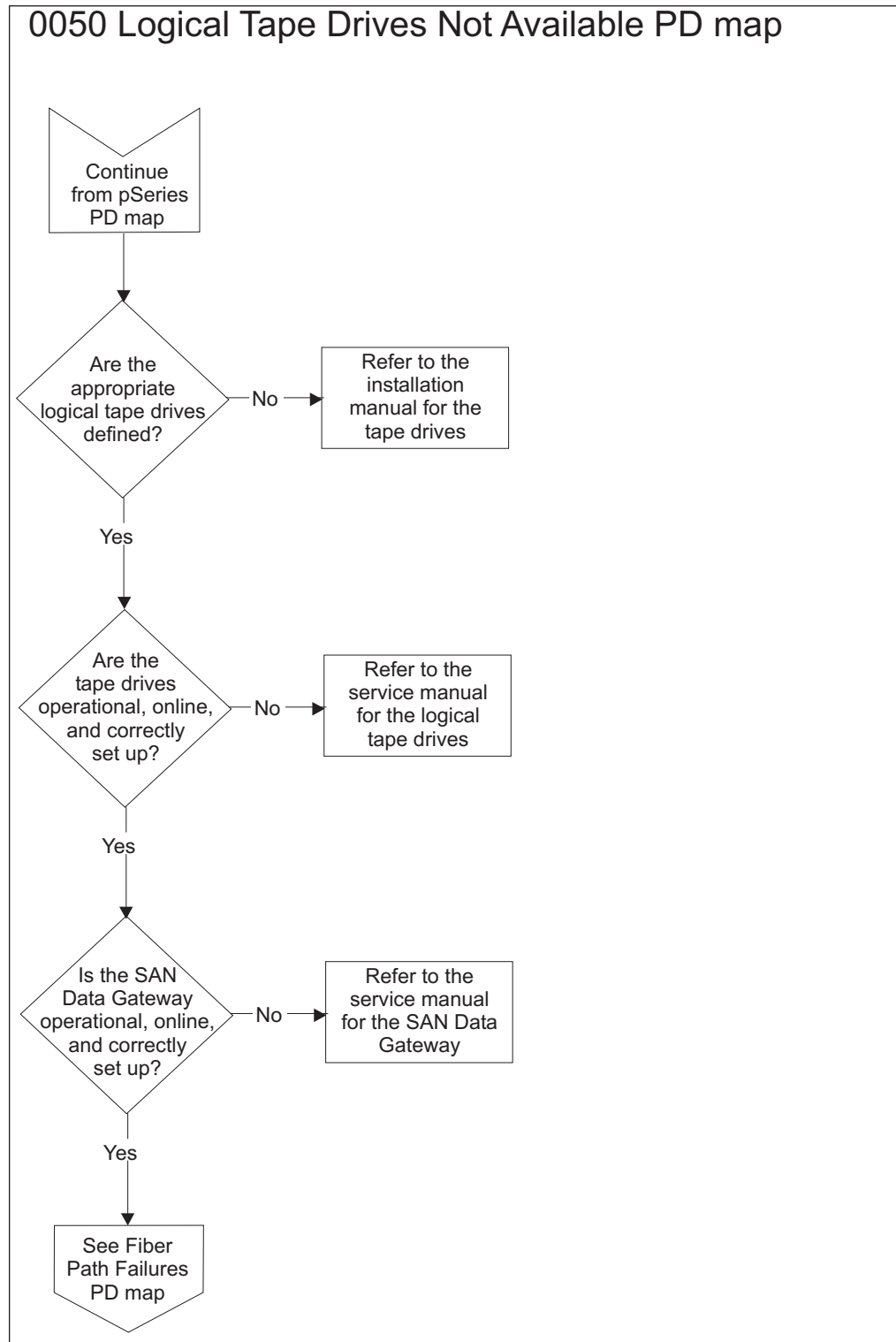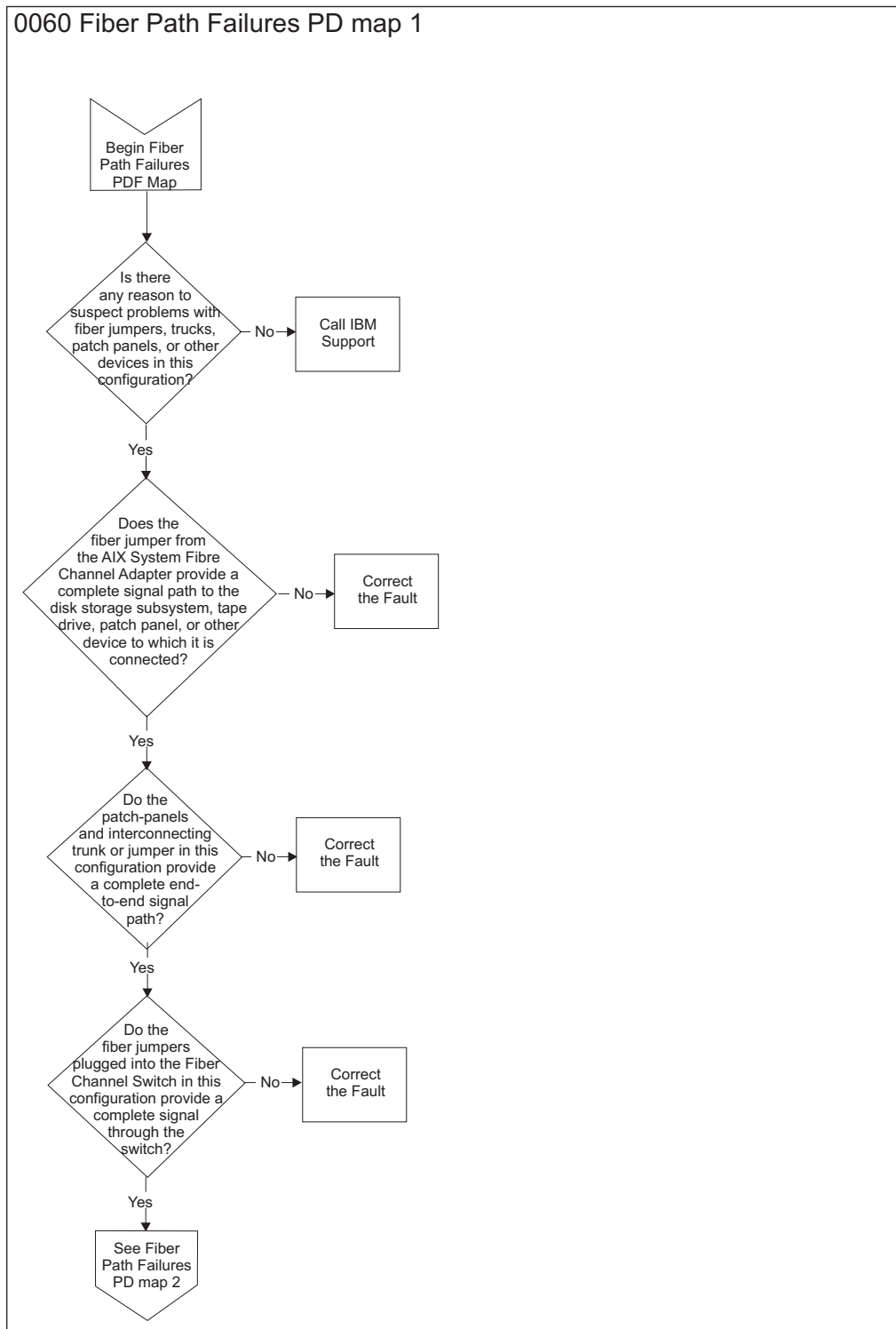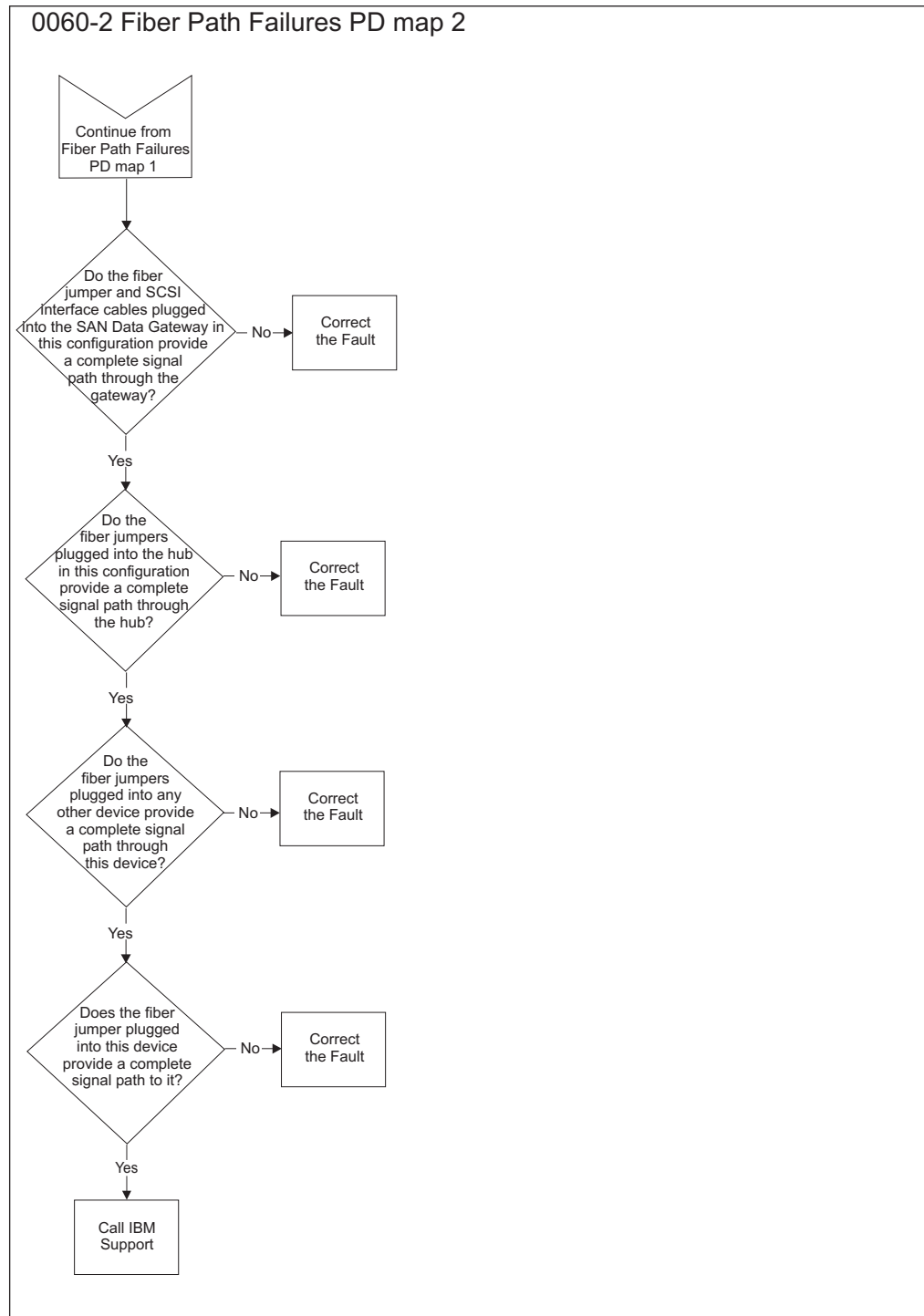
Chapter 4. Introduction to the QLogic SANsurfer application

This chapter introduces the QLogic SANsurfer application and includes background information on SAN environments and an overview of the functions of the SANsurfer application. The SANsurfer application replaces the IBM FAStT Management Suite Java™ (FAStT MSJ) application.

Note: See the SANsurfer online help for more detailed information about the SANsurfer application. The SANsurfer downloads are found under each specific DS4000 product.

SAN environment

In a typical Storage Area Network (SAN) environment, a system might be equipped with multiple host bus adapters (HBAs) that control devices on the local loop or on the fabric.

In addition, a single device can be visible to and controlled by more than one HBA. An example of this is dual-path devices used in a primary/failover setup.

In a switched or clustering setup, more than one system can access the same device; this type of configuration enables storage sharing. Sometimes in this scenario, a system must access certain LUNs on a device while other systems control other LUNs on the same device.

Because SAN has scalable storage capacity, you can add new devices and targets dynamically. After you add these new devices and targets, you need to configure them.

A SAN can change not only through the addition of new devices, but also through the replacement of current devices on the network. For device hot-swapping, you sometimes need to remove old devices and insert new devices in the removed slots.

In a complicated environment where there is hot-swapping of SAN components, some manual configuration is required to achieve proper installation and functionality.

SANsurfer Overview

The SANsurfer application is designed for the monitoring and configuration of a SAN environment. This application is specifically designed for the IBM Fibre Channel, in such an environment. Together with HBA components, storage devices and host systems, this application helps complete a Storage Area Network.

The SANsurfer application is a network-capable (client/server) application that can connect to and configure a remote Windows NT®, Linux, or Novell NetWare system. The application uses ONC RPC for network communication and data exchange. The networking capability of the application allows for centralized management and configuration of the entire SAN.

SANsurfer system requirements

The SANsurfer application consists of the following two components:

- SANsurfer client interface
- Host agent

Each component has different system requirements depending on the operating system.

SANsurfer client interface

The SANsurfer application, which is written in Java, runs on any platform that has a compatible Java VM installed. The minimum system requirements for the SANsurfer application to run on all platforms are as follows:

- A video adapter capable of 256 colors
- At least 128 MB of physical RAM; 256 MB is recommended. Running with less memory might cause disk swapping, which has a negative effect on performance.
- 64 MB of free disk space

Platform-specific requirements for the SANsurfer client interface are as follows:

- Red Hat Linux IA32
  - Red Hat Linux 7.0, 7.1, 7.2, 8.0, or 9.0 (recommended configuration). AS 2.1, 3.0
  - SuSe Linux SLES 8.0
  - PII 233MHz (recommended minimum)
- Red Hat Linux IA64
  - Red Hat Linux 7.1, 7.3. AS 3.0
  - Itanium® 2
- Linux PPC 64
  - SuSe Linux SLES 8.0
  - POWER4+™ at 1.2GHz or 1.45GHz.
- Microsoft® Windows IA32
  - Microsoft Windows NT 4.0, W2K, XP, W2K3 (recommended configuration)
  - Pentium® III processor 450 MHz or greater
- Microsoft Windows IA64
  - Microsoft W2K3 (recommended configuration)
  - Itanium 2
- Novell NetWare
  - Novell NetWare 5.x, or 6.x (recommended configuration)
  - Pentium III processor 450 MHz or greater

Host agent

Host agents are platform-specific applications that reside on a host with IBM HBAs attached. The minimum system requirements for an agent to run on all platforms are as follows:

- An IBM SANsurfer supported device driver (see the release.txt file in the release package for a list of supported device driver versions for each platform)
- At least 8 MB of physical RAM

- At least 2 MB of free disk space

Platform-specific requirements for the SANsurfer host agents are as follows:
- Linux x86 – Agent runs as a daemon
- Microsoft Windows NT, Windows 2000, Windows 2003, or Windows XP – Agent runs as a Windows NT service
- Novell NetWare Installation from a Windows system
  - Novell NetWare Installation Prerequisites

    Note: You must be logged on as an administrator.

    Be sure you have the following items before installing the SANsurfer application for NetWare.
    - On the Windows NT/2000 Client:
      - Load NetWare Client software (from Novell).
      - Log into the NetWare Server from the Windows NT/2000 client.
      - Map a Windows drive letter to the root of the SYS Volume of the NetWare server. Record this drive letter for later use.
      - Add the NetWare host name and IP address to the Hosts file.
      - Network protocols: TCP/IP transport protocol (from Microsoft)
    - On the NetWare Server:
      - NetWare 5.X server with support pack 7 or NetWare 6.0 server with support pack 4 or NetWare 6.5 server with support pack 2.
      - Network protocols: TCP/IP and IPX/SPX transport protocols (from NIC vendor)
    - Agent – Runs as an AUTOEXEC.NCF started NLM

      Attention: In the file AUTOEXEC.NCF, remove REM from the front of the following two lines:
      ```
      REM RPCSTART.NCF
      REM LOAD QLREMOTE.NLM
      ```

Limitations

The following is a list of limitations:
- **Multiple Network Interface Cards** If multiple Network Interface Cards (NICs) are present in the system, the SANsurfer client broadcasts to the first IP address subnet based on the binding order. Therefore, you must ensure that the NIC for the local subnet is first in the binding order. If this is not done, the diagnostics might not run properly, and remote connection might not occur. See the readme file in the release package for more information.
- **Host IP Addresses** The SANsurfer application attempts to prevent the user from connecting to the same host more than once. (Allowing more than one connection causes issues with policies and wasted system resources). This adds the requirement that all host IP addresses *must* resolve to a host name to allow connection to complete.
- **Local host file** If DNS is not used you must edit the local host file on the systems where you are running the SANsurfer GUI and the QLremote agent. Add the host name to IP mapping manually. Edit the file /etc/hosts.
- **Firewalls** Having systems with the firewall installed can cause problems with async alarms from the agent running on Linux to a remote machine. Problems

can also occur if the GUI is running on a Linux Client communicating to a remote machine. To circumvent this problem, type the following command at a shell prompt:

```
chkconfig --list
```

Verify that "ipchains and iptables" in run levels 2, 3, 4, 5 are disabled. To disable at a specific run level, set the following:

chkconfig --level 2 ipchains off
chkconfig --level 3 ipchains off
chkconfig --level 4 ipchains off
chkconfig --level 5 ipchains off
chkconfig --level 2 iptables off
chkconfig --level 3 iptables off
chkconfig --level 4 iptables off
chkconfig --level 5 iptables off

* **HBA connected to a fabric** When a DS4000 fibre channel HBA (QL2200, 2310, or 2340) is connected to the fabric (switch), Loopback test is disabled because the adapter is in a point-to-point mode. Unplugging the cable from the fabric and inserting a wrap plug at the end of the cable (or at the adapter) enables loopback test.
* **Online Help** The SANsurfer online Web help can only be viewed in the Netscape Communicator browser (version 4.5 or later).
* **Configuration refresh** When an online device fails and goes offline and a subsequent configuration refresh occurs, the loop id for that device does not reflect the original ID because, in effect, the device is no longer in the loop (might show x100 or xff).

Installing the SANsurfer FC HBA Manager

Installing the SANsurfer FC HBA Manager consists of installing the SANsurfer FC HBA Manager GUI, platform-specific agent, and help components, as appropriate. This section provides information about the initial installation and the uninstallation of the SANsurfer application.

Initial installation

Install the SANsurfer application, which includes the SANsurfer FC HBA Manager, using the software from the IBM Web site or from the SANsurfer CD.

Notes:

1. Be sure to install the same version of the SANsurfer application on all systems in the network.
2. If you have a previous version of the SANsurfer FC HBA Manager (for example, SMS 3.0), uninstall it before installing the latest version.

Installation options

The SANsurfer FC HBA Manager supports both stand-alone and networked configurations. Install the software that is appropriate for your configuration.

Table 2. Configuration option installation requirements

Configuration	Software Requirements
Stand-alone system	
This Windows 2000/Windows Server 2003 (IA32, IA64) or Red Hat/SuSE Linux (IA32) system monitors the QLA2xxx HBAs locally.	SANsurfer FC HBA Manager GUI
This Red Hat/SuSE Linux (IA64) or Solaris SPARC/x86 system monitors the Q LA2xxx HBAs locally.	SANsurfer FC HBA Manager GUI and one of the following: • SANsurfer FC Linux Agent • SANsurfer FC Solaris Agent
Networked system	
This system monitors the QLA2xxx HBAs locally and on remote systems running on the same network.	SANsurfer FC HBA Manager GUI and one of the following: • SANsurfer FC Windows NT 4/2000/2003 Agent • SANsurfer FC Linux Agent • SANsurfer FC Solaris Agent
This system monitors the QLA2xxx HBAs only on remote systems running on the same network.	SANsurfer FC HBA Manager GUI
The QLA2xxx HBAs on this system are monitored remotely only from other systems on the same network.	One of the following: • SANsurfer FC Windows NT 4/2000/2003 Agent • SANsurfer FC Linux Agent • SANsurfer FC Solaris Agent • SANsurfer FC NetWare 5/6.x Agent

Installation instructions

This section is written with the assumption that you might be installing all SANsurfer software components on any of the supported operating systems.

The SANsurfer installer is a self-extracting program that installs the SANsurfer software, including the SANsurfer FC HBA Manager and related software.

If you will be installing the SANsurfer FC HBA Manager agent on a NetWare server, note the following issues:

• You cannot install the SANsurfer FC HBA Manager agent directly on a NetWare server. You must install the agent from a Windows 2000 or Windows Server 2003 system that is connected to the NetWare server.
• The prerequisites for each NetWare server are:
  – A Windows 2000 or Windows Server 2003 system must be connected to the NetWare server through the TCP/IP network.
  – The Windows 2000 or Windows Server 2003 system must have a drive mapped to the NetWare server system volume (sys:\).

Perform these steps to install the SANsurfer FC HBA Manager on the system or on the NetWare server that is connected to the system:

1. Start the installation.
   a. Perform one of the following steps to access the SANsurfer installer:

- If you are installing the SANsurfer FC HBA Manager from the SANsurfer CD:

  1) Click **SANblade HBA Software** on the CD home page.
  2) Find the table that corresponds to your QLogic HBAs, and then select the appropriate operating system.
  3) Click **SANsurfer Software** in the SANblade HBA Management Software table to open the File Download window.
  4) Click **Save** in the File Download window. Select a directory on your system, and then download the file.

- If you are installing the SANsurfer FC HBA Manager from the IBM Web site:

  1) Click **Support** on the IBM Web site.
  2) Click **Drivers, Software, and Manuals**.
  3) Select your HBA.
  4) Click the appropriate operating system under the Drivers and Management Software heading.
  5) Click **Download** in the SANsurfer row of the table (SANsurfer for Windows, SANsurfer for Linux, or SANsurfer for Solaris) to open the File Download window.
  6) Click **Save** in the File Download window. Select a directory on your system, and then download the file.

b. Select and start the installation file. (Install is the SANsurfer installer file.)

- For a Windows 2000 or Windows Server 2003 system, locate the folder where you downloaded the install file, and then double-click the file.
- For a Red Hat/SuSE Linux or Solaris SPARC/x86 system:

  1) Open a shell.
  2) Navigate to the directory where you downloaded the SANsurfer installer.
  3) Type `sh ./install.bin`, and then press Enter to ensure that the SANsurfer installer file is executable and to start the installer.

2. The InstallAnywhere® program prepares to install the SANsurfer application. The installation Introduction window opens, as shown in Figure 1 on page 41. Click **Next**.
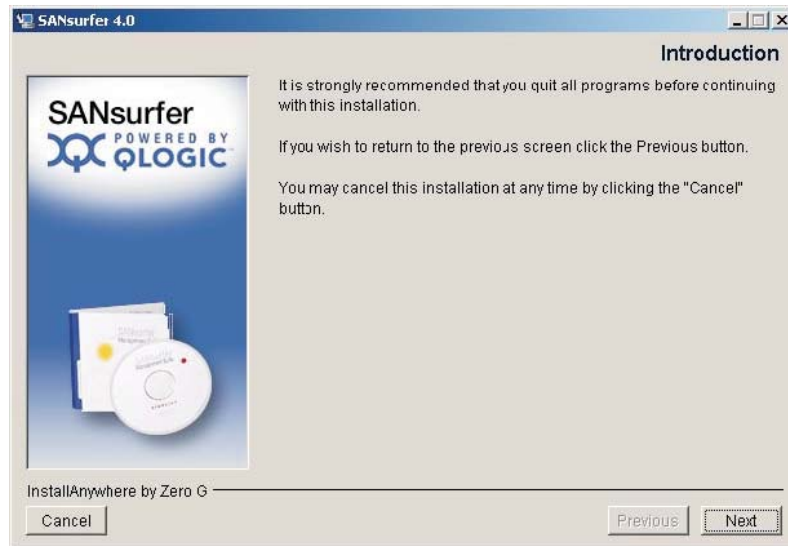
Figure 1. Installation Introduction window

3. The Important Information window opens as shown in Figure 2. Read the information in the Important Information window, and then click **Next**.

Figure 2. Important Information window

You can find this information in the readme.txt file in these locations:
- Windows 2000/Windows Server 2003: Program Files\QLogic Management Suite
- Red Hat/SuSE Linux and Solaris SPARC/x86: opt/QLogic_Corporation/ SANsurfer

4. The Choose Product Features window opens as shown in Figure 3 on page 42.

Figure 3. Choose Product Features window

> **Note:** Except for the agents that are installed, the feature options are the same for Windows 2000/Windows Server 2003, Red Hat/SuSE Linux, and Solaris SPARC/x86 systems.
>
> - Windows agents are installed on a Windows 2000/Windows Server 2003 system.
> - Linux agents are installed on a Red Hat/SuSE Linux system.
> - Solaris agents are installed on a Solaris SPARC/x86 system.
>
> The SANsurfer software supports the SANsurfer FC HBA Manager, as well as other applications. Install only the software that is appropriate for your configuration.
>
> > **Note:** The IBM DS4000 only supports the use of the SANsurfer FC HBA Manager and the appropriate agent for your operating system.

In addition, the SANsurfer FC HBA Manager supports both stand-alone and network configurations. See "Installation options" on page 38 for more information about configuration. You can select a preconfigured installation set or create a customized installation set.

To use a preconfigured installation set, select one of the following options, and then click **Next**:

- Click **ALL GUIs and ALL Agents** to install the SANsurfer FC HBA Manager, the SANsurfer iSCSI HBA Manager, and the SANsurfer Switch Manager GUIs, including the FC and iSCSI (Windows, Linux, or Solaris) agents.
- Click **SANsurfer FC HBA Manager** to install only the SANsurfer FC HBA Manager GUI.
- Click **SANsurfer Switch Manager GUI** to install only the SANsurfer Switch Manager GUI. For more information, see the appropriate *SANbox switch management user's guide* for your switch.
- Click **iSCSI GUI and Agent** to install the SANsurfer iSCSI HBA Manager GUI, including the iSCSI (Windows, Linux, or Solaris) agent. For

information about using the SANsurfer iSCSI HBA Manager, see the
SANsurfer iSCSI HBA Application User's Guide.

- Click **SANsurfer iSCSI HBA Manager** to install only the SANsurfer iSCSI
  HBA Manager GUI. This option does not install the iSCSI (Windows, Linux,
  or Solaris) agent. For information about using the SANsurfer iSCSI HBA
  Manager, see the *SANsurfer iSCSI HBA Application User's Guide.*

To use a custom installation set, click **Custom**. The Choose Product
Components window opens. An example of this window is shown in Figure 4;
The window will differ slightly, depending on whether you are installing on a
Windows 2000/Windows Server 2003, Red Hat/SuSE Linux, or Solaris
SPARC/x86 system.
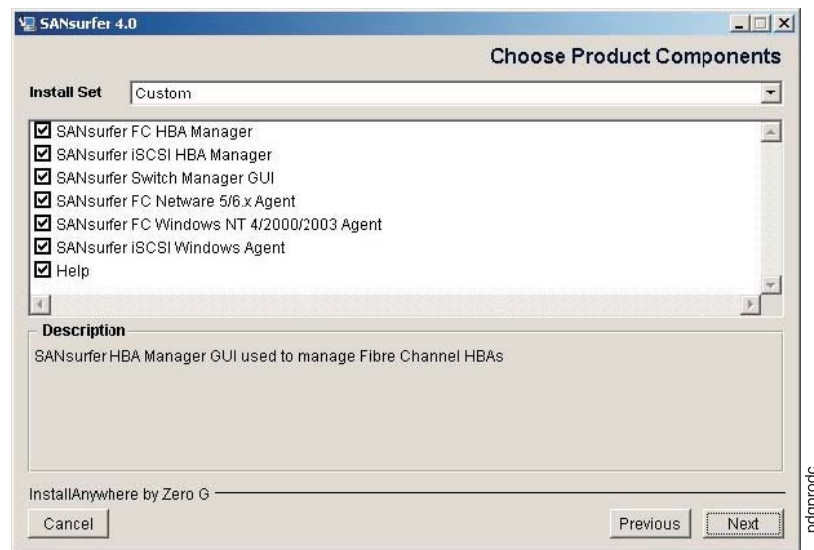
Figure 4. Choose Product Components window (sample)

To create a custom installation set, perform the following steps:

a. In the Choose Product Components window, select **Custom** from the
   Install Set list. A list of components is displayed that are specific to your
   operating system.

b. Select a component from the following list of components, and then click
   Next.

- For a Windows 2000/Windows Server 2003 system:
  – SANsurfer FC HBA Manager
  – SANsurfer FC NetWare 5/6.x Agent
  – SANsurfer FC Windows NT 4/2000/2003 Agent
  – Help
- For a Red Hat/SuSE Linux system:
  – SANsurfer FC HBA Manager
  – SANsurfer Linux Agent
  – Help
- For a Solaris SPARC/x86 system:
  – SANsurfer FC HBA Manager
  – SANsurfer FC Solaris Agent
  – Help

5. The Choose Install Folder window opens as shown in Figure 5.
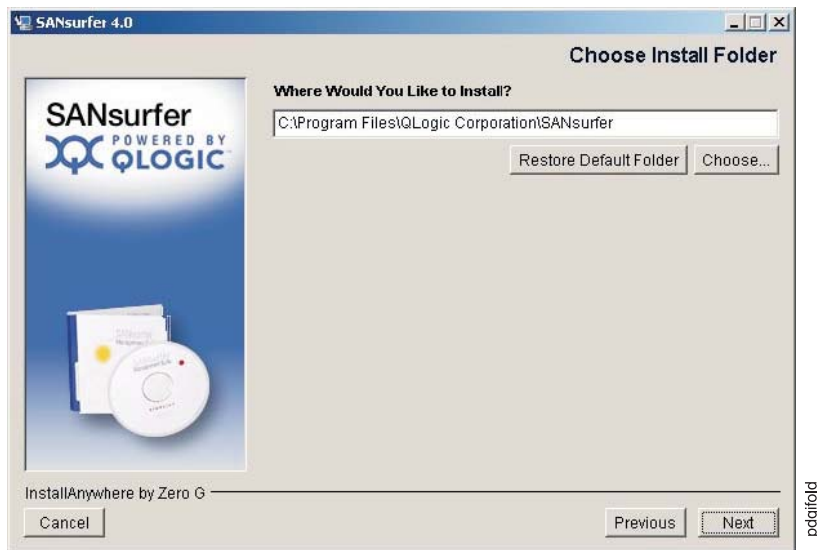
Figure 5. Choose Install Folder window

> **Note:** For NetWare, select the drive that is mapped to the NetWare server. You must select a location other than the default location.

To select a location, perform one of the following steps.

- To use the default location displayed in the **Where Would You Like to Install?** field, click **Next**. The default location is the recommended option.

  The default location for a Windows 2000/Windows Server 2003 system is: C:\Program Files\QLogic Corporation\SANsurfer

  The default location for a Red Hat/SuSE Linux and Solaris SPARC/x86 system is: /opt/QLogic_Corporation/SANsurfer

- To select a location other than the default, perform the following steps.
  a. Click **Choose**.
  b. Select the desired location. The Choose Install Folder window opens again.
  c. Click **Next**.

- To reselect the default location after selecting a location other than the default, perform the following steps
  a. Click **Restore Default Folder**.
  b. Click **Next**.

6. If there is a previous version of the SANsurfer application on the system, the previous `SANsurfer Install Detected` message window opens as shown in Figure 6 on page 45.
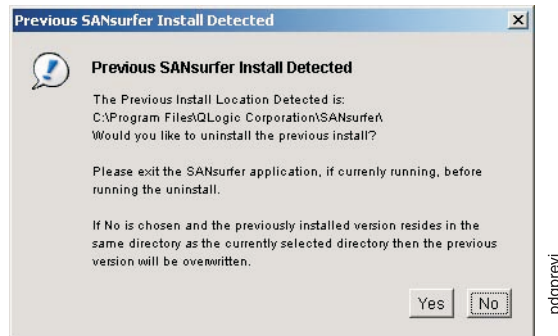
Figure 6. Previous SANsurfer Install Detected message

> **Attention:** If the SANsurfer application is running currently, close it before proceeding with the installation.

> If a previous version is detected, you can choose to uninstall it or you can install the new version of the SANsurfer application over the previous version.

> a. To uninstall the previous version, click **Yes**. Installation of the SANsurfer application stops while the previous version is being uninstalled.

>> **Attention:** If you are installing the SANsurfer application on a Windows 2000/Windows Server 2003 system, and you are prompted to restart the system after the uninstall is complete, restart your system before installing the new version in the same directory as the currently selected directory. Otherwise, the newly installed SANsurfer application will not operate properly.

> b. To install the new version of the SANsurfer application without uninstalling the previous version, click **No**. If the previously installed version resides in the same directory as the currently selected directory, the previous version is overwritten.

7. If you are installing the SANsurfer FC HBA Manager GUI on a Windows 2000/Windows Server 2003 system, the Select Shortcut Profile window opens as shown in Figure 7
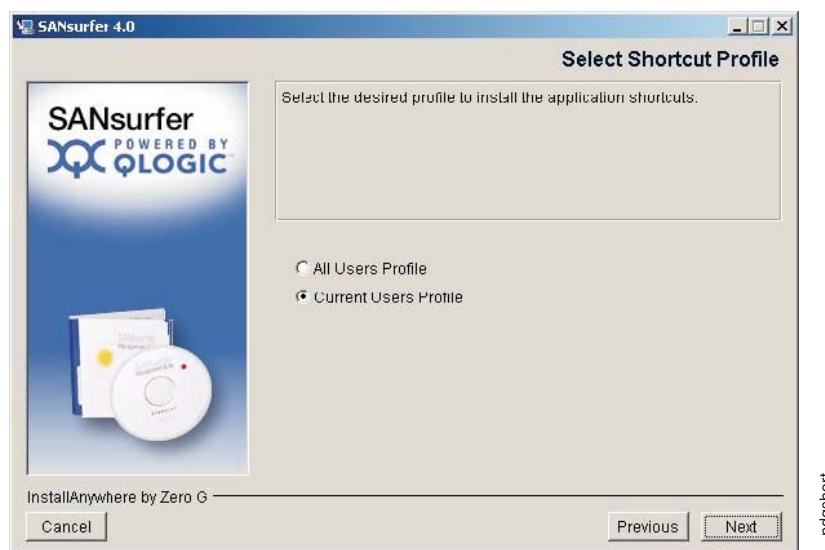
Figure 7. Select Shortcut Profile window

.

Perform the following steps:

a. Select one of the following options:

- Click **All Users Profile** if you want the application shortcuts to be available for all users.
- Click **Current Users Profile** (this is the default) if you want the application shortcuts to be available only for you (the current user).

b. Click **Next**.

The following application shortcuts are created:

- The SANsurfer icon on the desktop

    Note: Adding the SANsurfer icon to the desktop is optional. If you choose to create the desktop icon, you can do so in step 8.

- The QLogic Management Suite (SANsurfer and SANsurfer Uninstaller) in the **Start** menu.

8. If you are installing the SANsurfer FC HBA Manager GUI on a Windows 2000/Windows Server 2003 system, the Create Desktop Icon Selection window opens as shown in Figure 8.
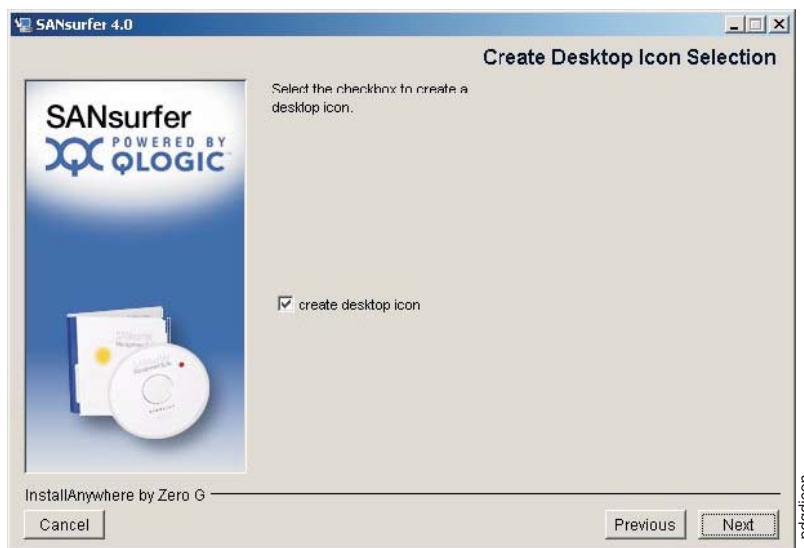
Figure 8. Create Desktop icon Selection window

To create the desktop icon, perform the following steps:

a. Select the **Create Desktop Icon** check box (This check box is selected by default).

b. Click **Next**.

    Note: If you select the **Create Desktop Icon** check box, the SANsurfer icon is created for the current user profile or for all user profiles, depending upon your selection in step 7a.

9. The Pre-Installation Summary window opens as shown in Figure 9 on page 47. Review the preinstallation summary information. Click **Previous** if you want to change any of this information. Click **Install** to continue with your installation.

Figure 9. Pre-Installation Summary window

10. The Installing SANsurfer window, which indicate that the installation is progressing, opens as shown in Figure 10.
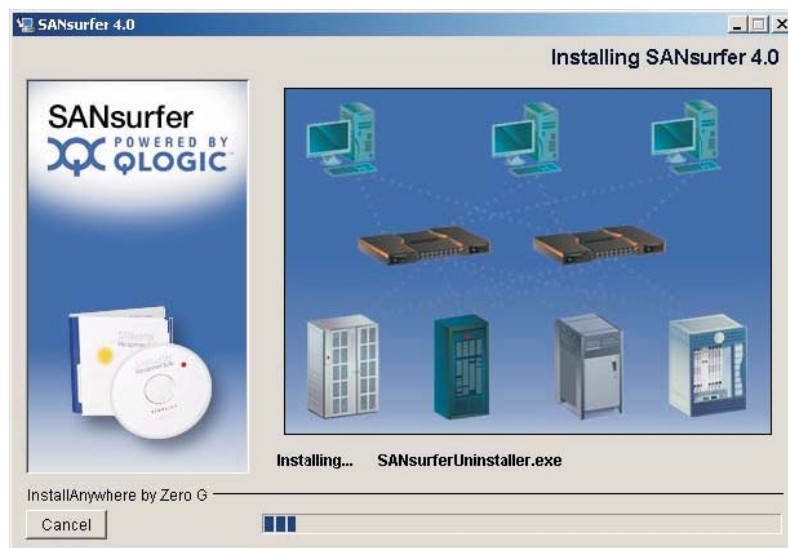
Figure 10. Installing SANsurfer window

11. If you are installing NetWare, the Novell NetWare Disk Selection window opens as shown in
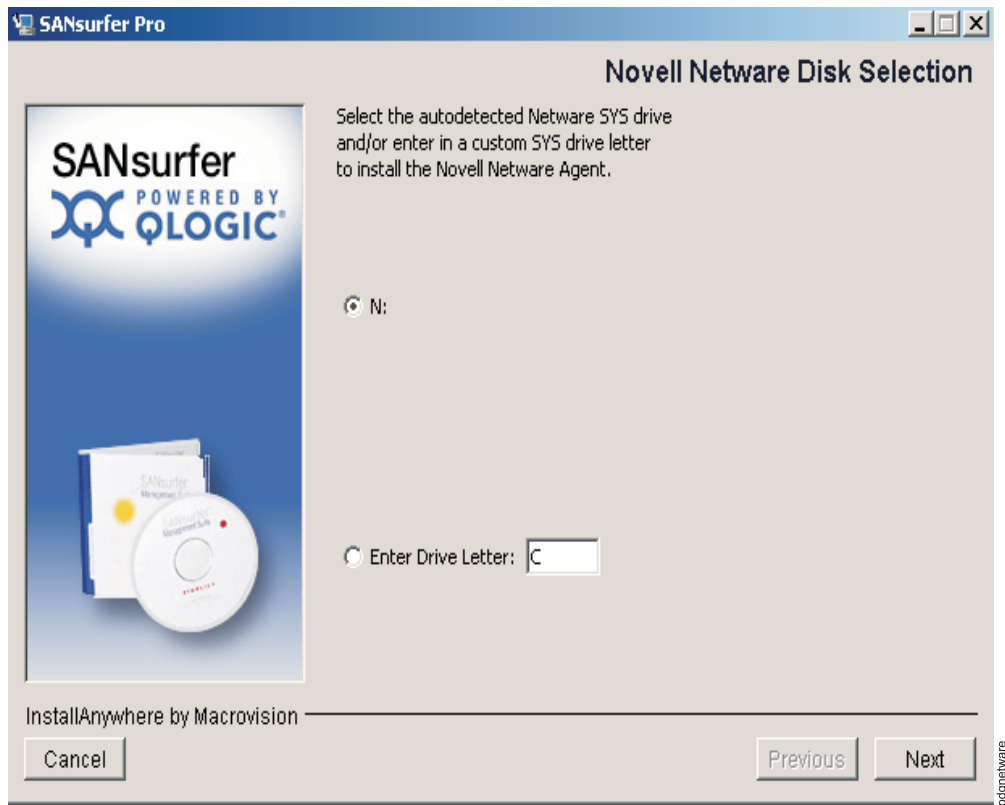
Figure 11. Novell NetWare Disk Selection window

A list of the autodetected Windows 2000/Windows Server 2003 drives that are mapped to the NetWare server system volumes (sys:\) is displayed.

Perform the following steps to select the Windows 2000/Windows Server 2003 drives on which to install the NetWare agent. Each drive must be mapped to a NetWare server system volume (sys:\).

a. As appropriate, select one or more of the autodetected drives.

b. If a Windows 2000/Windows Server 2003 drive (that you want to select) has not been mapped to the NetWare server system volume, perform one of the following steps:

- Leave the Novell NetWare Disk Selection window open. In the Exploring window, click **Tools**, and then select Map Network Drive to map the Windows 2000/Windows Server 2003 drive to the NetWare Server system volume (sys:\).

- In the Novell NetWare Disk Selection window, type the drive letter in the **Enter Drive Letter** field, and then click **Enter Drive Letter**. For example, in Figure 11 type C in the **Enter Drive Letter** field, and then click **Enter Drive Letter**.

c. Click **Next**.

12. If you are installing the SANsurfer FC HBA Manager on a Windows 2000/Windows Server 2003, Novell NetWare, or Red Hat/SuSE Linux system, the Default Failover Enable/Disable window opens as shown in Figure 12 on page 49.
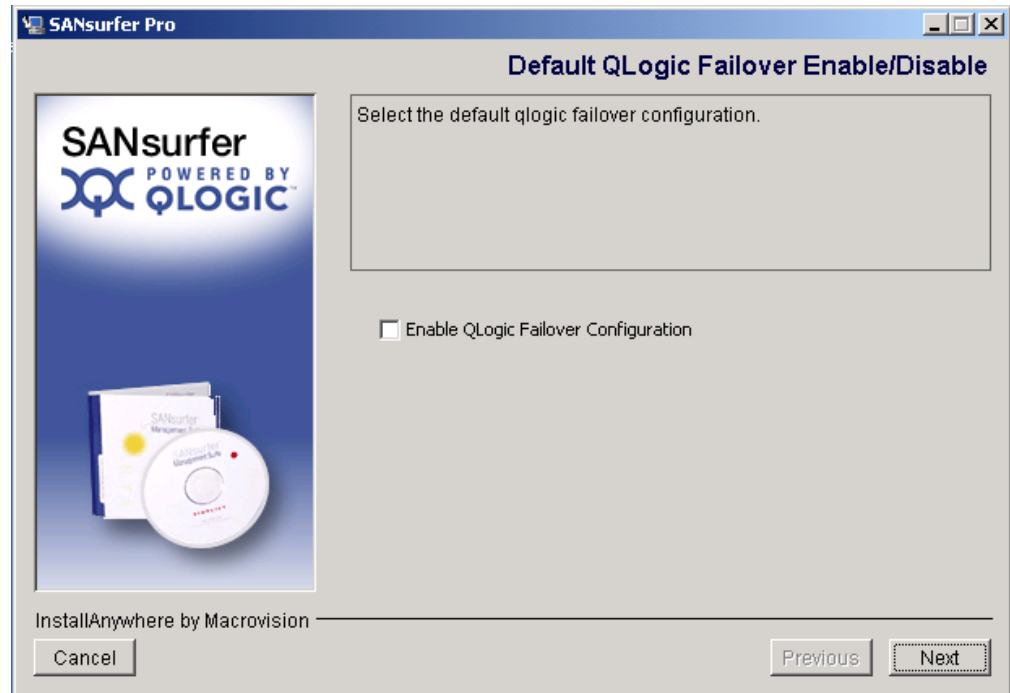
Figure 12. Default QLogic Failover Enable/Disable window

The Failover Configuration feature ensures data availability and system reliability by assigning alternate path and automatic HBA failover for device resources. For Linux systems, it is optional to use either the QLogic Failover Configuration or the IBM DS4000 RDAC driver.

Attention: For Windows, NetWare, and Solaris systems, *do not* enable QLogic Failover Configuration. The IBM DS4000 RDAC driver that is provided with your Storage Manager software is used for failover configuration.

To enable failover, perform the following steps:

a. Depending on your operation system, either select or clear the **Enable Failover Configuration** check box.

b. Click **Next**.

13. The Install Complete window opens as shown in Figure 13 on page 50. Click **Done**.
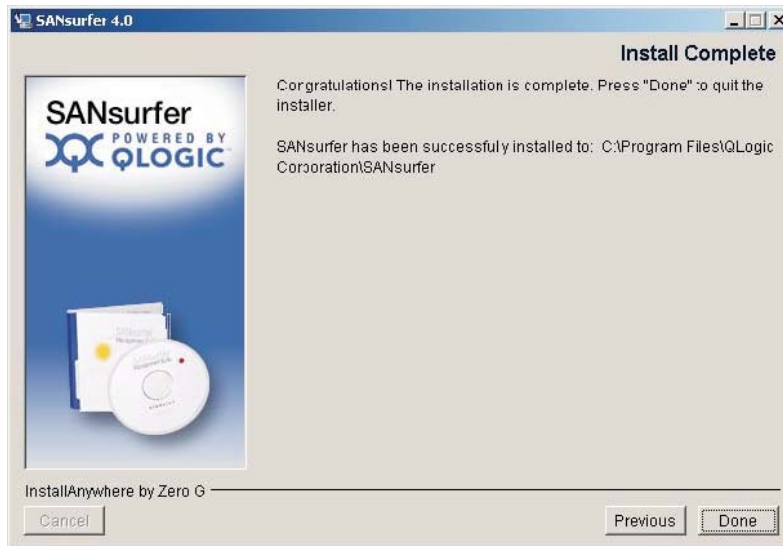
Figure 13. Install Complete window

14. Customize the SANsurfer FC HBA Manager and set your security parameters. For more information, see the QLogic SANsurfer online help.

Uninstalling the SANsurfer applications software

This section provides information about uninstalling the entire SANsurfer applications software (including the SANsurfer FC HBA Manager) and uninstalling specific features from the system. Close all the SANsurfer applications before you uninstall any of these applications.

Note: If you are uninstalling NetWare, ensure that the following tasks are completed.

- Uninstall the NetWare agent from the Windows 2000/Windows Server 2003 drive that is mapped to the Novell NetWare server.
- The Windows 2000/Windows Server 2003 system must have a drive mapped to the NetWare server system volume (sys:\).

To uninstall the SANsurfer applications software or to uninstall specific features, perform the following steps:

1. Start the SANsurfer uninstaller utility.

   For a Windows 2000/Windows Server 2003 system, do one of the following:

   - Click **Start** -> **Programs** -> **QLogic Management Suite**, and then click **SANsurfer Uninstaller**.
   - To use the Add/Remove Programs utility, do the following:
     a. Click **Start** ->**Settings**, and then click **Control Panel**.
     b. Double-click the **Add/Remove Programs** icon.
     c. The Add/Remove Programs window opens as shown in Figure 14 on page 51. Click **Change or Remove Programs** (this is the default).
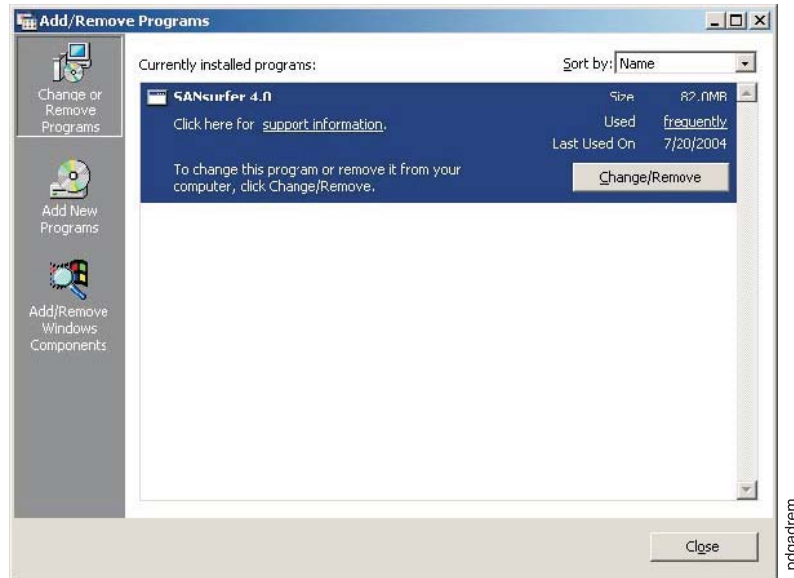
Figure 14. Add/Remove Programs window

    d. Select **SANsurfer** *x.x*.

    e. Click **Change/Remove**.

For a Red Hat/SuSE Linux or Solaris SPARC/x86 system, do one of the following, and then press Enter.

- On a Red Hat/SuSE Linux system, if /usr/local/bin is in the path, type `SANsurferUninstaller`.

- On a Solaris SPARC/x86 system, if /usr/bin is in the path, type `SANsurferUninstaller`.

- On a Red Hat/SuSE Linux system (if /usr/local/bin is not in the path) or a Solaris SPARC/x86 system (if /usr/bin is not in the path), do the following:

    a. Navigate to the directory where the SANsurfer application is installed. The default location is /opt/QLogic_Corporation/SANsurfer /UninstallData.

    b. Type `./SANsurferUninstaller`.

2. The Uninstall SANsurfer window opens with SANsurfer *x.x* as the program to be uninstalled as shown in Figure 15 on page 52. Click **Next**.
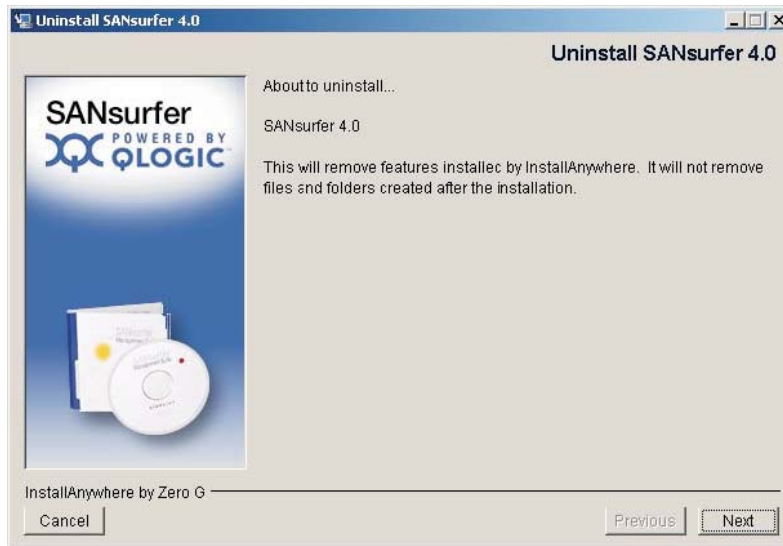
Figure 15. Uninstall SANsurfer window

3. The Uninstall Options window opens as shown in Figure Figure 16.
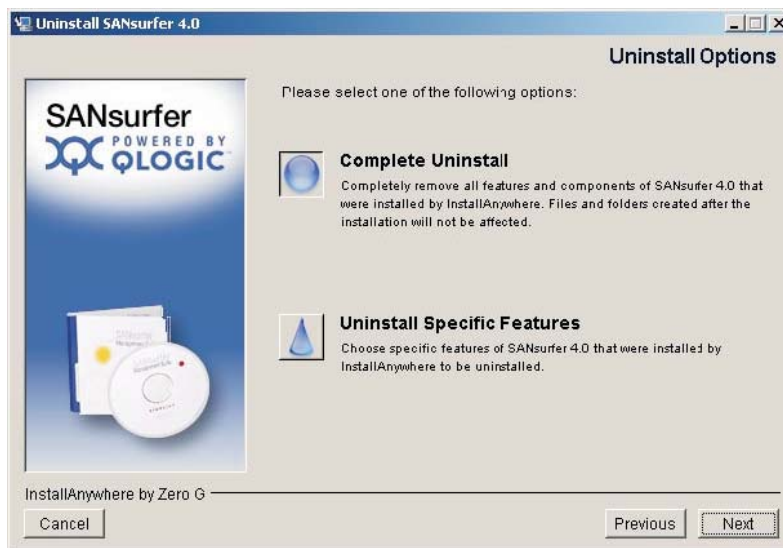
Figure 16. Uninstall Options window

To uninstall the entire SANsurfer application or specific features, do one of the following:

- Select **Complete Uninstall** to remove all features and components of the SANsurfer application that were installed by the InstallAnywhere utility. This will not affect files and folders created after the installation.
- Select **Uninstall Specific Features** to remove specific features of the SANsurfer application that were installed by the InstallAnywhere utility. The Choose Product Features window opens as shown in Figure 4 on page 43. This window differs slightly depending on your operating system.
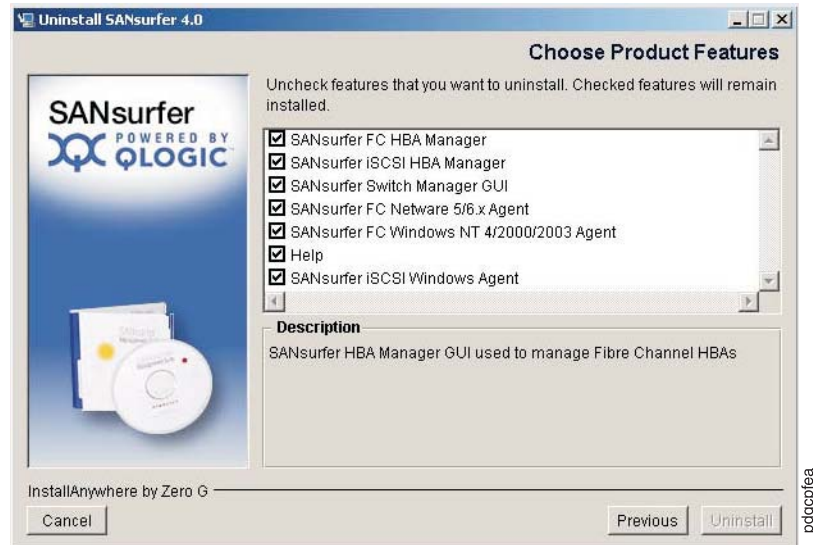
Figure 17. Choose Product Features window

    a. Clear the applicable check box for each feature that you want to uninstall. All features with selected check boxes will remain installed on your system. Select from the following components. (All the components might not be displayed and the order of the components might vary.)

    For a Windows 2000/Windows Server 2003 system:

    – SANsurfer FC HBA Manager

    – SANsurfer FC NetWare 5/6.x Agent

    – SANsurfer FC Windows NT 4/2000/2003 Agent

    – Help

    For a Red Hat/SuSE Linux system:

    – SANsurfer FC HBA Manager

    – SANsurfer FC Linux Agent

    – Help

    For a Solaris SPARC/x86 system:

    – SANsurfer FC HBA Manager GUI

    – SANsurfer FC Solaris Agent

    – Help

    b. Click **Uninstall**.

4. The Uninstall SANsurfer window contains a list of the features that are being uninstalled, as shown in Figure 15 on page 52.

Figure 18. Uninstall SANsurfer window

5. The Uninstall Complete window opens when the uninstall utility has completed the uninstall as shown in Figure 19. Click **Done**.
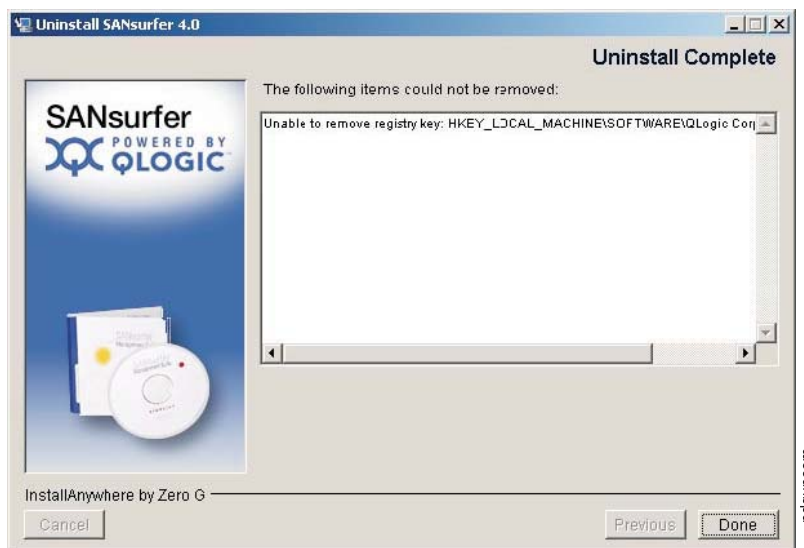
Figure 19. Uninstall Complete window

6. Some files and directories remain after uninstalling the SANsurfer application. Delete any remaining SANsurfer files or directories from the location where the SANsurfer application was installed on the computer's hard disk drive. The default locations are as follows:

   • For Windows 2000/Windows Server 2003 systems: Program Files\QLogic_Corporation\SANsurfer

   • For Red Hat/SuSE Linux and Solaris SPARC/x86 systems: /opt/QLogic_Corporation/SANsurfer

7. If you used the **Add/Remove Programs** utility to uninstall the SANsurfer FC HBA Manager from a Windows 2000/Windows Server 2003 system, do the following:

a. Click **Cancel** to close the Add/Remove Programs window.

b. Click **Close** to close the Control Panel.

8. If prompted to do so, restart the system.

SANsurfer FC HBA Manager features

The SANsurfer FC HBA Manager has the following features:

- **Asset management** Connect to and disconnect from local and remote hosts. The SANsurfer FC HBA Manager also provides information about connected hosts and their attached QLogic HBAs with connected storage devices.

- **Configuration management** Configure local and remote systems. Use the SANsurfer FC HBA Manager to do the following tasks:

  - Configure QLogic Fibre Channel HBAs.

  - Configure Fibre Channel devices.

  - Compare hosts. View the differences between the current host and any saved host configuration, to see what has changed in the SAN.

  - Configure LUNs for a device (load balancing).

    See the SANblade HBA Support Matrix (Fibre Channel & iSCSI) on the SANsurfer CD for a list of HBAs that support LUN load balancing.

    Support for additional operating systems and HBAs will be added in future versions of the SANsurfer FC HBA Manager.

  - Configure LUN path failover. See the *SANblade HBA Support Matrix (Fibre Channel & iSCSI)* on the SANsurfer CD for a list of HBAs that support LUN path failover.

  - Support for additional operating systems and HBAs will be added in future versions of the SANsurfer FC HBA Manager.

  - Persistently bind targets.

  - Replace devices.

  - Update the NVRAM, flash BIOS, and HBA driver.

- **Statistics** The SANsurfer FC HBA Manager provides statistics for each host and HBA port. These statistics can be collected automatically or by request; they can be reset at any time. In addition, you can export the statistics to a comma separated values (CSV) file that can be imported into other applications, such as Microsoft Excel.

- **Diagnostics** The SANsurfer FC HBA Manager provides end-to-end diagnostics that enable you to test the HBAs and the devices to which they are connected. The SANsurfer FC HBA Manager diagnostics allow you to do the following tasks:

  - Test the link status of each HBA and its attached devices

  - Perform a loopback test, which is external to the HBA, to evaluate the ports (transmit and receive transceivers) on the HBA and the error rate.

  - Perform a read/write buffer test, which tests the link between the HBA and its attached devices.

- **Alarm and event notifications** The SANsurfer FC HBA Manager provides asynchronous notification of various conditions and problems through alarms and events. Alarm information includes severity, time, host, HBA, application, and description. Event information includes severity, time, and message. In addition, the alarm and event information can be exported to a CSV file that can be imported into other applications, such as Microsoft Excel. Alarm information can be sent automatically by e-mail to a distribution list.

QLogic SANsurfer basic features overview

This section lists the SANsurfer features and contains general information needed to run the SANsurfer application on any supported platform.

For additional details about the SANsurfer functions, refer to the SANsurfer online help.

Features

The SANsurfer application enables you to perform the following actions:
- Set the SANsurfer options
- Connect to hosts
- Disconnect from a host
- View extensive event and alarm log information
- Use host-to-host SAN configuration policies
- Configure port devices
- Use LUN Level configuration
- Watch real time to see when failovers occur with the Failover Watcher
- Control host-side agent operations, including setting the host agent polling interval
- Review host adapter information, including:
  - General information
  - Statistics
  - Information on attached devices
  - Attached device link status
- Perform adapter functions, including:
  - Configure adapter NVRAM settings
  - Run fibre channel diagnostics (read/write and loopback tests)
  - Perform flash updates on an adapter
  - Perform NVRAM updates on an adapter
- Manage configurations
  - Save configurations for offline policy checks and SAN integrity
  - Load configurations from file if host is offline for policy checks and SAN integrity
- Confirm security

Options

To configure the SANsurfer application, click **View**, and then click **Options**. The Options window opens.

The Options window has four panels and two buttons:
- Event Log
- Alarm Log
- Warning Displays
- Configuration Change Alarm
- **OK** (save changes) and **Cancel** (discard changes) buttons

The Options window functions are described in the following sections.

Event log

The event log size can be restricted to a certain number of entries. If the log size is reached, the oldest entries are removed to allow space for the newest entries. The current log size can range from 20 to 200 event entries. If information or warning events are to be logged, click the associated check box. Logged information includes: communication and file system errors. The SANsurfer application stores the event entries in a file called 'events.txt'.

Example entries follow:

```
Tue Dec 23 16:22:29 PST 2003, 4, RPC request 42 for Host 10.3.10.64
failed., 2

Tue Dec 23 16:22:29 PST 2003, 4, Retrying RPC request 42 for Host
10.3.10.64., 2

Tue Dec 23 16:22:30 PST 2003, 4, RPC request 42 for Host 10.3.10.64
failed., 2

Tue Dec 23 16:22:30 PST 2003, 4, Retrying RPC request 42 for Host
10.3.10.64., 2

Tue Dec 23 16:22:30 PST 2003, 4, RPC request 42 for Host 10.3.10.64
failed., 2
```

Alarm log

While the SANsurfer application communicates with a host, the application continually receives notification messages from the host indicating various changes directly or indirectly made on a host's adapter(s). The log size can be restricted to a certain number of entries. If the log size is reached, the oldest entries are removed to allow space for the newest entries. The current log size can range from 20 to 200 event entries. Logged information includes: status, configuration and NVRAM changes. The SANsurfer application stores the alarm entries in a file called 'alarms.txt'.

Example entries follow:

```
Wed Dec 24 10:27:28 PST 2003, qlogic-agc001, 1-QLA2300/2310, 0, Status
Change:  Good Status. Loop Down., 1

Wed Dec 24 10:27:28 PST 2003, qlogic-agc001, 4-QLA2350, 0, Status Change:
Good Status. Loop Down., 1

Wed Dec 24 10:27:50 PST 2003, qlogic-agc001, 1-QLA2300/2310, 0, Status
Change:  Good Status. Loop Down., 1

Wed Dec 24 10:27:50 PST 2003, qlogic-agc001, 4-QLA2350, 0, Status Change:
Good Status. Loop Down., 1
```

Warning displays

The SANsurfer application displays additional warning dialogs throughout the application. By default, the Warning Displays option is enabled. To disable the display of warning dialogs, clear the **Enable warning displays** check box in the Options window.

Configuration change alarm

The SANsurfer application attempts to keep current the devices and the LUNs that the adapter displays. During cable disconnects, device hot plugs, or device removal, configuration change alarms are generated to keep the GUI current. You can control the way the SANsurfer application handles configuration change alarms with the Configuration Change Alarm option. You can choose from the following options:

- Apply Configuration Changes Automatically

  When a configuration change alarm is detected by the GUI, the application disconnects the host and reconnects to get the new configuration automatically.

- Confirm Configuration Change Applies (default setting)

  When a configuration change alarm is detected by the GUI, the application opens a window in which the user clicks **Yes** or **No** to refresh the configuration for the specified host.

- Ignore Configuration Changes

  With this setting, a configuration change alarm detected by the GUI is ignored. For the configuration to be updated, you must perform a manual disconnect and connect of the host must be performed.

Note: Refresh the configuration by selecting the desired host and clicking **Refresh** on the toolbar or by right-clicking the desired host and clicking **Refresh** from the menu.

Connecting to hosts

There are three ways to connect to hosts in a network:

- Manually
- Automatically with the Broadcast function
- Host files

For multi-homed or multiple IP hosts, the SANsurfer application tries to ensure that a specified host is not loaded twice into the recognized host tree. If a particular host has multiple interfaces (NICs), each with its own IP address, and proper name-resolution-services are prepared, the host will not be loaded twice into the tree. Problems can occur when one or more IPs are not registered with a host.

A blinking heart indicator (blue pulsating heart icon) indicates that the connection between the client and remote agent is active for this test.

Manual connection

Perform the following steps to manually connect to a host:

1. In the SANsurfer main window, click **Connect** or click **Connect** from the **Host** menu.

   The Connect to Host window opens.

2. Type the host name (you want to connect to) in the field, or select the host name from the list. You can use the computer IP address or its host name. If the computer you want to connect to is the computer on which the SANsurfer application is running, select **localhost** from the list. To delete all user-entered host names from the list, click **Clear**.

3. After you have selected or typed the host name, click **Connect** to initiate the connection.

If the connection attempt fails, an error message is displayed indicating the failure and potential causes. If the connection is successfully established, the host's name and its adapters are shown on the HBA tree.

Click **Cancel** to stop the connection process and return to the main window.

Broadcast connections

the SANsurfer application can auto-connect to all hosts running an agent in a network. For auto-connect to function properly, ensure that the **Broadcast** setting is enabled. To enable auto-connect, select the **Auto Connect** check box from the **Settings** menu. To disable auto-connect, clear the **Auto Connect** check box.

Note: If multiple NICs are present in the system, the SANsurfer client will broadcast to the first IP address subnet based on the binding order. Therefore, ensure that the NIC for the local subnet is first in the binding order. If this is not done, the diagnostics might not run properly and remote connection might not occur. See the readme file in the release package for more information.

Host files

The final way that the SANsurfer application provides to connect to a specified agent or agents is by using a host file to connect to all specified hosts (that are present in the file). The feature can be useful if you (the system administrator) have to manage a number of fibre channel attached hosts that are in the same SAN and do not want to connect to each of the host(s) individually.

Creating a Host File: Perform the following steps to save the group of hosts that display in the HBA tree to a host file.

1. Do one of the following:
   * From the Host menu In the SANsurfer main window, click **Save Group**.
   * Right-click the HBA tree. From the menu, click **Save Group**.
2. The Save window opens. Save the host file (.hst) in an appropriate directory. Click **Save**.

Note: You can also create a host file (.hst) from the command line. The format of the file is one host name per line, for example:
```
adsw2ksys2
nt4ssys1
  nw51sys7
```

Using a Host File to Connect to Hosts: Perform the following steps to connect to a group of hosts using a previously created host file.

1. Do one of the following:
   * From the Host menu In the SANsurfer main window, click **Open Group**.
   * Right-click the HBA tree. From the menu, click **Open Group**.
2. The ″Open″ window opens. Save the host file (.hst) that contains the hosts to which you want to connect. Click **Open**. The host names are displayed in the SANsurfer main window HBA tree.

Disconnecting from a host

Perform the following steps to disconnect from a host:

1. From the HBA tree in the SANsurfer main window, click the name of host from which you want to disconnect.
2. Click **Host -> Disconnect**.

When a host is disconnected, its entry in the HBA tree is removed.

Polling interval

You can set polling intervals on a per-host basis to retrieve information. The polling interval setting can be in the range from 1 second to 3600 seconds (one hour). Perform the following steps to set the polling interval:

1. From the HBA tree in the SANsurfer main window, click the host name.
2. Click **Host** -> **Polling**. The "Polling Settings - target" window opens.
3. Type the new polling interval, and then click **OK**.

Security

the SANsurfer application protects everything written to the adapter or adapter configuration with an agent-side password. You can set the host agent password from any host that can run the SANsurfer GUI and connect to the host agent.

When a configuration change is requested, the Security Check window opens. Type the application-access password to validate it.

To change a host agent password, click the host name in the HBA tree. The Information/Security window opens. Click the **Security** tab to open the Security page.

The security page is divided into two panels: Host Access and Application Access.

Host access

The Host Access panel verifies that the host user login and password has administrator or root privileges before an application access is attempted. The login and password values are the same as those used to access the computer.

Login   A host user account with administrator or root-level rights.

Password
        The password for the host user account.

Application access

The Application Access panel enables you to change the SANsurfer host agent password. To change the password, type the following information in the following fields:

Old password
        The current application-access password for the host. The original default password is *config*. Immediately change the default password to a new password.

New password
        The new application-access password for the host.

Verify Password
        The new application-access password for host verification.

The Help menu

From the SANsurfer **Help** menu, you can specify the location of the browser to open when help is requested by a user. You can also view the SANsurfer application version information.

The **Help** menu contains the following items:

- **Set Browser Location**

  Opens the Browser Location window. Type the file path of the browser that the SANsurfer application opens when a user requests help, or click **Browse** to navigate to the file location.

- **Browse Contents**

  Opens the SANsurfer help.

- **About**

  Displays information about the SANsurfer application, including the current SANsurfer version number.

Chapter 5. PD hints: Common path/single path configurations

You should be referred to this chapter from a PD map or indication. If this is not the case, see Chapter 2, "Problem determination starting points," on page 3.

After you read the relevant information in this chapter, return to "Common Path PD map 1" on page 20.

In Figure 20, the HBA, HBA-to-concentrator cable, and the port that this cable uses are on the common path to all storage. The other cables and ports to the controllers are on their own paths so that a failure on them does not affect the others. This configuration is referred to a common or single path.
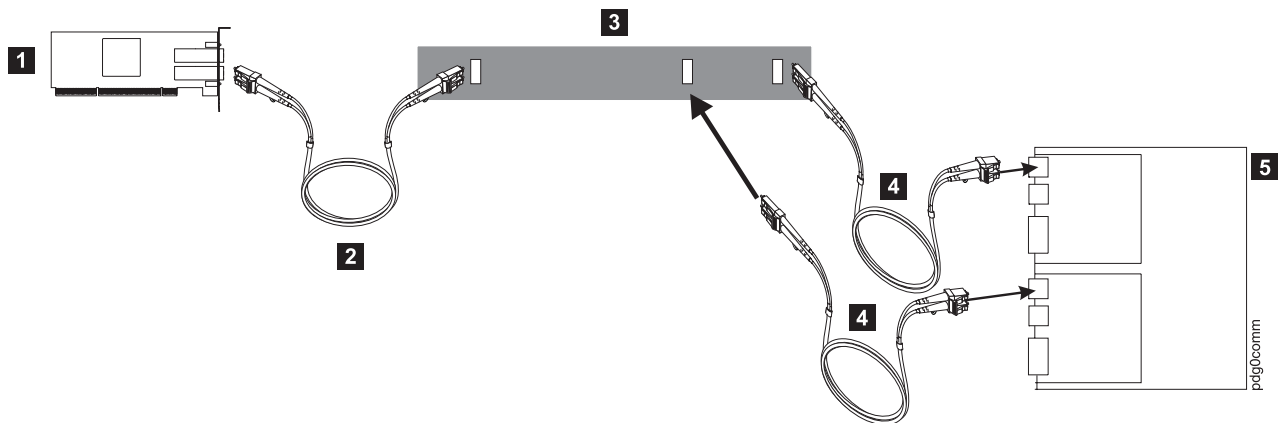
Figure 20. Common path configuration

Table 3. Description of Figure 20

Number	Description
1	FC host adapter (HBA)
2	Common path—concentrator to HBA
3	Concentrator
4	Single path(s)—Concentrator to controller
5	Controller A
6	Controller B

Chapter 6. PD hints: RAID controller errors in the Windows 2000, Windows 2003, or Windows NT event log

You should be referred to this chapter from a PD map or indication. If this is not the case, see Chapter 2, "Problem determination starting points," on page 3.

After you read the relevant information in this chapter, return to "RAID Controller Passive PD map" on page 9.

This chapter presents general guidelines that explain the errors that can appear in an event log and what actions to perform when these errors occur.

Note: If you have a system running on the Windows NT 4.0 operating system, the driver is listed as SYMarray. If you have a system running on the Windows 2000 or Windows 2003 operating systems, the driver is listed as RDACFLTR.

Common error conditions

- **Getting a series of SYMarray event ID 11s in the Windows event log**

  Open and review the event log. A series of event ID 11s generally indicates a number of bus resets and might be caused by a bad host bus adapter or a bad cable.

- **Getting a series of SYMarray event ID 11s and 18s in the Windows event log**

  Open and review the event log. A series of event ID 11s generally indicates LIPs (Loop resets). This generally indicates a bad fibre path. It could be an indication of a problem with a GBIC, an MIA, or an adapter.

  Event ID 18s indicate that RDAC failed a controller path. The fault will most likely be a component in the fibre path, rather than the controller.

- **Getting a series of SYMarray event ID 15s in the Windows event log**

  This error is undocumented. A series of event ID 15s indicates that the link is down. The problem is generally within the Fibre path.

Event log details

In addition to reviewing the SANtricity Storage Manager log, you can choose to review the Windows event log, which is viewed in a GUI environment (see Figure 21). To open the event log, click **Start -> Programs -> Administrative Tools -> Event Viewer**.

Date	Time	Source	Category	Event	User
2/22/99	4:35:25 AM	symarray	None	11	N/A
2/21/99	11:34:35 PM	symarray	None	11	N/A
2/18/99	12:47:45 AM	SNMP	None	1001	N/A

Figure 21. Event log

Table 4 on page 66 lists the most common, but not necessarily the only, event IDs encountered in a SYMarray (RDAC) event.

Table 4. Common SYMarray (RDAC) event IDs

Event	Microsoft Label Identifier	Description
9	IO_ERR_TIMEOUT	The device %s did not respond within timeout period.
11	IO_ERR_CONTROLLER_ERROR	Driver detected controller failure.
16	ERR_INVALID_REQUEST	The request is incorrectly formatted for %1.
18	IO_LAYERED_FAILURE	Driver beneath this layer failed.
389	STATUS_IO_DEVICE_ERROR	The I/O device reported an I/O error.

Event ID 18 is a special case. SYMarray uses event ID 18 to designate a failed controller path. (The controller on the physical path is the failed controller.) All LEDs on the controller are usually lit when a failure occurs. This does not necessarily mean that the controller is defective, but rather that a component along the path to the controller is generating errors. Possible problem components include the host adapter, fibre cable, GBIC, hub, and so on.

In a multi-node cluster with multiple event ID 18s, the earliest log entry most likely initiated the original controller failure. Event ID 18s on other nodes were most likely responses to the original failure and typically contain an SRB status of (0x0a - SCSI Selection Timeout). Check the system date and time stamp for synchronization to validate which entry occurred first. To review an entry in the Event Viewer, perform the following steps:

1. Double-click the entry you want to review.
2. Select the **Words** radio button to convert the bottom text from bytes to words. See Figure 22.
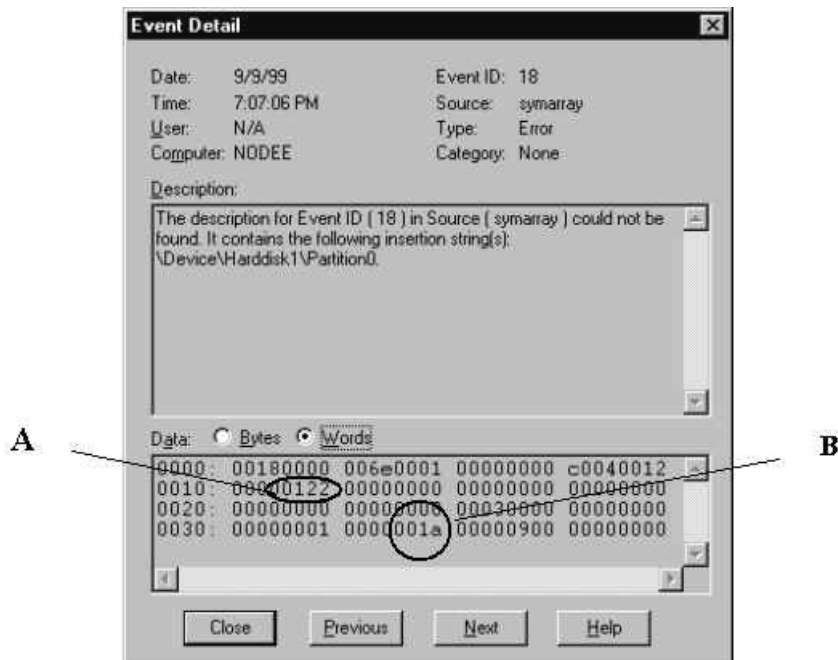
Figure 22. Event detail

A. The last four digits (2 bytes) in this field indicate the unique error value. In this example, the error value shown indicates a Controller Failover Event.

B. For Event ID 18, this offset represents the SCSI operation that was attempted when the failover event took place.

Table 5. Unique error value - Offset 0x0010

Unique Error Value - Offset 0x0010			
Value	Meaning	Value	Meaning
100	Media Error (check condition)	110	Device Not Ready (check condition)
101	Hardware Error (check condition)	111	No Sense (check condition)
102	Recovered Error (check condition)	112	Unrecognized Sense Key
103	Default - Controller Error	113	Error being returned to system that will otherwise not be logged
105	Command Aborted or Timed Out	114	SCSI Release Configuration Error, Multiple paths to the same controller
106	Phase Sequence Error	115	SCSI Reserve Configuration Error, Multiple paths to the same controller
107	Request Flushed	116	The driver has discovered more paths to a controller than are supported (four are supported)
108	Parity Error or Unexpected Bus Free	117	The driver has discovered devices with the same WWN but different LUN numbers
109	SCSI Bus Error Status (busy, queue full, and so on)	122	Controller Failover Event (alternate controller/path failed)
10a	Bus Reset	123	A path to a multipath controller failed
10e	Aborted Command (check condition)	124	A controller failover failed
10f	Illegal Request (check condition)	125	A Read/Write error has been returned to the system

The example shown in Figure 23 is a recovered drive timeout error on drive 2, 1.
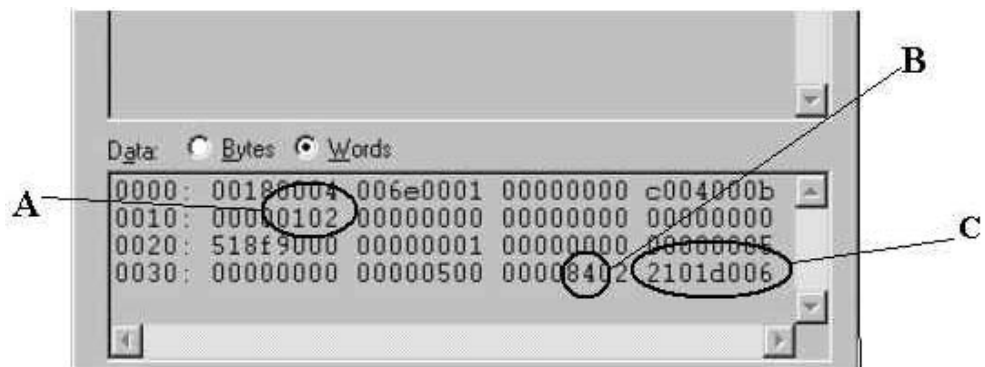
Figure 23. Unique error value example

A. This error indicates (according to the error codes listed in Table 5) a recovered error.

B. This bit indicates validity of the following word. A number 8 means field C is a valid sense key. A number other than 8 means that field C is not valid and should be disregarded.

C. This word represents the FRU code, SCSI sense key, ASC and ASCQ.

ffkkaaqq –			
ff = FRU code	kk = SCSI sense key	aa = ASC	qq = ASCQ

Sense Key table

Table 6 lists Sense Key values and descriptions.

Table 6. Sense Key table

SENSE KEY	DESCRIPTION
0x00	No Sense
0x01	Recovered Error
0x02	Not Ready
0x03	Medium Error
0x04	Hardware Error
0x05	Illegal Request
0x06	Unit Attention
0x07	Data Protect (Not Used)
0x08	Blank Check (Not used)
0x09	Vendor Specific (Not used)
0x0A	Copy Aborted (Not used)
0x0B	Aborted Command
0x0C	Equal (Not used)
0x0D	Volume Overflow (Not used)
0x0E	Miscompare
0x0F	Reserved (Not used)

ASC/ASCQ table

This section lists the Additional Sense Codes (ASC) and Additional Sense Code Qualifier (ASCQ) values returned by the array controller in the sense data. SCSI-2 defined codes are used when possible. Array-specific error codes are used when necessary, and are assigned SCSI-2 vendor-unique codes 80 through FFH. More detailed sense key information can be obtained from the array controller command descriptions or the SCSI-2 standard.

Codes defined by SCSI-2 and the array vendor-specific codes are shown in Table 7. The sense keys most likely to be returned for each error are also listed in the table.

Table 7. ASC/ASCQ values

ASC	ASCQ	Sense Key	Description
00	00	0	No Additional Sense Information The controller has no sense data available for the requesting host and addressed logical unit combination.

Table 7. ASC/ASCQ values (continued)

ASC	ASCQ	Sense Key	Description
04	01	2	Logical Unit is in the Process of Becoming Ready The controller is running its initialization functions on the addressed logical unit. This includes drive spinup and validation of the drive and logical unit configuration information.
04	02	2	Logical Unit Not Ready, Initializing Command Required The controller is configured to wait for a Start Stop Unit command before spinning up the drives, but the command has not yet been received.
04	04	2	Logical Unit Not Ready, Format In Progress The controller previously received a Format Unit command from an initiator, and is in the process of running that command.
04	81	2	Storage Module Firmware Incompatible - Manual Code Synchronization Required
04	A1	2	Quiescence Is In Progress or Has Been Achieved
0C	00	4	Unrecovered Write Error Data could not be written to media due to an unrecoverable RAM, battery, or drive error.
0C	00	6	Caching Disabled Data caching has been disabled due to loss of mirroring capability or low battery capacity.
0C	01	1	Write Error Recovered with Auto Reallocation The controller recovered a write operation to a drive and no further action is required by the host. Auto reallocation might not have been used, but this is the only standard ASC/ASCQ that tells the initiator that no further actions are required by the driver.
0C	80	4, (6)	Unrecovered Write Error Due to Non-Volatile Cache Failure The subsystem Non-Volatile cache memory recovery mechanisms failed after a power cycle or reset. This is possibly due to some combination of battery failure, alternate controller failure, or a foreign controller. User data might have been lost.
0C	81	4, (6)	Deferred Unrecoverable Error Due to Memory Failure Recovery from a Data Cache error was unsuccessful. User data might have been lost.
11	00	3	Unrecovered Read Error An unrecovered read operation to a drive occurred and the controller has no redundancy to recover the error (RAID 0, degraded RAID 1, degraded mode RAID 3, or degraded RAID 5).
11	8A	6	Miscorrected Data Error - Due to Failed Drive Read A media error has occurred on a read operation during a reconfiguration operation. User data for the LBA indicated has been lost.

Table 7. ASC/ASCQ values (continued)

ASC	ASCQ	Sense Key	Description
18	02	1	Recovered Data - Data Auto Reallocated The controller recovered a read operation to a drive and no further action is required by the host. Auto reallocation might not have been used, but this is the only standard ASC/ASCQ that tells the initiator that no further actions are required by the driver.
1A	00	5	Parameter List Length Error A command was received by the controller that contained a parameter list and the list length in the CDB was less than the length necessary to transfer the data for the command.
20	00	5	Invalid Command Operation Code The controller received a command from the initiator that it does not support.
21	00	5	Logical Block Address Out of Range The controller received a command that requested an operation at a logical block address beyond the capacity of the logical unit. This error could be in response to a request with an illegal starting address or a request that started at a valid logical block address and the number of blocks requested extended beyond the logical unit capacity.
24	00	5	Invalid Field in CDB The controller received a command from the initiator with an unsupported value in one of the fields in the command block.
25	00	5	Logical Unit Not Supported The addressed logical unit is currently unconfigured. An Add LUN operation in the Logical Array Mode Page must be run to define the logical unit before it is accessible.
26	00	5	Invalid Field in Parameter List The controller received a command with a parameter list that contained an error. Typical errors that return this code are unsupported mode pages, attempts to change an unchangeable mode parameter, or attempts to set a changeable mode parameter to an unsupported value.
28	00	6	Not Ready to Ready Transition The controller has completed its initialization operations on the logical unit and it is now ready for access.
29	00	6	Power On, Reset, or Bus Device Reset Occurred The controller has detected one of the above conditions.
29	04	6	Device Internal Reset The controller has reset itself due to an internal error condition.
29	81	(6)	Default Configuration has been Created The controller has completed the process of creating a default logical unit. There is now an accessible logical unit that did not exist previously. The host should run its device scan to find the new logical unit.
29	82	6	Controller Firmware Changed Through Auto Code Synchronization The controller firmware has been changed through the Auto Code Synchronization (ACS) process.

Table 7. ASC/ASCQ values (continued)

ASC	ASCQ	Sense Key	Description
2A	01	6	Mode Parameters Changed The controller received a request from another initiator to change the mode parameters for the addressed logical unit. This error notifies the current initiator that the change occurred. This error might also be reported in the event that Mode Select parameters changed as a result of a cache synchronization error during the processing of the most recent Mode Select request.
2A	02	6	Log Parameters Changed The controller received a request from another initiator to change the log parameters for the addressed logical unit. This error notifies the current initiator that the change occurred. This error is returned when a Log Select command is issued to clear the AEN log entries.
2F	00	6	Commands Cleared by Another Initiator The controller received a Clear Queue message from another initiator. This error is to notify the current initiator that the controller cleared the current initiators commands if it had any outstanding.
31	01	1, 4	Format Command Failed A Format Unit command issued to a drive returned an unrecoverable error.
32	00	4	Out of Alternates A Reassign Blocks command to a drive failed.
3F	01	(6)	Drive micro-code changed
3F	0E	6	Reported LUNs data has changed Previous LUN data reported using a Report LUNs command has changed (due to LUN creation or deletion or controller hot-swap).

Table 7. ASC/ASCQ values (continued)

ASC	ASCQ	Sense Key	Description
3F	8N	(6)	Drive No Longer Usable The controller has set a drive to a state that prohibits use of the drive. The value of N in the ASCQ indicates the reason why the drive cannot be used. 0 - The controller set the drive state to ″Failed - Write failure″ 1 - Not used 2 - The controller set the drive state to ″Failed″ because it was unable to make the drive usable after replacement. A format or reconstruction error occurred. 3 - Not used 4 - Not used 5 - The controller set the drive state to ″Failed - No response″ 6 - The controller set the drive state to ″Failed - Format failure″ 7 - The controller set the drive state to ″User failed via Mode Select″ 8 - Not used 9 - The controller set the drive state to ″Wrong drive removed/replaced″ A - Not used B - The controller set the drive state to ″Drive capacity < minimum″ C - The controller set the drive state to ″Drive has wrong block size″ D - The controller set the drive state to ″Failed - Controller storage failure″ E - Drive failed due to reconstruction failure at Start of Day (SOD)
3F	98	(6)	Drive Marked Offline Due to Internal Recovery Procedure An error has occurred during interrupted write processing causing the LUN to transition to the Dead state. Drives in the drive group that did not experience the read error will transition to the Offline state (0x0B) and log this error.
3F	BD	(6)	The controller has detected a drive with Mode Select parameters that are not recommended or which could not be changed. Currently this indicates the QErr bit is set incorrectly on the drive specified in the FRU field of the Request Sense data.
3F	C3	(6)	The controller had detected a failed drive side channel specified in the FRU Qualifier field.
3F	C7	(6)	Non-media Component Failure The controller has detected the failure of a subsystem component other than a disk or controller. The FRU codes and qualifiers indicate the faulty component.
3F	C8	(6)	AC Power Fail The Uninterruptible Power Source has indicated that ac power is no longer present and the UPS has switched to standby power.
3F	C9	(6)	Standby Power Depletion Imminent The UPS has indicated that its standby power source is nearing depletion. The host should take actions to stop IO activity to the controller.

Table 7. ASC/ASCQ values (continued)

ASC	ASCQ	Sense Key	Description
3F	CA	(6)	Standby Power Source Not at Full Capability

The UPS has indicated that its standby power source is not at full capacity. |
| 3F | CB | (6) | AC Power Has Been Restored

The UPS has indicated that ac power is now being used to supply power to the controller. |
| 3F | D0 | (6) | Write Back Cache Battery Has Been Discharged

The controllers battery management has indicated that the cache battery has been discharged. |
| 3F | D1 | (6) | Write Back Cache Battery Charge Has Completed

The controllers battery management has indicated that the cache battery is operational. |
| 3F | D8 | (6) | Cache Battery Life Expiration

The cache battery has reached the specified expiration age. |
| 3F | D9 | (6) | Cache Battery Life Expiration Warning

The cache battery is within the specified number of weeks of failing. |
| 3F | E0 | (6) | Logical Unit Failure

The controller has placed the logical unit in a Dead state. User data, parity, or both can no longer be maintained to ensure availability. The most likely cause is the failure of a single drive in non-redundant configurations or a second drive in a configuration protected by one drive. The data on the logical unit is no longer accessible. |
| 3F | EB | (6) | LUN marked Dead due to Media Error Failure during SOD

An error has occurred during interrupted write processing causing the LUN to transition to the Dead state. |

Table 7. ASC/ASCQ values (continued)

ASC	ASCQ	Sense Key	Description
40	NN	4, (6)	Diagnostic Failure on Component NN (0x80 - 0xFF) The controller has detected the failure of an internal controller component. This failure might have been detected during operation as well as during an on-board diagnostic routine. The values of NN supported in this release of the software are as follows: 80 - Processor RAM 81 - RAID Buffer 82 - NVSRAM 83 - RAID Parity Assist (RPA) chip or cache holdup battery 84 - Battery Backed NVSRAM or Clock Failure 91 - Diagnostic Self Test failed non-data transfer components test 92 - Diagnostic Self Test failed data transfer components test 93 - Diagnostic Self Test failed drive Read/Write Buffer data turnaround test 94 - Diagnostic Self Test failed drive Inquiry access test 95 - Diagnostic Self Test failed drive Read/Write data turnaround test 96 - Diagnostic Self Test failed drive Self Test
43	00	4	Message Error The controller attempted to send a message to the host, but the host responded with a Reject message.
44	00	4, B	Internal Target Failure The controller has detected a hardware or software condition that does not allow the requested command to be completed. If the sense key is 0x04, indicating a hardware failure, the controller has detected what it believes is a fatal hardware or software failure and it is unlikely that a retry will be successful. If the sense key is 0x0B, indicating an aborted command, the controller has detected what it believes is a temporary software failure that is likely to be recovered if retried.
45	00	1, 4	Selection Time out on a Destination Bus A drive did not respond to selection within a selection time out period.
47	00	1, B	SCSI Parity Error The controller detected a parity error on the host SCSI bus or one of the drive SCSI buses.
48	00	1, B	Initiator Detected Error Message Received The controller received an Initiator Detected Error Message from the host during the operation.
49	00	B	Invalid Message Error The controller received a message from the host that is not supported or was out of context when received.
49	80	B	Drive Reported Reservation Conflict A drive returned a status of reservation conflict.

Table 7. ASC/ASCQ values (continued)

ASC	ASCQ	Sense Key	Description
4B	00	1, 4	Data Phase Error The controller encountered an error while transferring data to or from the initiator or to or from one of the drives.
4E	00	B	Overlapped Commands Attempted The controller received a tagged command while it had an untagged command pending from the same initiator or it received an untagged command while it had one or more tagged commands pending from the same initiator.
5D	80	6	Drive Reported PFA (Predicted Failure Analysis) Condition
80	02	1, 4	Bad ASC code detected by Error/Event Logger
80	03	4	Error occurred during data transfer from SRM host.
84	00	4, 5	Operation Not Allowed With the Logical Unit in its Current State. The requested command or Mode Select operation is not allowed with the logical unit in the state indicated in byte 76 of the sense data. For example, such as an attempt to read or write a dead logical unit or an attempt to verify or repair parity on a degraded logical unit.
84	06	4	LUN Awaiting Format A mode select has been done to create a LUN but the LUN has not been formatted.
85	01	4	Drive IO Request Aborted IO Issued to Failed or Missing drive due to recently failed removed drive. This error can occur as a result of IOs in progress at the time of a failed or removed drive.
87	00	4	Microcode Download Error The controller detected an error while downloading microcode and storing it in non-volatile memory.
87	08	4	Incompatible Board Type For The Code Downloaded
87	0C	6	Download failed due to UTM LUN number conflict
87	0E	6	Controller Configuration Definition Inconsistent with Alternate Controller
88	0A	(6)	Subsystem Monitor NVSRAM values configured incorrectly
8A	00	5	Illegal Command for Drive Access The initiator attempted to pass a command through to a drive that is not allowed. The command could have been sent in pass-thru mode or by attempting to download drive microcode.
8A	01	5	Illegal Command for the Current RAID Level The controller received a command that cannot be run on the logical unit due to its RAID level configuration. Examples are parity verify or repair operations on a RAID 0 logical unit.
8A	10	5	Illegal Request- Controller Unable to Perform Reconfiguration as Requested The user requested a legal reconfiguration but the controller is unable to run the request due to resource limitations.
8B	02	B, (6)	Quiescence Is In Progress or Has Been Achieved
8B	03	B	Quiescence Could Not Be Achieved Within the Quiescence Timeout Period
8B	04	5	Quiescence Is Not Allowed

Table 7. ASC/ASCQ values (continued)

ASC	ASCQ	Sense Key	Description
8E	01	E, (6)	A Parity/Data Mismatch was Detected The controller detected inconsistent parity/data during a parity verification.
91	00	5	General Mode Select Error An error was encountered while processing a Mode Select command.
91	03	5	Illegal Operation for Current Drive State A drive operation was requested through a Mode Select that cannot be run due to the state of the drive. For example, a Delete Drive when the drive is part of a LUN.
91	09	5	Illegal Operation with Multiple SubLUNs Defined An operation was requested that cannot be run when multiple SubLUNs are defined on the drive.
91	33	5	Illegal Operation for Controller State The requested Mode Select operation could not be completed due to the current state of the controller.
91	36	5	Command Lock Violation The controller received a Write Buffer Download Microcode, Send Diagnostic, or Mode Select command, but only one such command is allowed at a time and there was another such command active.
91	3B	6	Improper LUN Definition for Auto-Volume Transfer mode - AVT is disabled. Controller will operate in normal redundant controller mode without performing Auto-Volume transfers.
91	50	5	Illegal Operation For Drive Group State An operation was requested that cannot be run due to the current state of the Drive Group.
91	51	5	Illegal Reconfiguration Request - Legacy Constraint Command could not be completed due to Legacy configuration or definition constraints.
91	53	5	Illegal Reconfiguration Request - System Resource Constraint Command could not be completed due to resource limitations of the controller.
94	01	5	Invalid Request Due to Current Logical Unit Ownership
95	01	4	Extended Drive Insertion/Removal Signal The controller has detected the drive insertion/removal signal permanently active.
95	02	(6)	Controller Removal/Replacement Detected or Alternate Controller Released from Reset The controller detected the activation of the signal or signals used to indicate that the alternate controller has been removed or replaced.
98	01	(6)	The controller has determined that there are multiple sub-enclosures with the same ID value selected.
98	02	(6)	Sub-enclosure with redundant ESMs specifying different Tray IDs
98	03	(6)	Sub-enclosure ESMs have different firmware levels

Table 7. ASC/ASCQ values (continued)

ASC	ASCQ	Sense Key	Description
A0	00	(6)	Write Back Caching Could Not Be Enabled The controller could not perform write-back caching due to a battery failure or discharge, Two Minute Warning signal from the UPS, or an ICON failure.
A1	00	(6)	Write Back Caching Could Not Be Enabled - RDAC Cache Size Mismatch The controller could not perform write back caching due to the cache sizes of the two controllers in the RDAC pair not matching.
A4	00	(6)	Global Hot Spare Size Insufficient for All Drives in Subsystem. A defined Global Hot Spare is not large enough to cover all of the drives present in the subsystem. Failure of a drive larger than the Global Hot Spare will not be covered by the Global Hot Spare drive.
A6	00	(6)	Recovered processor memory failure The controller has detected and corrected a recoverable error in processor memory.
A7	00	(6)	Recovered data buffer memory error The controller has detected and corrected a recoverable error in the data buffer memory. Sense bytes 34-36 will contain the count of errors encountered and recovered.
C0	00	4, (6)	The Inter-controller Communications Have Failed The controller has detected the failure of the communications link between redundant controllers.
D0	06	4	Drive IO time out The controller destination IO timer expired while waiting for a drive command to complete.
D1	0A	4	Drive Reported Busy Status A drive returned a busy status in response to a command.
E0	XX	4	Destination Channel Error XX = 00 through 07 indicates the Sense Key returned by the drive after a check condition status XX = 10 indicates that a bus level error occurred
E0	XX	6	Fibre Channel Destination Channel Error XX = 20 indicates redundant path is not available to devices XX = 21 indicates destination drive channels are connected to each other Sense Byte 26 will contain the Tray ID. Sense Byte 27 will contain the Channel ID.

FRU code table

A nonzero value in the FRU code byte identifies a FRU that failed or a group of field-replaceable modules that includes one or more failed devices. For some Additional Sense Codes, the FRU code must be used to determine where the error occurred. For example, the Additional Sense Code for SCSI bus parity error is returned for a parity error detected on either the host bus or one of the drive buses. In this case, the FRU field must be evaluated to determine whether the error occurred on the host channel or a drive channel.

Because of the large number of replaceable units possible in an array, a single byte is not sufficient to report a unique identifier for each individual FRU. To provide meaningful information that will decrease field troubleshooting and problem resolution time, FRUs have been grouped. The defined FRU groups and their descriptions are listed in Table 8.

Table 8. FRU codes

FRU code	Title	Description
0x01	Host Channel Group	A FRU group consisting of the host SCSI bus, its SCSI interface chip, and all initiators and other targets connected to the bus
0x02	Controller Drive Interface Group	A FRU group consisting of the SCSI interface chips on the controller that connect to the drive buses
0x03	Controller Buffer Group	A FRU group consisting of the controller logic used to implement the on-board data buffer.
0x04	Controller Array ASIC Group	A FRU group consisting of the ASICs on the controller associated with the array functions.
0x05	Controller Other Group	A FRU group consisting of all controller-related hardware not associated with another group
0x06	Subsystem Group	A FRU group consisting of subsystem components that are monitored by the array controller, such as power supplies, fans, thermal sensors, and ac power monitors. Additional information about the specific failure within this FRU group can be obtained from the additional FRU bytes field of the array sense.
0x07	Subsystem Configuration Group	A FRU group consisting of subsystem components that are configurable by the user, on which the array controller will display information (such as faults)
0x08	Sub-enclosure Group	A FRU group consisting of the attached enclosure devices. This group includes the power supplies, environmental monitor, and other subsystem components in the sub-enclosure.
0x09-0x0F	Reserved	
0x10-0xFF	Drive Groups	A FRU group consisting of a drive (embedded controller, drive electronics, and Head Disk Assembly), its power supply, and the SCSI cable that connects it to the controller; or supporting sub-enclosure environmental electronics

The FRU code designates the channel ID in the most significant nibble and the SCSI ID of the drive in the least significant nibble.
Note: Channel ID 0 is not used because a failure of drive ID 0 on this channel will cause a FRU code of 0x00, which the SCSI-2 standard defines as no specific unit has been identified to have failed or that the data is not available. |

Chapter 7. PD hints: Configuration types

You should be referred to this chapter from a PD map or indication. If this is not the case, see Chapter 2, "Problem determination starting points," on page 3.

After you read the relevant information in this chapter, return to the "Configuration Type PD map" on page 8.

To simplify a complicated configuration so that it can be debugged readily, reduce the configuration to subsets that you can use to build the larger configuration. This process yields two basic configurations. (The type of RAID controller is not material; DS4800 is shown in the following examples.) The following two sections discuss these two basic configurations.

Type 1 configuration

The identifying features of a type 1 configuration (as shown in Figure 24) are:

- Host adapters are connected directly to mini-hubs of Controller A and B, with one or more host adapters per system.
- Multiple servers can be connected, but without system-to-system failover (no cluster).
- Uses some type of isolation mechanism (such as partitions) between server resources.
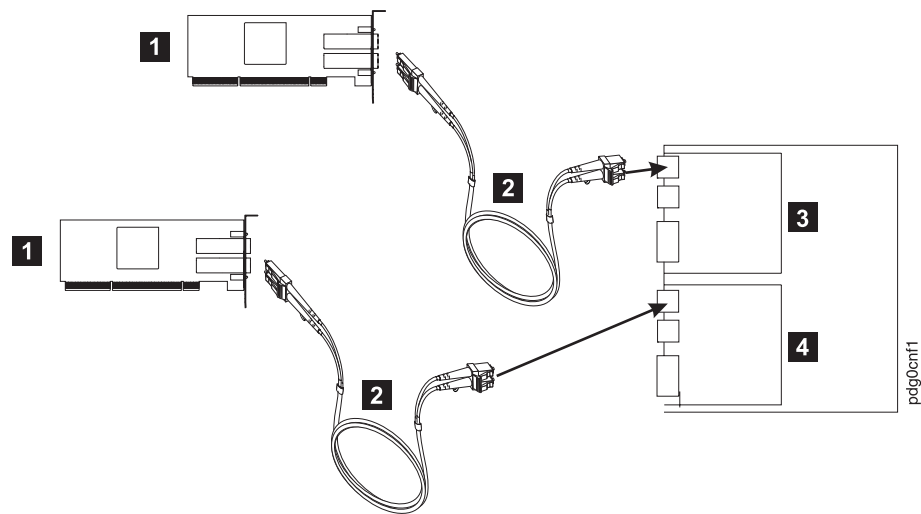
Figure 24. Type 1 configuration

Table 9. Description of Figure 24

Number	Description
1	FC host adapter (HBA)
2	Single path(s)—adapter to controller
3	DS4800 controller A
4	DS4800 controller B

Type 2 configuration

The type 2 configuration can occur with or without hubs and switches, as shown in Figure 25 and Figure 26 on page 82.
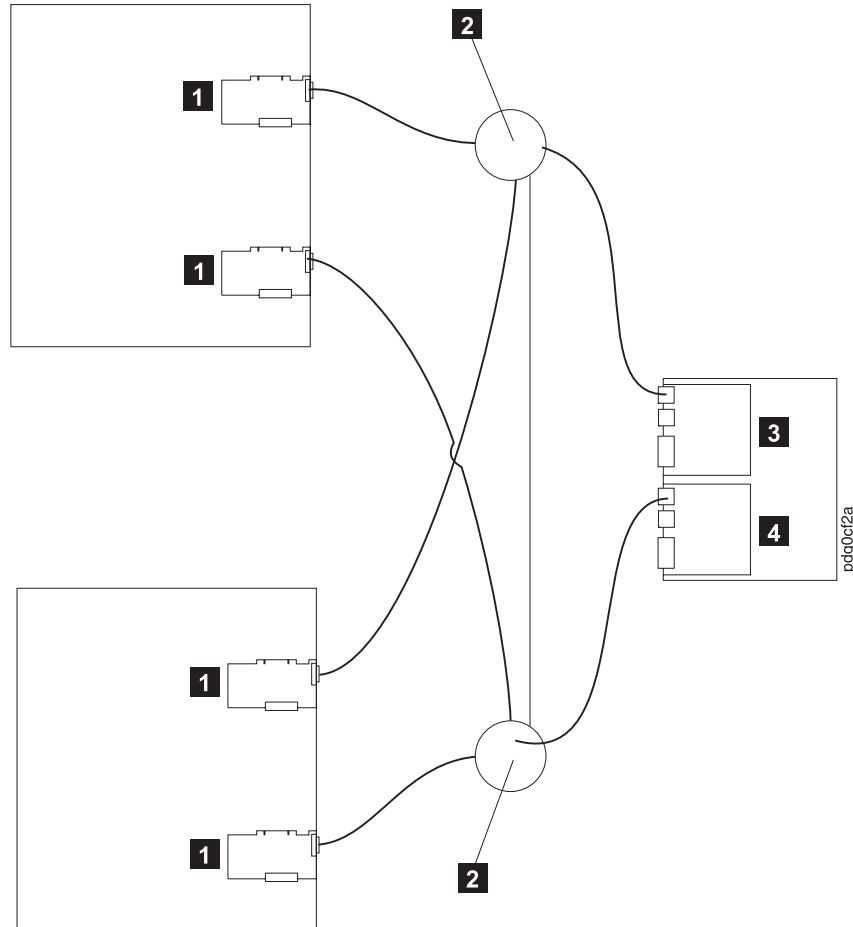
Figure 25. Type 2 configuration—with switches

Table 10. Description of Figure 25

Number	Description
1	FC host adapter (HBA)
2	Managed switch
3	DS4800 controller A
4	DS4800 controller B

The identifying features of a type 2 configuration are:
- Multiple host adapters are connected for full redundancy across systems having failover support such as MSCS.
- Host adapters are connected either directly to mini-hubs or through managed hubs or switches (2 GBIC ports per mini-hub are possible).
- A redundant path to mini-hubs can be separated using optional mini-hubs, as shown in the following figure in red (versus the green path).

Figure 26. Type 2 configuration—without switches

Table 11. Description of Figure 26

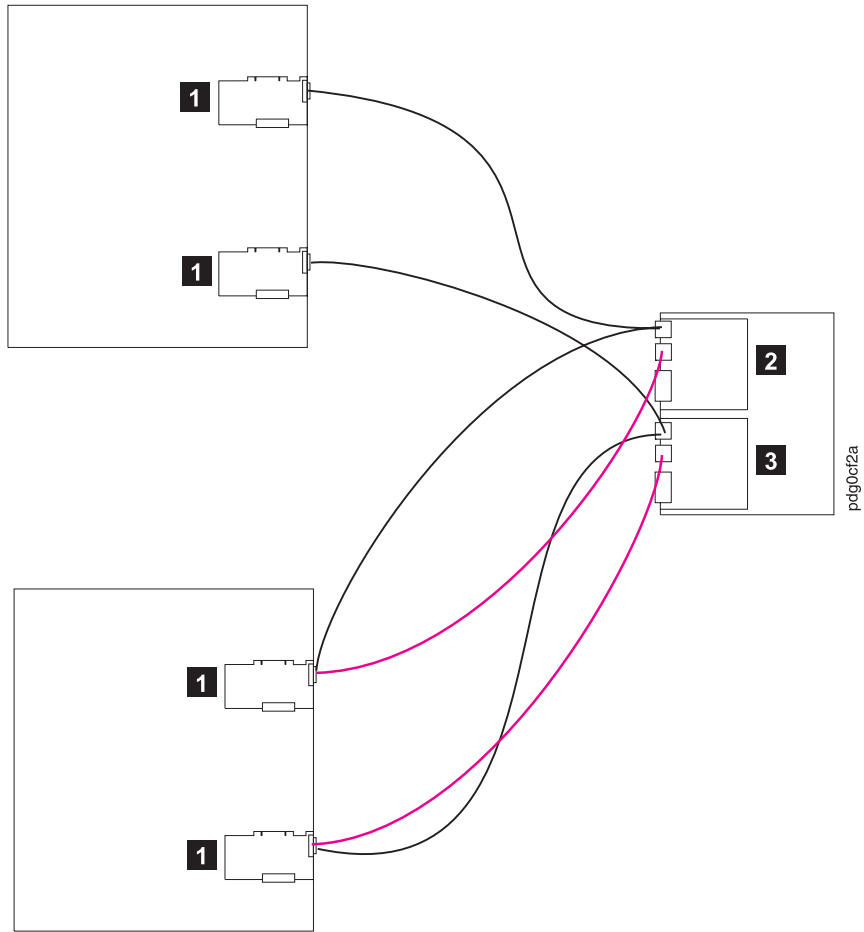| Number	Description
1	FC host adapter (HBA)
2	DS4800 controller A
3	DS4800 controller B

Diagnostics and examples

In a type 1 configuration there are no externally managed hubs or switches to aid in debugging. The diagnostic tools available are the SANsurfer application (from the host adapter end) and the `sendEcho` command (from the RAID controller end). If you intend to diagnose a failed path while using the alternate path for production, be sure that you are familiar with the tools and the loop connections so that the correct portion is being exercised and you do not unplug anything in the active path.

For a type 2 configuration, use the features of the switches and managed hubs and the capability of MSCS to isolate resources from the bad or marginal path before beginning debug activities. Switches and managed hubs allow a view of log information that shows what problems have been occurring, as well as diagnostics that can be initiated from these managed elements. Also, a type 2 configuration has the capability to have more than one RAID controller unit behind a switch or managed hub. In the diagnostic maps, the switches and managed hubs are referred to generically as *concentrators*. Figure 27 shows a type 2 configuration with multiple controller units.
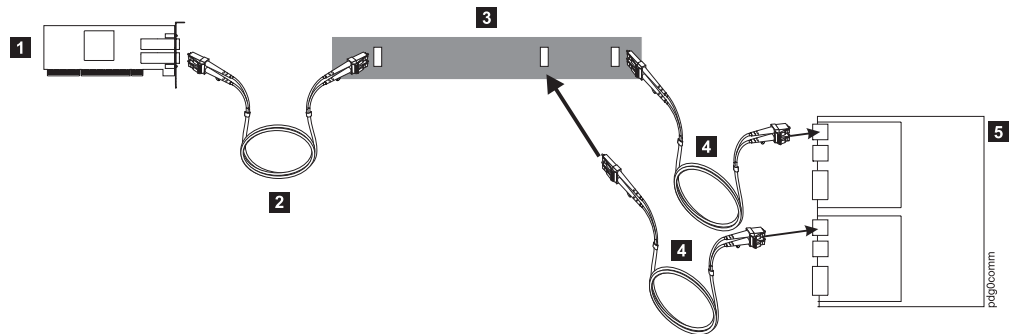
Figure 27. Type 2 configuration with multiple controller units

Table 12. Description of Figure 27

Number	Description
1	FC host adapter (HBA)
2	Common path—concentrator to HBA
3	Concentrator
4	Single path(s)—concentrator to controller
5	Controller A
6	Controller B

Debugging example sequence

An example sequence for debugging a type 2 MSCS configuration is shown in the following sequence of figures.

You can attach multiple server pairs to the switches by using zoning or partitioning for pair isolation or combinations of type 1 and type 2 configurations. Break the larger configuration into its smaller subelements and work with each piece separately. In this way you can remove the good path and leave only the bad path, as shown in the following sequence.

1. One controller is passive. In the example shown in Figure 28, controller B (**4**) is passive.
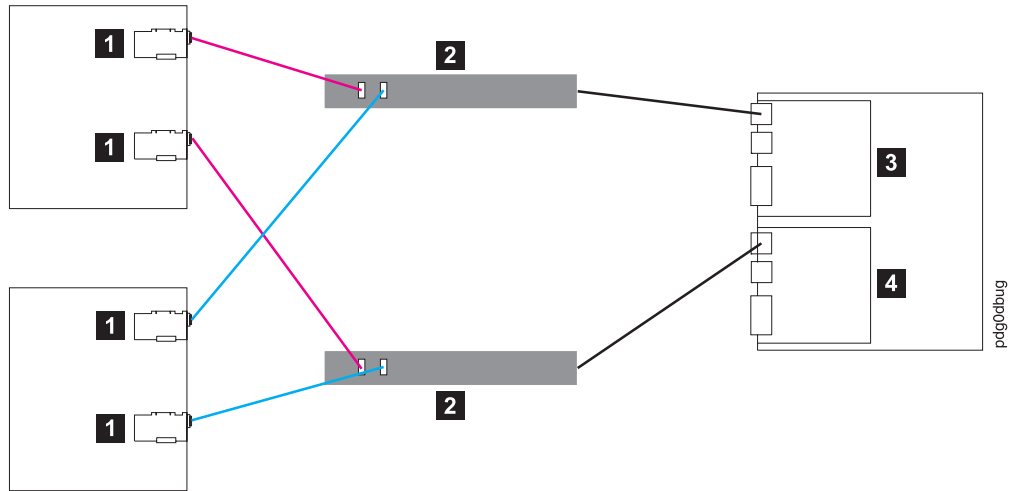
Figure 28. Passive controller B

Table 13. Description of Figure 28

Number	Description
1	FC host adapter (HBA)
2	Concentrator
3	DS4800 controller A
4	Passive DS4800 controller B

2. All I/O is flowing through controller A (**4**). This yields the diagram shown in Figure 29 for debugging.
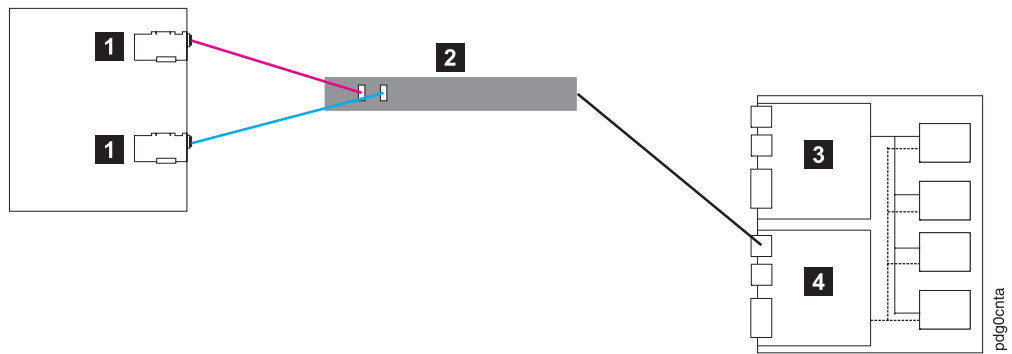
Figure 29. All I/O flowing through controller A

Table 14. Description of Figure 29

Number	Description
1	FC host adapter (HBA)
2	Managed switch
3	DS4800 controller A
4	Passive DS4800 controller B

3. To see more clearly what is involved, redraw the configuration showing the path elements in the loop, as shown in Figure 30.
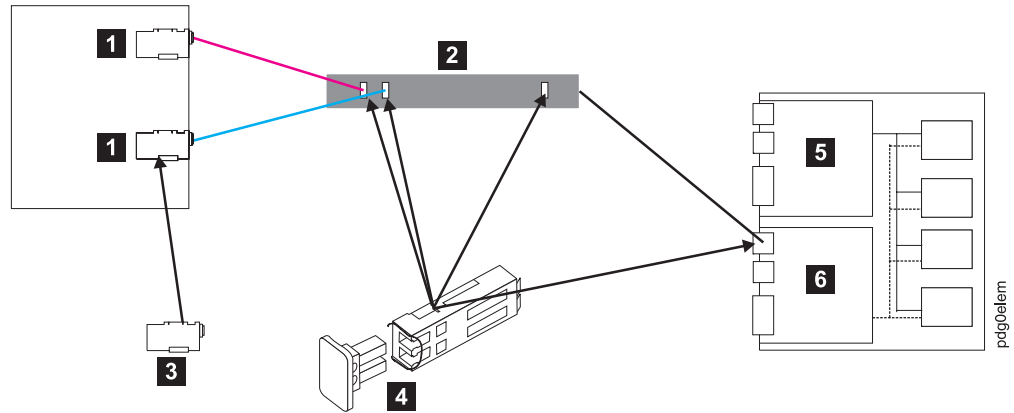
Figure 30. Path elements loop

Table 15. Description of Figure 30

Number	Description
1	FC host adapter (HBA)
2	Managed switch
3	2200 FC host adapter (HBA)
4	SFP module
5	DS4800 controller A
6	Passive DS4800 controller B

Chapter 8. PD hints: Passive RAID controller

You should be referred to this chapter from a PD map or indication. If this is not the case, see Chapter 2, "Problem determination starting points," on page 3.

After you read the relevant information in this chapter, return to "RAID Controller Passive PD map" on page 9.

Use the DS4000 Storage Manager client to view the controller properties of the passive controller, which appears as a dimmed icon.

As shown in Figure 31, right-click the dimmed controller icon and click **Properties**.
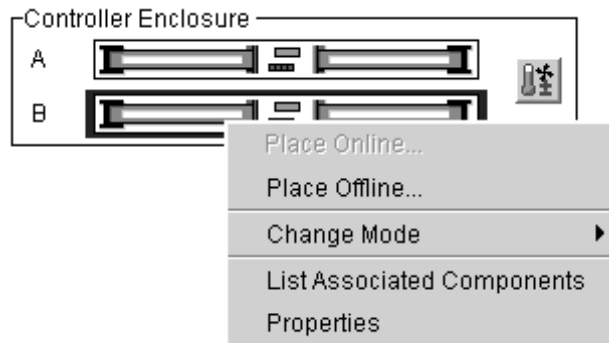
Figure 31. Controller right-click menu
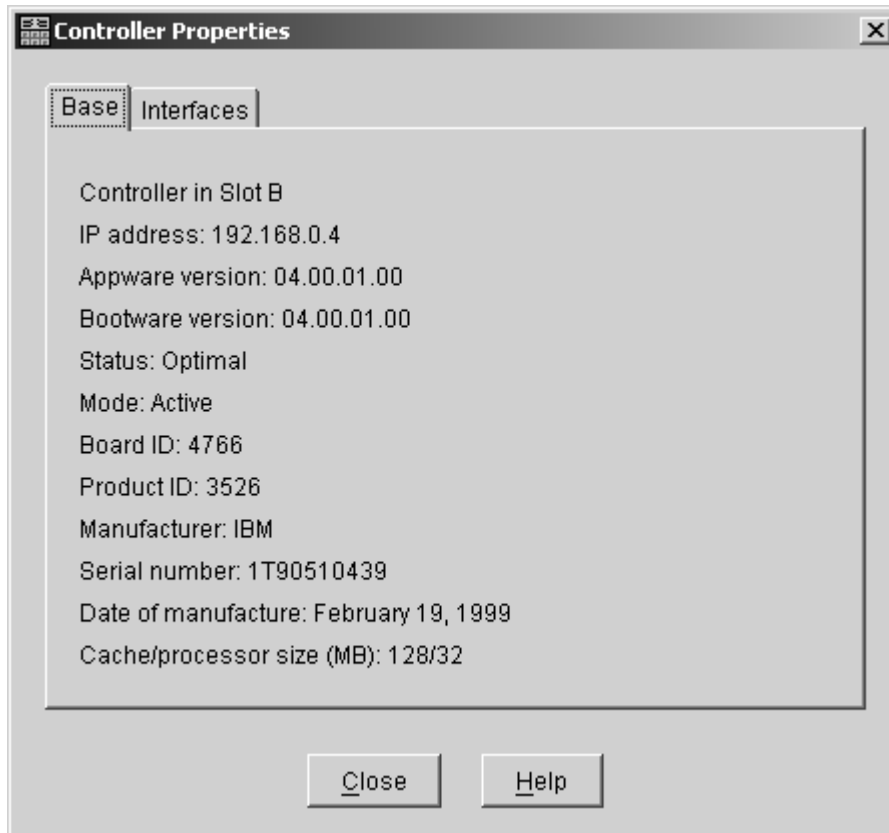
Figure 32. Controller Properties window

If the Controller Properties view (shown in Figure 32) of the dimmed controller icon does not include a message about it being cached, then the controller is passive. Return to the PD map at the page that referred you here ("RAID Controller Passive PD map" on page 9) and continue.

If the Controller Properties information cannot be retrieved, then call IBM Support.

Perform the following steps when you encounter a passive controller and want to understand the cause:

1. Check the controller LEDs to verify that a controller is passive and to see which controller is passive.
2. Look on the system event viewer of the server to find the SYMarray event ID 18. When you find it, write down the date, time, and SRB status. (The SRB status is found in offset x3A in the Windows NT event log. For an example of offset x3A, see the fourth row, third column of the figure on page 66.)
3. If multiple servers are involved, repeat step 2 for each server.
4. Look for the first event ID 18 found in step 2. The SRB status provides information as to why the failure occurred but is valid only if the high order bit is on (8x, 9x, Ax).
5. Check the history of the event log looking for the QL2200/QL2100 events. These entries will give further clues as to whether the fibre loop was stable or not.
   - SRB statuses of 0x0d, 0x0e, and 0x0f point to an unstable loop. (To find the value, discard the high order "valid" bit. For example, 8d yields an SRB status of 0d.)

- QL2200/2100 events of 80110000, 80120000 indicate an unstable loop.
6. If an unstable loop is suspected, diagnose the loop using the fibre path PD aids (see "Fibre Path PD map 1" on page 16).
7. If the diagnosis in step 6 does not reveal the problem, then the adapter and the controller might be the cause. If you determine that the adapter and controller caused the problem, then reset all fibre components on the path and retest.
8. If fibre cabling can be rearranged, swap the adapter cabling so that the adapter communicating to controller A is now connected to controller B (and vice-versa).

   Note: *Do not* do this in a system that is still being used for business. It is useful for bring-up debug.
9. When the problem is resolved, set the controller back to active and rebalance the logical drives.
10. If the problem occurred as the result of an I/O condition, then rerun and determine whether the failure reoccurs.

Note: If the failure still occurs, then you need to perform further analysis, including the use of the serial port to look at loop statuses. The previous steps do not include consideration of switches or managed hubs. If these are included, then see "Hub/Switch PD map 1" on page 13 for helpful tools.

Chapter 9. PD hints: Performing sendEcho tests

You should arrive at this chapter from a PD map or indication. If this is not the case, see Chapter 2, "Problem determination starting points," on page 3.

After you read the relevant information in this chapter, return to "Single Path Fail PD map 1" on page 18.

The 3526 RAID controllers use MIA copper-to-optical converters, while the FAStT200, FAStT500, DS4400, DS4500, DS4300, DS4100, and DS4800 controllers use GBICs or SFPs. There are times when these devices, and their corresponding cable mediums, need to be tested to insure that they are functioning properly.

Note: Running the loopback test for a short period of time might not catch intermittent problems. It might be necessary to run the test in a continuous loop for at least several minutes to track down intermittent problems.

Setting up for a loopback test

This section describes how to set up for a loopback test.

Loopback test for MIA or mini-hub testing

Perform the following steps to set up a loopback test:

1. Remove the fiber-optic cable from the controller MIA or mini-hub.

2. Depending on whether you are working with a 3526 RAID controller or with a FAStT500, DS4400, DS4500, DS4300, DS4100 or DS4800 RAID controller, perform one of the following actions to set up a loopback test:

   a. For a Type 3526 RAID controller, install a wrap plug to the MIA on controller A. See Figure 33.

Failed path of read/write buffer test

3526 Controller Unit

Ctrl A

Install wrap plug to MIA on controller A
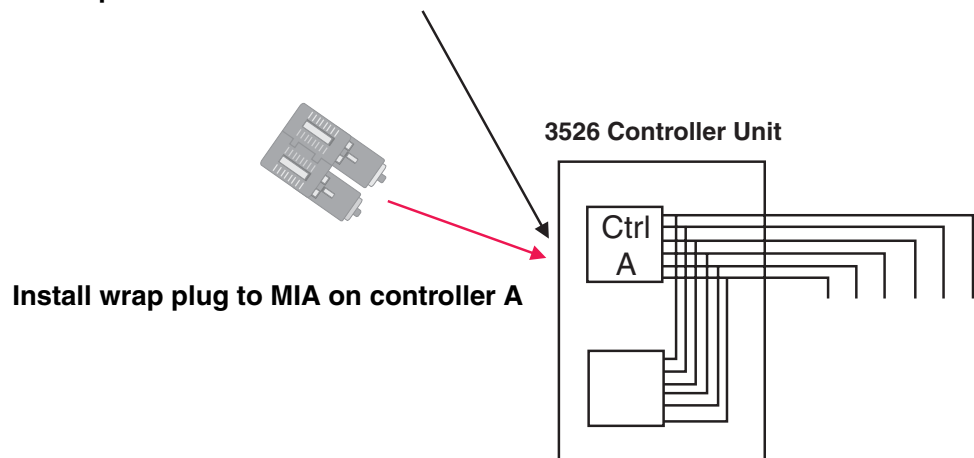
Figure 33. Install wrap plug to MIA on controller A

b. For a FAStT500, DS4400, DS4500, DS4300, DS4100 or DS4800 RAID controller, install a wrap plug to the GBIC or SFP in the mini-hub on controller A. See Figure 34.
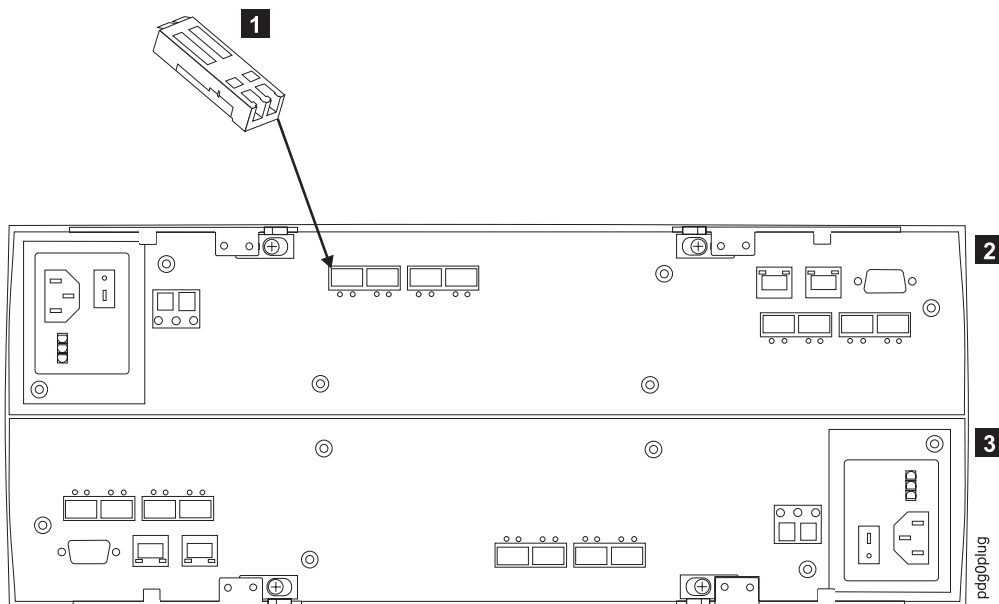
Figure 34. Install wrap plug to SFP on controller A

Table 16. Description of Figure 34

Number	Description
1	Wrap plug
2	DS4800 controller A
3	DS4800 controller B

3. Go to the appropriate Loopback Test section (either "Running the loopback test on a 3526 RAID controller" on page 93 or "Running the loopback test on a FAStT200, FAStT500, DS4100, DS4200, DS4300, DS4400, DS4700, or DS4800 RAID controller" on page 93).

Loopback test for optical cable testing

Perform the following steps for optical cable testing:

1. Detach the remote end of the optical cable from its destination.
2. Plug the female-to-female converter connector from your kit onto the remote end of the optical cable.
3. Insert the wrap plug from your kit into the female-to-female converter. See Figure 35 on page 93.
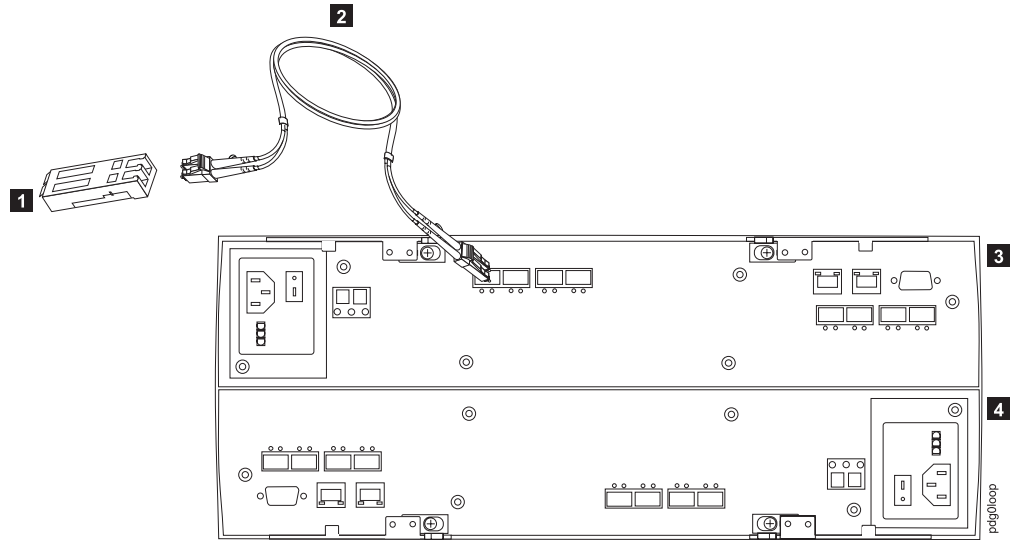
Figure 35. Install wrap plug

Table 17. Description of Figure 35

Number	Description
1	Wrap plug
2	FC cable
3	Controller A
4	Controller B

4. Go to the appropriate loopback test section (either "Running the loopback test on a 3526 RAID controller" or "Running the loopback test on a FAStT200, FAStT500, DS4100, DS4200, DS4300, DS4400, DS4700, or DS4800 RAID controller").

Running the loopback test on a 3526 RAID controller

Perform the following steps for a loopback test on a 3526 RAID controller:

1. In the controller shell, type the following command: `fc 5`
2. From the output, write down the AL_PA (Port_ID) for this controller.
3. Type the command

   `isp sendEcho,<AL_PA>,<# of iterations>`

   It is recommended that you use **50 000** for `# of iterations`. A value of **-1** will run for an infinite number of iterations. Message output to the controller shell is generated for every 10 000 frames sent.
4. Type the command `stopEcho` when tests are complete.

Running the loopback test on a FAStT200, FAStT500, DS4100, DS4200, DS4300, DS4400, DS4700, or DS4800 RAID controller

Perform the following steps for a loopback test on a FAStT200, FAStT500, DS4400, DS4300, DS4100, or DS4800 RAID controller:

1. In the controller shell, type the following command: `fcAll`
2. From the output, write down the AL_PA (Port_ID) for the channel to be tested.

3. Type the command `fcChip=X` where X=the chip number for the loop to be tested.
4. Type the command

   `isp sendEcho,<AL_PA>,<# of iterations>`

   It is recommended that you use **50 000** for `# of iterations`. A value of **-1** will run for an infinite number of iterations. Message output to the controller shell is generated for every 10 000 frames sent.
5. Type the command `stopEcho` when tests are complete.

If the test is successful, you will receive the following message:

`Echo accept (count n)`

If you receive the following message:

`Echo timeout interrupt: interrupt ... end echo test`

or if you receive nonzero values after entering the command `isp sendEcho`, then there is still a problem. Continue with the "Single Path Fail PD map 1" on page 18.

Chapter 10. PD hints: Tool hints

You should be referred to this chapter from a PD map or indication. If this is not the case, refer back to Chapter 2, "Problem determination starting points," on page 3.

This chapter contains the following tool hints:
- "Determining the configuration"
- "Start delay" on page 97
- "Connectors and locations" on page 99
- "Controller diagnostics" on page 105
- "Linux port configuration" on page 106

Determining the configuration

Use the SANsurfer application to determine what host adapters are present and where they are in the systems, as well as what RAID controllers are attached and whether they are on Fabric (switches) or loops. Alternately, you can click **Control Panel -> SCSI adapters** in Windows NT or **Control Panel -> System -> Hardware -> Device Manager -> SCSI and RAID Controllers** in Windows 2000.

Figure 36 shows the SANsurfer window for a configuration with two 2200 host adapters. When only the last byte of the Port ID is displayed, this indicates that the connection is an arbitrated loop.
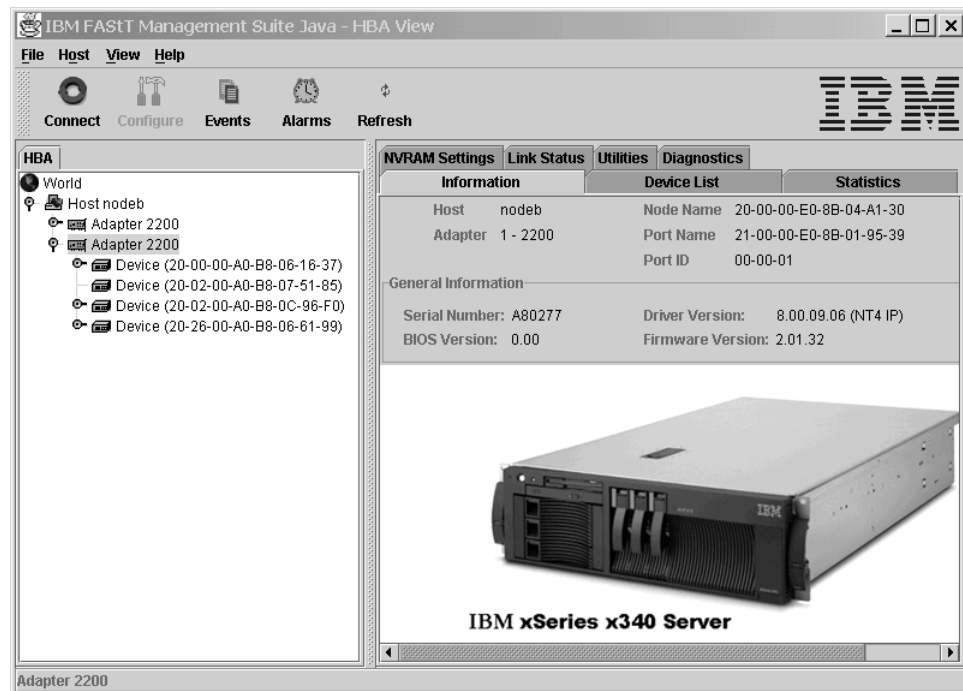
Figure 36. SANsurfer window—Two 2200 host adapters

A different configuration is shown in Figure 37 on page 96, which shows a 2200 adapter. Its WWN is 20-00-00-E0-8B-04-A1-30, and it has five devices attached to it.

When the first two bytes of the Port ID display (and they are other than 00), the configuration is Fabric (switch).
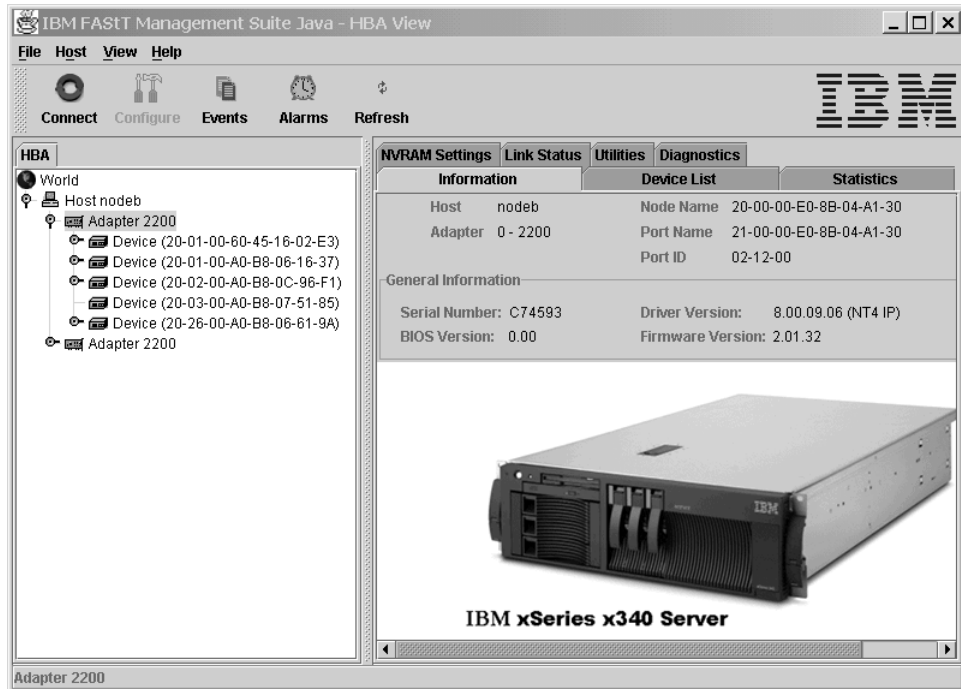
Figure 37. SANsurfer window—One 2200 host adapter

As shown in Figure 38, if you select one of the devices beneath a host adapter, you find that it is a controller in a 3526 RAID controller unit.
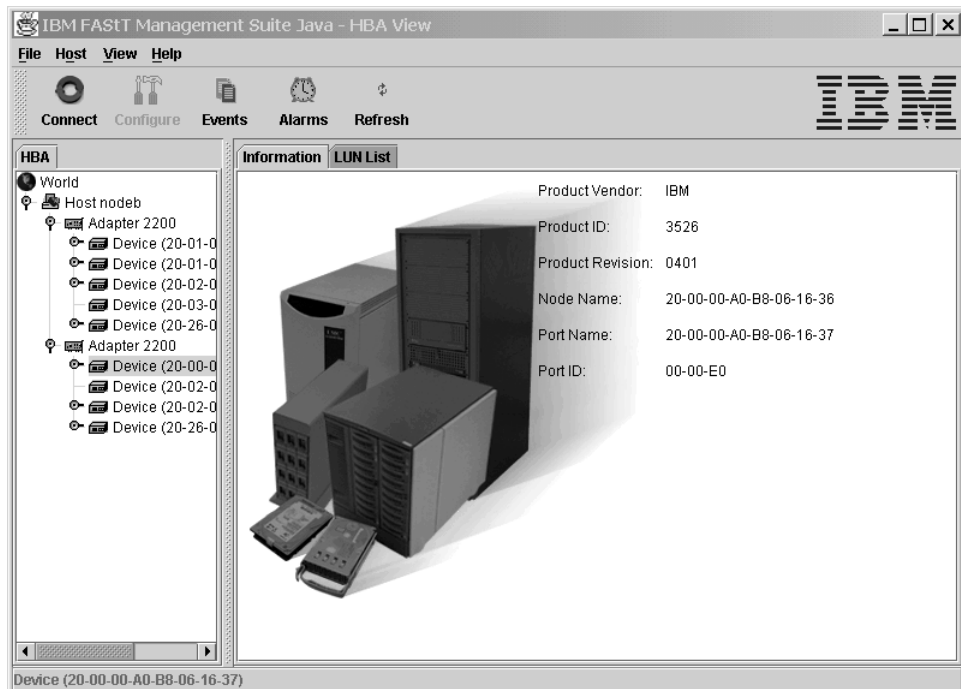
Figure 38. 3526 controller information

Start delay

In Windows operating systems, an extended startup delay indicates that the Windows system cannot find the configuration that is in the Windows registry. In Linux operating systems, the delay also might be caused by an incorrectly configured storage subsystem (see "Linux port configuration" on page 106 for hints on troubleshooting this problem.)

The startup delay in the Windows operating system can be caused by several things, but the following example shows what typically happens when a fibre channel cable connecting a host adapter to the storage fails (a failed cable is broken so that no light makes it through the cable).

Note: The screen, containing white text on a blue background, that appears when a Microsoft Windows operating system locks up, is referred to as the *blue screen*. The following blue-screen example describes startup delay symptoms in a Windows NT operating system. In the Windows 2000 operating system, the Starting Up progress bar will freeze. To retrieve the SCSI information in Windows 2000, open the Computer Management window (right-click **My Computer**, and then select **Manage**.)

1. Windows NT displays the blue screen and reports the first two lines (version, number of processors, and amount of memory). Windows NT takes a long time to start. The SCSI Adapters applet in the Control Panel opens the SCSI Adapters window shown in Figure 39 for the 2100.
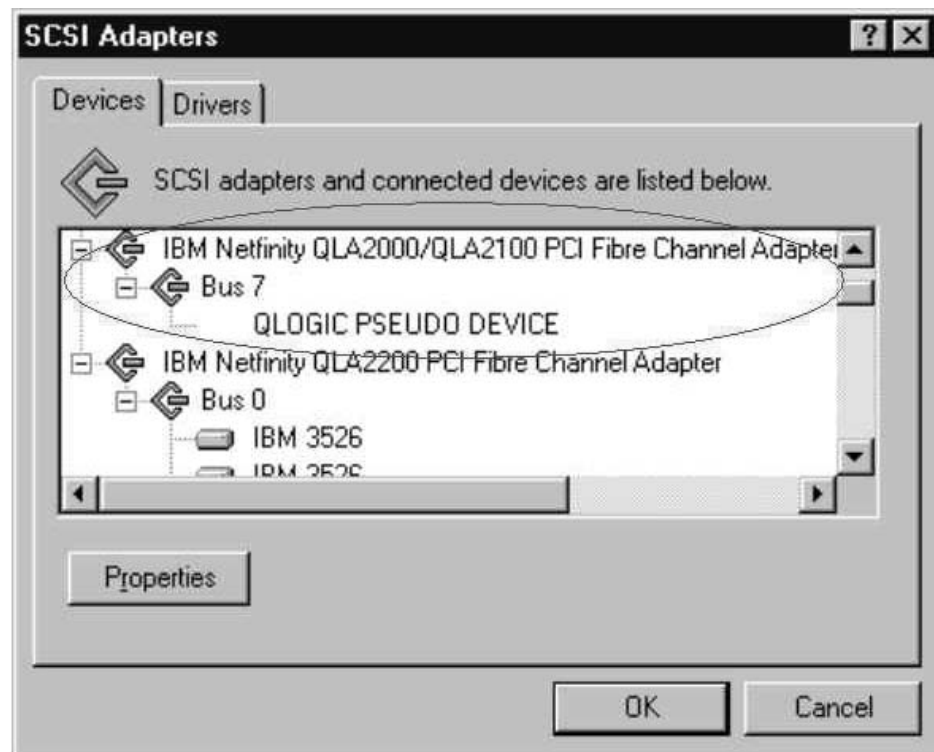
Figure 39. SCSI adapters

There are no other devices; there should be a Bus 0 with 21 of the IBM 3526s and one IBM Universal Xport. The 2100 DD shows as started in the Drivers page and in the Control Panel Devices applet.

2. WINDISK is started. It takes longer than normal to start (and there is a particularly long pause at the 100% mark), and then displays the message shown in Figure 40.

Figure 40. Disk Administrator information window

3. Because the disks were balanced across the two RAID controllers before the error occurred, every other disk shows in the Disk Administrator as offline, and the partition information section is not available, the following message is displayed:

```
Configuration information not available
```

The drive letters do not change for the drives. The drive letters are *sticky* (do not change), even though they are set only for the *boot drive* (drive that contains the operating system and is used to start the computer). Because the cable to RAID controller A is the failed cable, it is Disk 0, Disk 2, and so on, that are missing. See Figure 41.

Figure 41. Disk Administrator

4. **If Done:** Return to "Start Delay PD map" on page 11.

Connectors and locations

Controller units

Figure 42 shows the locations of the controller units in a DS4100 fibre channel controller unit.

Ethernet
Host port 2
Host port 1
Expansion port
Serial port
Host port 2
Host port 1
Ethernet
Serial port
Expansion port

AC power connector   AC power switch   Server ID switch   1 Gbps/ 2 Gbps switch   AC power connector   AC power switch

pdg04100
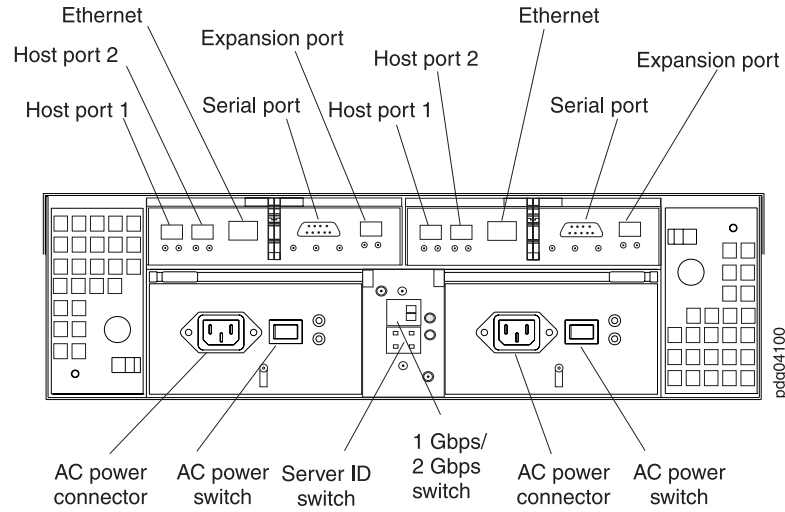
Figure 42. DS4100 fibre channel controller unit

Figure 43 shows the locations of the controller units in a DS4200 fibre channel controller unit.
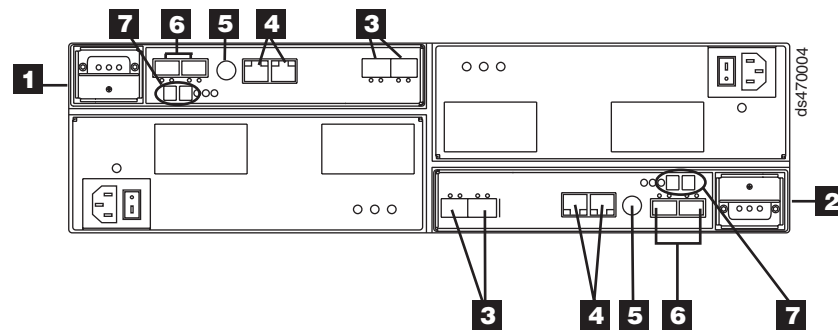
Figure 43. DS4200 fibre channel controller unit

Table 18. Description of Figure 43

Number	Description
1	Controller A
2	Controller B
3	Host channels
4	Ethernet ports
5	Serial port
6	Dual-ported drive channel
7	Enclosure ID

Figure 44 shows the locations of the controller units in a DS4300 fibre channel controller unit.
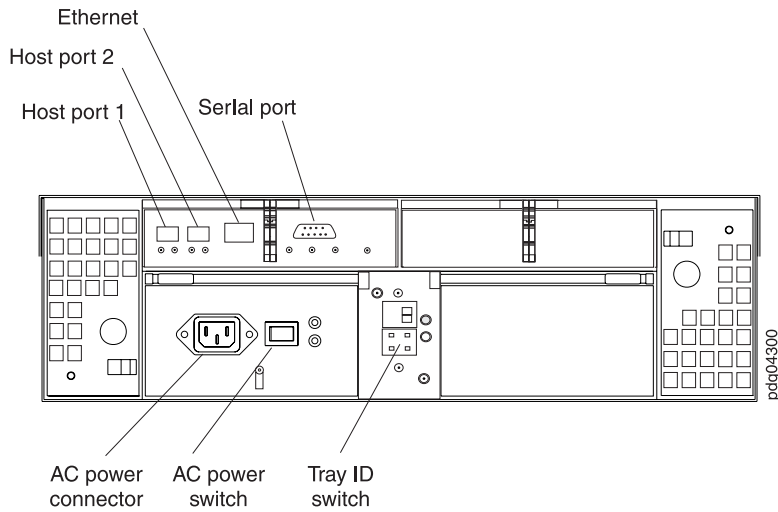
Figure 44. DS4300 fibre channel controller unit

Figure 45 shows the locations of the controller units in a DS4400 and DS4500 fibre channel controller unit.
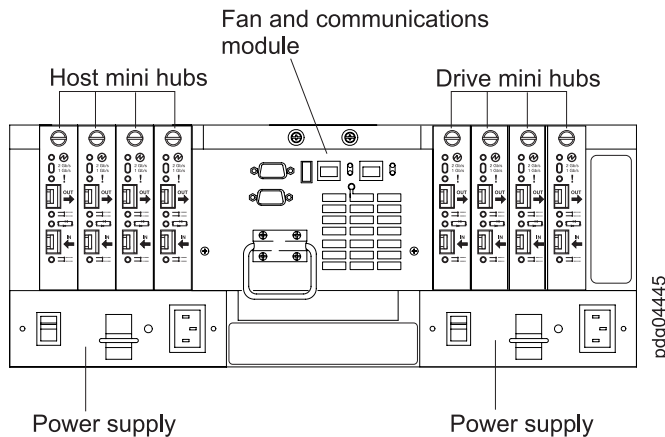
Figure 45. DS4400 / DS4500 fibre channel controller unit

Figure 46 shows the locations of the controller units in a DS4700 fibre channel controller unit.
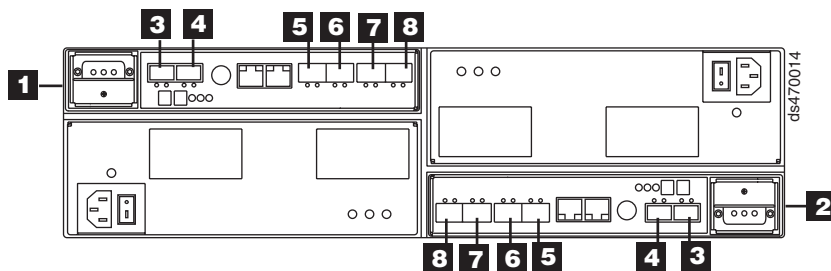
Figure 46. DS4700 fibre channel controller unit

Table 19. Description of Figure 46

Number	Description
1	Controller A
2	Controller B
3	Drive Channel 1 - Port 2 on Controller A Drive Channel 2 - Port 2 on Controller B
4	Drive Channel 1 - Port 1 on Controller A Drive Channel 2 - Port 1 on Controller B
5	Host Port 4
6	Host Port 3
7	Host Port 2
8	Host Port 1

Figure 47 shows the locations of the controller units in a DS4800 fibre channel controller unit.
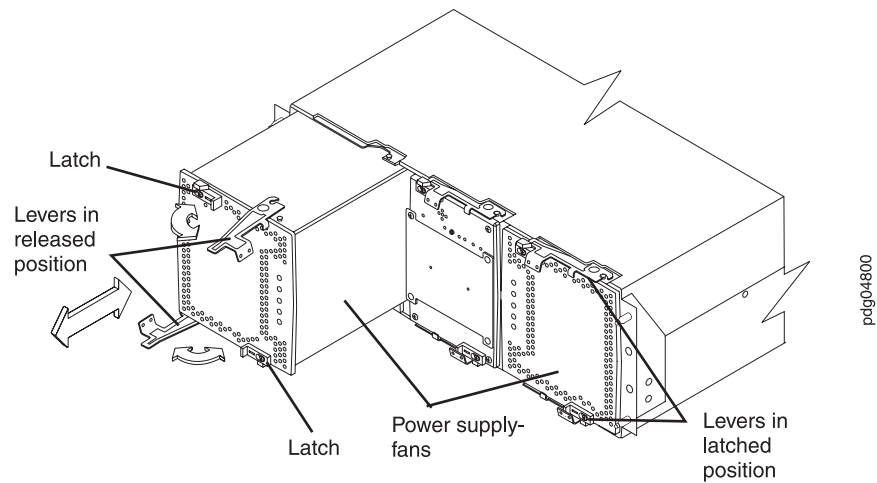
Figure 47. DS4800 fibre channel controller unit

Figure 48 on page 102 shows the locations of the controller connections in a FAStT500 or DS4400 fibre channel controller unit.

Note: In Figure 48 on page 102, a FAStT500 controller unit is shown.
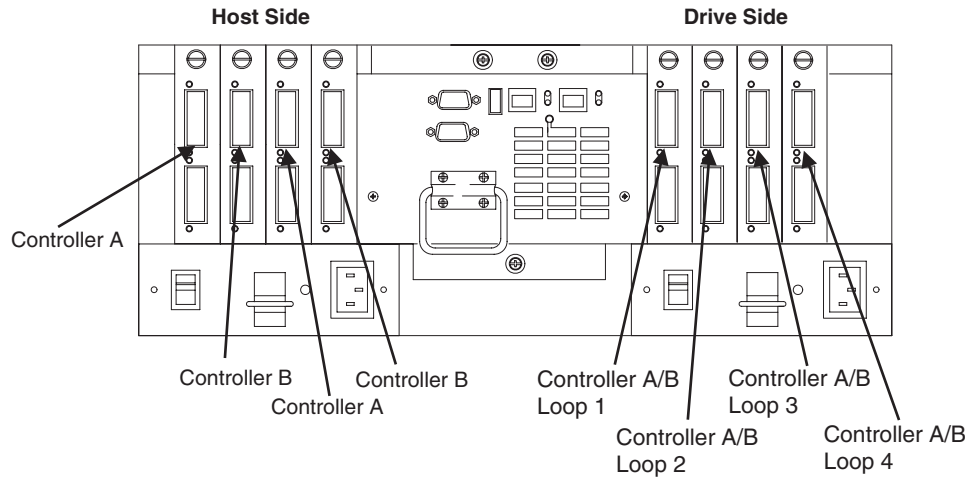
Figure 48. FAStT500 controller connection locations

Figure 49 shows the locations of the controller units in a FAStT200 fibre channel controller and drive enclosure unit.
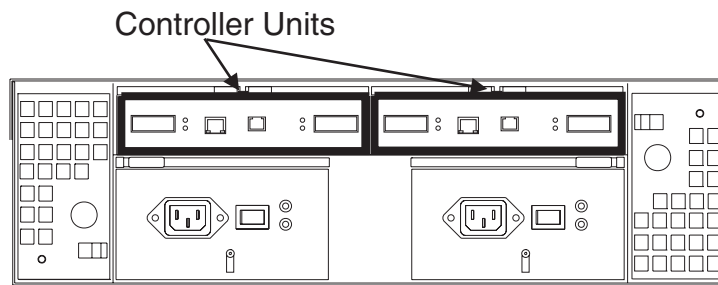
Figure 49. FAStT200 fibre channel controller unit locations

Figure 50 on page 103 shows a FAStT200 configuration containing both controllers. It uses GBICs for the connection but does not have the mini-hub feature of the FAStT500. There is a place for a single host to attach to each controller without using an external concentrator. The other connection on each is used to attach more drives using EXP500 enclosures.
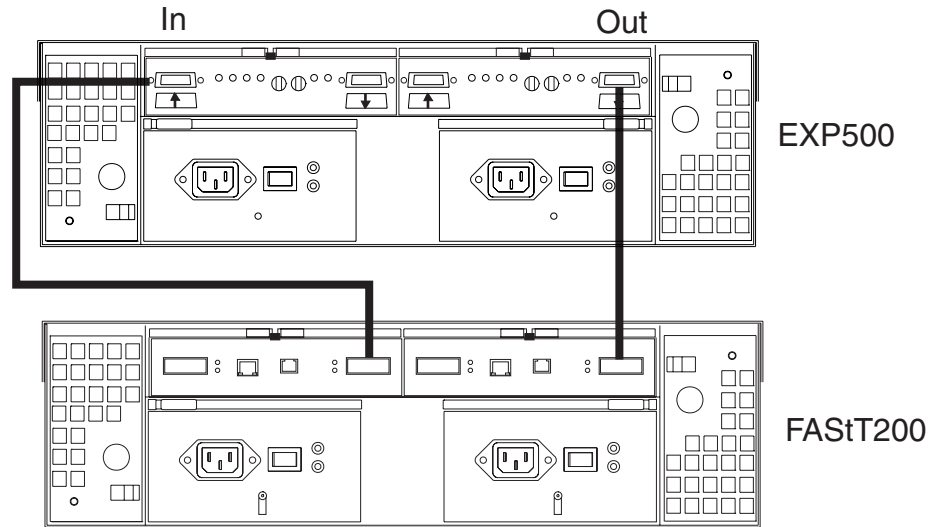
Figure 50. EXP500 and FAStT200 configuration

Drive enclosures

In Figure 51 (an EXP500 fibre channel drive enclosure), there are two loops in the box. The ESM on the left controls one loop path and the ESM on the right controls another loop path to the drives. This enclosure can be used with the FAStT500, FAStT200, DS4400, or DS4500.
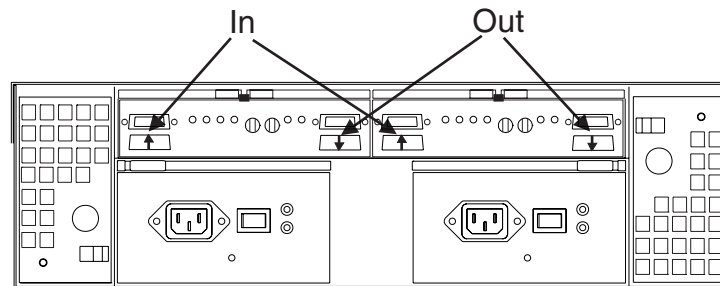
Figure 51. EXP500 fibre channel drive enclosure

Note: In the previous figure, the connections for the GBICs or SFPs are labeled as In and Out. This designation of the connections is for cabling routing purposes only, as all fibre cables have both a transmit fiber and receive fiber in them. Any connection can function as either output or input (transmitter or receiver).

In Figure 52 on page 104 (an EXP710 fibre channel drive enclosure), there are two loops in the box. The ESM on the left (**1**) controls one loop path and the ESM on the right (**2**) controls another loop path to the drives. The EXP100 and EXP700 have similar ESMs to the EXP710.
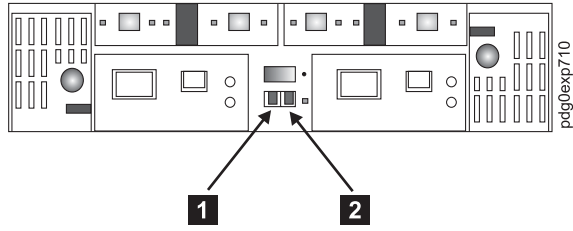
Figure 52. EXP710 fibre channel drive enclosure

Controller diagnostics

The DS4000 Storage Manager Diagnostics option enables a user to verify that a controller is functioning properly, using various internal tests. One controller is designated as the Controller Initiating the Test (CIT). The other controller is the Controller Under Test (CUT).

The diagnostics use a combination of three different tests: Read Test, Write Test, and Data Loopback Test. You should run all three tests at initial installation and any time there are changes to the storage subsystem or components that are connected to the storage subsystem (such as hubs, switches, and host adapters).

Note: During the diagnostics, the controller on which the tests are run (CUT) will NOT be available for I/O.

- **Read Test**

  The Read Test initiates a read command as it would be sent over an I/O data path. It compares data with a known, specific data pattern, checking for data integrity and redundancy errors. If the read command is unsuccessful or the data compared is not correct, the controller is considered to be in error and is failed.

- **Write Test**

  A Write Test initiates a write command as it would be sent over an I/O data path (to the Diagnostics region on a specified drive). This Diagnostics region is then read and compared to a specific data pattern. If the write fails or the data compared is not correct, the controller is considered to be in error and is failed and placed offline. (Use the Recovery Guru to replace the controller.)

- **Data Loopback Test**

  Important: The Data Loopback Test does not run on controllers that have SCSI connections between the RAID controllers and drive (model 3526).

  The Data Loopback Test is run only on controllers that have fibre channel connections between the controller and the drives. The test passes data through each controller's drive-side channel, mini-hub, out onto the loop and then back again. Enough data is transferred to determine error conditions on the channel. If the test fails on any channel, then this status is saved so that it can be returned if all other tests pass.

All test results display in the status area of the Diagnostics window.

Events are written to the DS4000 Storage Manager Event Log when diagnostics is started, and when it is has completed testing. These events will help you to evaluate whether diagnostics testing was successful or failed, and the reason for the failure. To view the Event Log, click **View -> Event Log** in the Subsystem Management Window.

Running controller diagnostics

Important: If diagnostics are run while a host is using the logical drives owned by the selected controller, the I/O directed to this controller path is rejected.

Perform the following steps to run various internal tests to verify that a controller is functioning properly.

1.

   a. For FAStT200 and FAStT500 subsystems, in the Subsystem Management Window, highlight a controller. Then, either click **Controller -> Run**

Diagnostics from the main menu or right-click the controller and click **Run Diagnostics** from the menu. The Diagnostics window opens.

   b. For DS4400, DS4500, DS4300, DS4100, and DS4800, from the Subsystem Management Window, highlight a controller. Click **Advanced -> Troubleshooting -> Run Diagnostics** from the main menu. The Diagnostics window opens.

2. Select the check boxes for the diagnostic tests to be run. Choose from the following list:

   - Read Test
   - Write Test
   - Data Loopback Test

3. To run the Data Loopback Test on a single channel, select a channel from the drop-down list.

4. Select a Data Pattern file for the Data Loopback Test. Select **Use Default Data Pattern** to use the default Data Pattern or **Use Custom Data Pattern file** to specify another file.

   Note: A custom Data Pattern file called diagnosticsDataPattern.dpf is provided on the root directory of the Storage Manager folder. This file can be modified, but the file must have the following properties to work correctly for the test:

   - The file values must be entered in hexadecimal format (00 to FF) with one space ONLY between the values.
   - The file must be no larger than 64 bytes in size. (Smaller files will work but larger files will cause an error.)

5. Click **Run**. The Run Diagnostics confirmation window opens.

6. Type yes in the confirmation field, and then click **OK**.

   The selected diagnostic tests begin. When the tests are complete, the Status field is updated with test results. The test results contain a generic, overall status message, and a set of specific test results. Each test result contains the following information:

   - Test (Read/Write/Data Loopback)
   - Port (Read/Write)
   - Level (Internal/External)
   - Status (Pass/Fail)

7. Click **Close** to close the window.

   Important: When diagnostics are completed, the controller should automatically allow data to be transferred to it. However, if there is a situation where data transfer is not re-enabled, highlight the controller and click **Data Transfer -> Enable**.

Linux port configuration

Linux operating systems do not use the IBM DS4000 Storage Manager to configure their associated Storage Subsystems. Instead, use the SANsurfer application to perform Device and LUN configuration on Linux operating systems. However, the DS4000 Storage Manager is used to map the DS4000 Storage Servers' logical drives to the appropriate operating system (in this case, Linux). The following sections provide you with hints on how to correctly configure your storage for a Linux system.

DS4000 Storage Manager hints

Use the DS4000 Storage Manager to map the desired logical drives to Linux storage. See the *Storage Manager User's Guide* for instructions. Note the following:

- Host ports for the Linux host are defined as Linux. See Chapter 14, "Heterogeneous configurations," on page 153 for more information.
- The Access LUN (LUN 31, also called the UTM LUN) is not present. the SANsurfer application will typically display the following messages when attempting to configure the storage and LUN 31 is detected:
  - An invalid device and LUN configuration has been detected
  - Non-SPIFFI compliant device(s) have been separated (by port names)

    Note: The Device node name (DS4000 Storage Server World Wide Node name) should appear once in the SANsurfer Fibre Channel Port Configuration dialog (see the figure following Step 5 on page 108) for both device ports. The Device port names reflect the DS4000 Storage Server controller Port World Wide Node names. If the Device node name is split (that is, if the Device node name is shown once for each Port name), then an invalid configuration is present. Check the storage mapping once more by using the DS4000 Storage Manager.

- LUNs are sequential and start with LUN 0.
- Prior to configuration, all LUNs are assigned to the controller that is attached to the first HBA.
- Both storage controllers must be active. Failover is only supported in an ACTIVE/ACTIVE mode.

Linux system hints

After you have properly mapped the storage, configure the Linux host. See the HBA driver readme file for instructions on how to configure the driver to allow for Failover support.

Make sure the HBAs that are installed in your systems are of the same type and are listed in the modules.conf file in the /etc/ directory. Add the following options string to allow more than 1 LUN to be reported by the driver:

options scsi_mod max_scsi_luns=32

You might see the following example in the modules.conf file:

```
alias eth1 eepro100
alias scsi_hostadapter aic7xxx
alias scsi_hostadapter1 qla2200
alias scsi_hostadapter2 qla2200
options scsi_mod max_scsi_luns=32
```

SANsurfer application

Use the SANsurfer application to configure the driver for failover. See Chapter 4, "Introduction to the QLogic SANsurfer application," on page 35 for installation instructions and to familiarize yourself with this application.

Configuring the driver with the SANsurfer application

To configure the driver and launch the SANsurfer application, perform the following steps:

1. Open a new command window, type `qlremote`, and then press Enter. The **glremote** command will run the qlremote agent in the command window.
2. Open a new command window and run /usr./SANsurfer.
3. Select **CONNECT**.
4. Type the IP address of the server or select LOCALHOST.
5. Select **CONFIGURE**. The Fibre Channel Port Configuration window opens (see Figure 53).
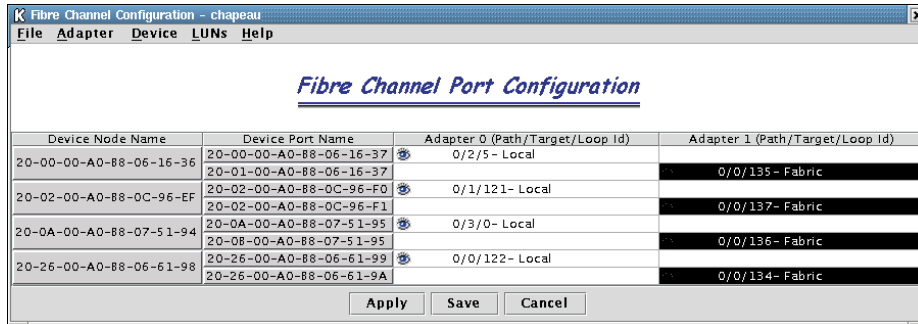
Figure 53. Fibre Channel Port Configuration window

6. Right-click the Device node name.
7. Click **Configure LUNs**. The LUN Configuration window opens (see Figure 54).
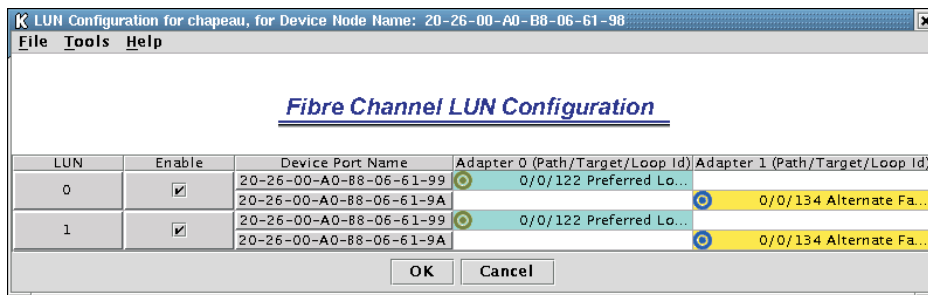
Figure 54. Fibre Channel LUN Configuration window

8. Click **Tools** -> **Automatic Configuration**.
9. Click **Tools** -> **Load Balance**.

   Your configuration should look similar to Figure 55 on page 109, which shows the preferred and alternate paths alternating between the adapters.
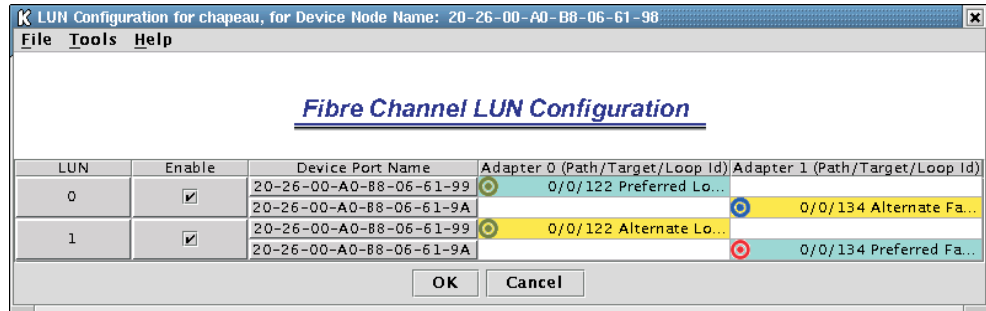
Figure 55. Preferred and alternate paths between adapters

10. Click **OK**.

11. Click **Apply** or **Save**.

12. This will save the configuration into the etc/modules.conf file. Verify that the option string reflecting the new configuration was written to that file. The string should look like the following example:

```
options qla2300 ConfigRequired=1 ql2xopts=scsi-qla00-adapter
port=210000e08b05e875\;scsi-qla00-tgt-000-di-00-node=202600a0b8066198\;scsi-
qla00-tgt-000-di-00-port=202600a0b8066199\;scsi-qla00-tgt-000-di-00-
preferred=fffffffffffffffffffffffffffffffffffffffffffffffffffffffffffffffd\;scsi
-qla00-tgt-000-di-00-control=00\;scsi-qla00-tgt-001-di-00-
node=200200a0b80c96ef\;scsi-qla00-tgt-001-di-00-port=200200a0b80c96f0\;scsi-
qla00-tgt-001-di-00-
preferred=ffffffffffffffffffffffffffffffffffffffffffffffffffffffffffffffff\;scsi
-qla00-tgt-001-di-00-control=00\;scsi-qla00-tgt-002-di-00-
node=200000a0b8061636\;scsi-qla00-tgt-002-di-00-port=200000a0b8061637\;scsi-
qla00-tgt-002-di-00-
preferred=ffffffffffffffffffffffffffffffffffffffffffffffffffffffffffffffff\;scsi
-qla00-tgt-002-di-00-control=00\;scsi-qla00-tgt-003-di-00-
node=200a00a0b8075194\;scsi-qla00-tgt-003-di-00-port=200a00a0b8075195\;scsi-
qla00-tgt-003-di-00-
preferred=ffffffffffffffffffffffffffffffffffffffffffffffffffffffffffffffff\;scsi
-qla00-tgt-003-di-00-control=00\;scsi-qla01-adapter-port=210000e08b058275\;scsi-
qla01-tgt-001-di-01-node=200200a0b80c96ef\;scsi-qla01-tgt-001-di-01-
port=200200a0b80c96f1\;scsi-qla01-tgt-001-di-01-control=80\;scsi-qla01-tgt-003-
di-01-node=200a00a0b8075194\;scsi-qla01-tgt-003-di-01-
port=200b00a0b8075195\;scsi-qla01-tgt-003-di-01-control=80\;scsi-qla01-tgt-002-
di-01-node=200000a0b8061636\;scsi-qla01-tgt-002-di-01-
port=200100a0b8061637\;scsi-qla01-tgt-002-di-01-control=80\;scsi-qla01-tgt-000-
di-01-node=202600a0b8066198\;scsi-qla01-tgt-000-di-01-
port=202600a0b806619a\;scsi-qla01-tgt-000-di-01-
preferred=00000000000000000000000000000000000000000000000000000000000000002\;scsi
-qla01-tgt-000-di-01-control=80\;
```

SANsurfer hints

The following hints are for using the SANsurfer application to configure Linux ports:

- The SANsurfer application does not automatically launch the qlremote agent. If you are unable to connect the host or hosts, make sure that you have started the qlremote agent.

- Any time a change is made to your storage (for example, if LUNs are added or removed), you must kill (stop) the qlremote agent (Ctrl + C), unload your HBA driver, and then reload it.

  – To unload: modprobe -r qla2x00

  – To load: modprobe qla2x00

– To restart: qlremote

You will then need to run the SANsurfer application to perform failover configuration.

- Do not mix HBA types. For example, qla2200 must be matched with another qla2200.
- If you replace an HBA, make sure that you change the mapping in the DS4000 Storage Manager to point to the WWN name for the new adapter. You will then need to reconfigure your storage.

Chapter 11. PD hints: Drive side hints and RLS diagnostics

You should be referred to this chapter from a PD map or indication. If this is not the case, refer back to Chapter 2, "Problem determination starting points," on page 3.

This chapter contains hints in the following PD areas:
- "Drive side hints"
- "Read Link Status (RLS) Diagnostics" on page 138

Drive side hints

When there is a drive side (device side) issue, looking at DS4000 Storage Manager often helps to isolate the problem. Figure 56 shows the status of drive enclosures attached to the RAID controller unit. Notice that the windows show that enclosure path redundancy is lost. This is an indication that a path problem exists between the controllers and one or more drive enclosures.
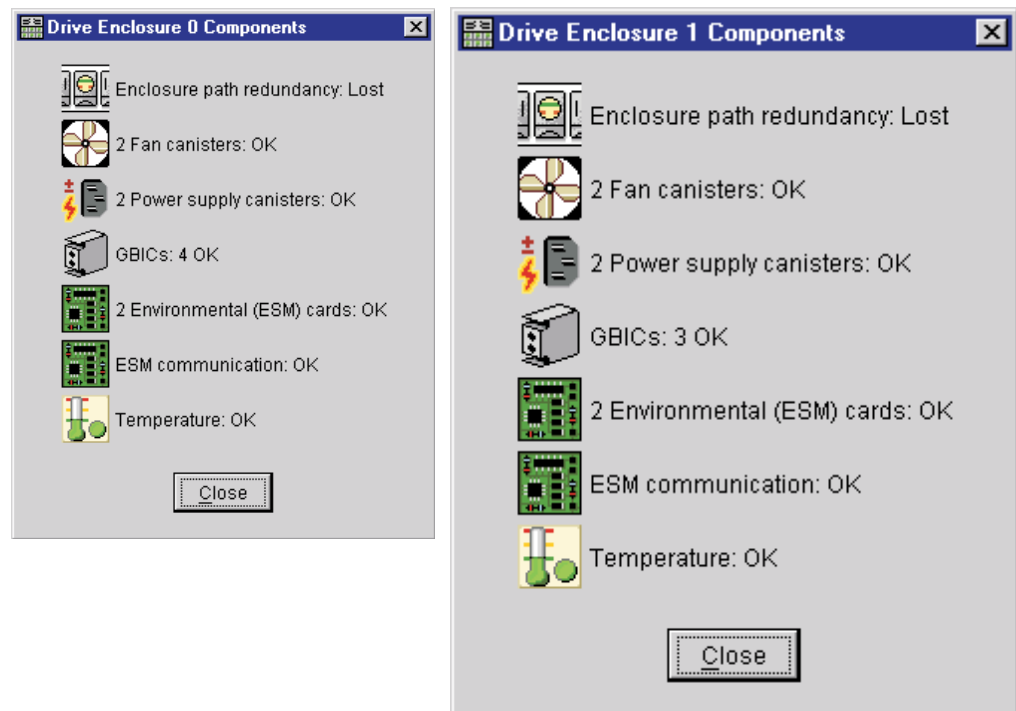
Figure 57 on page 112 shows that an ESM failed.

Figure 56. Drive enclosure components
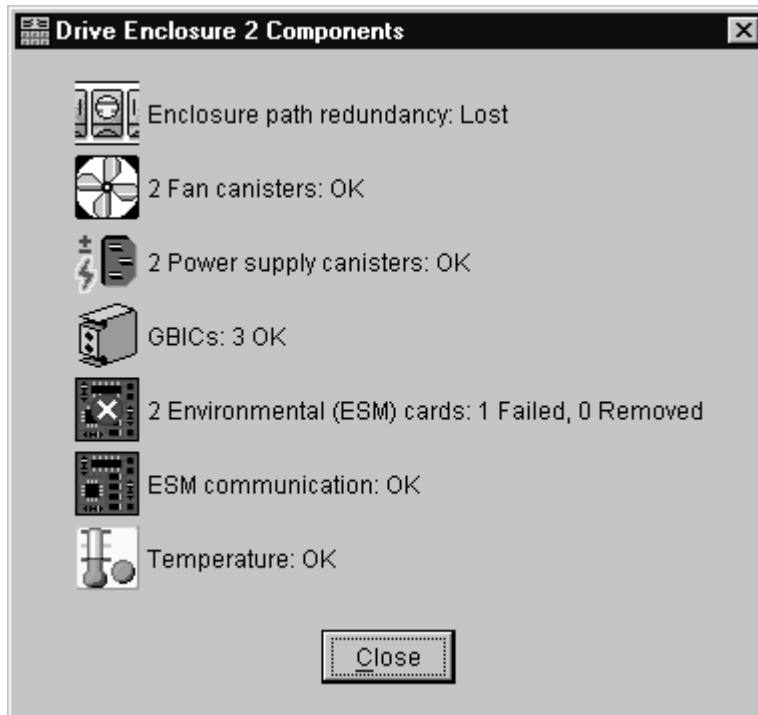
Figure 57. Drive enclosure components—ESM failure

When an ESM fails, go to the Recovery Guru for suggestions on resolving the problem. See Figure 58 on page 113.
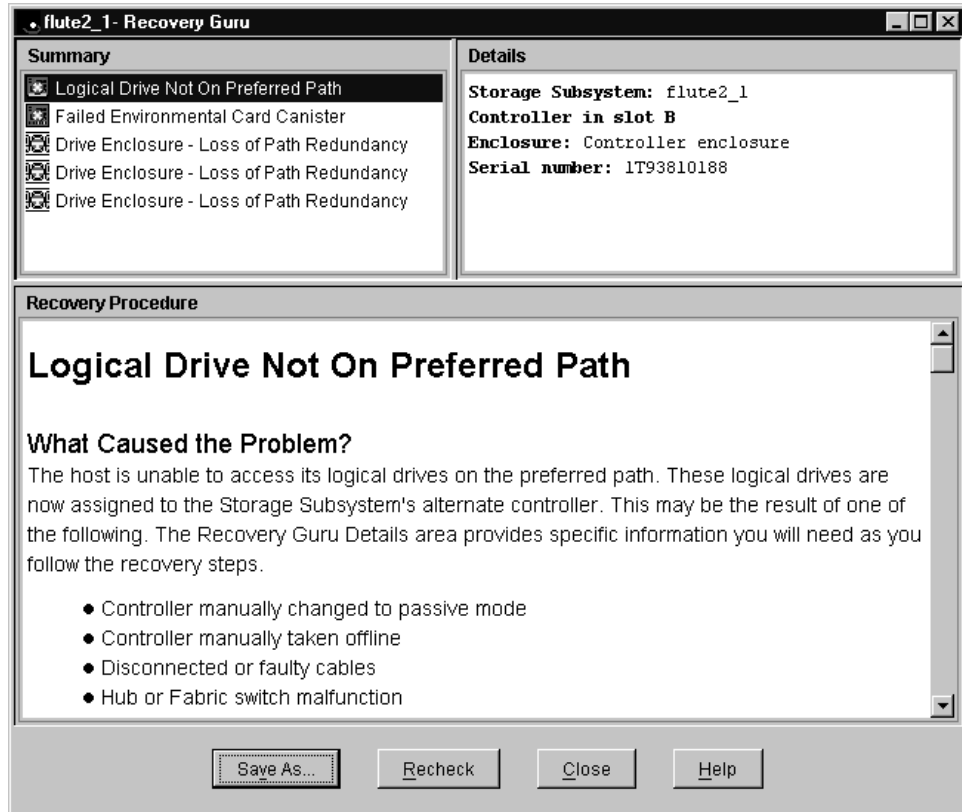
Figure 58. Recovery Guru window

Note: In the Recovery Guru window, the message `Logical drive not on preferred path` does not necessarily pertain to the current problem. The drive could have been moved to the other controller and not moved back. The loss of redundancy and the failed ESM are what is important.

Figure 59 on page 114 also shows the message `Failed or Removed Power Supply Cannister`. However, this message is not significant here because the power supply was removed for purposes of illustration.
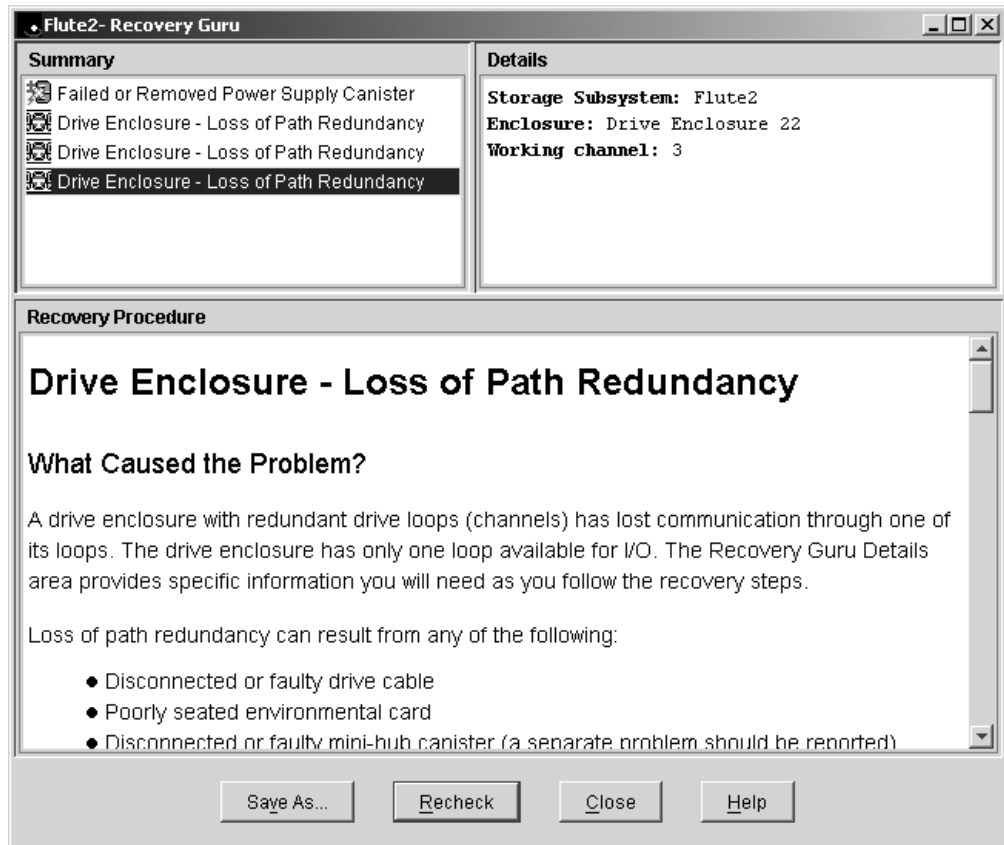
Figure 59. Recovery Guru—Loss of path redundancy

"Indicator lights and problem indications" identifies the indicators for drive side problems for DS400 series products.

Indicator lights and problem indications

The following sections show the indicator lights for each unit on the device side (for the mini-hub, the host side is also shown). In each section, the table following each figure shows the normal and problem indications.

FAStT200 RAID controller

Figure 60 on page 115 shows the controller indicator lights for a FAStT200 controller.
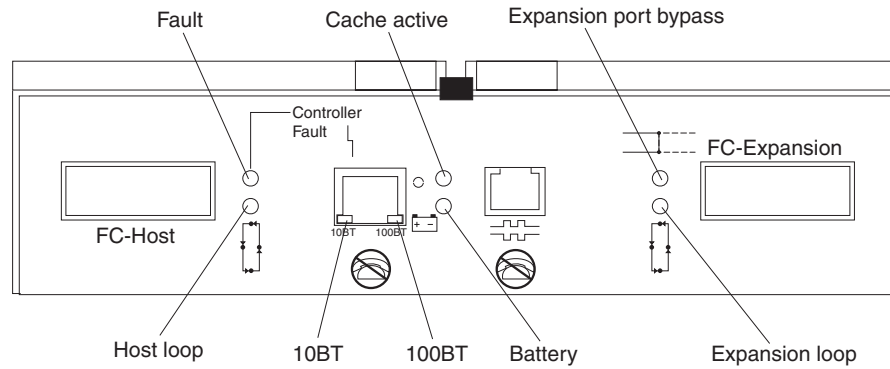
Figure 60. FAStT200 controller indicator lights

Table 20. FAStT200 controller indicator lights

Icon	Indicator Light	Color	Normal Operation	Problem Indicator	Possible condition indicated by the problem indicator
⌐_	Fault	Amber	Off	On	The RAID controller failed
⊏⋯⊐	Host Loop	Green	On	Off	• The host loop is down, not turned on, or not connected • GBIC failed, is loose, or not occupied • The RAID controller circuitry failed or the RAID controller has no power.
⊏⋯⊐	Expansion Loop	Green	On	Off	The RAID controller circuitry failed or the RAID controller has no power.
⇒=	Expansion Port Bypass	Amber	Off	On	• Expansion port not occupied • FC cable not attached to an expansion unit • Attached expansion unit not turned on • GBIC failed, FC cable or GBIC failed in attached expansion unit

FAStT500 RAID controller

Figure 61 on page 116 shows the mini-hub indicator lights for the FAStT500 RAID controller.
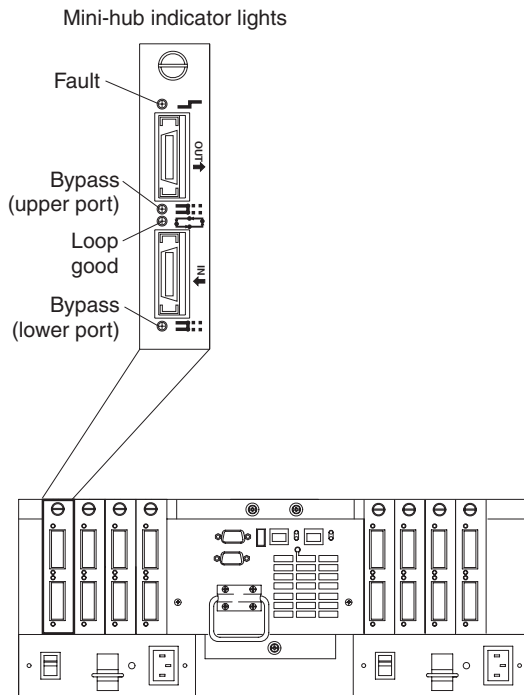
Figure 61. FAStT500 RAID controller mini-hub indicator lights

Table 21. Description of Figure 61

Icon	Indicator Light	Color	Normal Operation	Problem Indicator	Possible condition indicated by the problem indicator
	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.

DS4300 and DS4100 RAID controllers

Figure 62 shows the RAID controller indicator lights for the DS4300 and DS4100 Storage Servers.

Figure 62. DS4300 and DS4100 RAID controller LEDs

Table 22. Description of Figure 62

Icon	LED	Color	Operating states[1]

	Fault	Amber	• **Off** - Normal operation.
			• **On** - One of the following situations has occurred:
			  – The RAID controller has failed.
			  – The RAID controller was placed offline
			  – The controller battery had failed (in conjunction with the battery LED in off state).

	Host loop	Green	• **On** - Normal operation.
			• **Off** - One of the following situations has occurred:
			  – The host loop is down, not turned on, or not connected.
			  – A SFP has failed, or the host port is not occupied.
			  – The RAID controller circuitry has failed, or the RAID controller has no power.

	Cache active	Green	• **On** - There is data in the RAID controller cache.
			• **Off** - One of the following situations has occurred:
			  – There is no data in cache.
			  – There are no cache options selected for this array.
			  – The cache memory has failed, or the battery has failed.

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

Table 22. Description of Figure 62 (continued)

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

DS4200 RAID controller

Figure 63. DS4200 RAID controller LEDs

Table 23. Description of Figure 63

Number	LED	Normal Status	Problem Status
1	Service Action Allowed (OK to Remove)	Off	On
2	Service Action Required (Fault)	Off	On
3	Cache Active	On - Data is in cache Off - Caching is turned off. No data in cache	Not applicable
4	Diagnostic	On - Seven-segment LEDs indicate diagnostic code Off - Seven-segment LEDs indicate enclosure ID	Not applicable
5	Heartbeat	Blinking	Off
6	Host Channel Speed - L1		
7	Host Channel Speed - L2		
8	Ethernet Link Speed	On - 100 Mbps Off - 10 Mbps	Not applicable
9	Ethernet Link Activity	On - link established Off - no link established Blinking - activity	Not applicable

Number	LED	Normal Status	Problem Status
10	Drive Channel Port Bypass (One LED per port) **Note:** The drive channel consists of two FC ports. This LED indicates the drive port bypass status of one of the two FC ports that comprise a drive channel. The LED marked 13 shows the status of the other port.	Off (Also off if no SFP connected)	On - No valid device detected and port is bypassed
11	Drive Channel Speed - L1		
12	Drive Channel Speed - L2		
13	Drive Channel Port 2 Bypass (One LED per port) **Note:** The drive channel consists of two FC ports. This LED indicates the drive port bypass status of one of the two FC ports that comprise a drive channel. The LED marked 10 shows the status of the other port.	Off (Also off if no SFP connected)	On - No valid device detected and port is bypassed

DS4400 RAID controller

Figure 64 shows the host-side indicator lights on the DS4400 Storage Server.

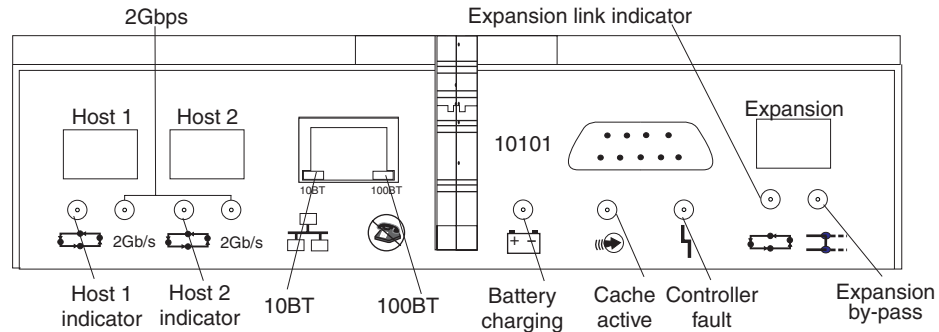*Figure 64. DS4400 RAID controller LEDs*

Table 24. Description of Figure 64

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 24. Description of Figure 64 (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.

DS4500 RAID controller

Figure 65 on page 123 shows the host-side indicator lights.
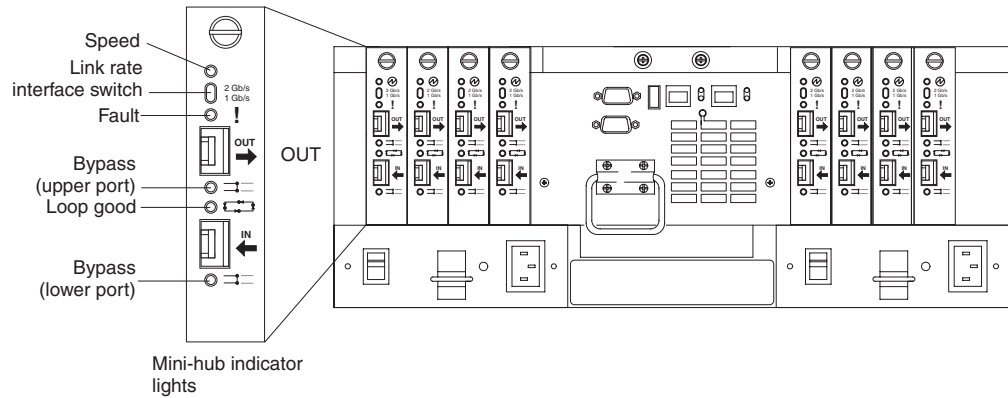
Figure 65. Type 1742 DS4500 Storage Server mini-hub indicator lights

Table 25 describes the indicator light status when there are fibre channel connections between host-side and drive-side mini-hubs.

Table 25. Type 1742 DS4500 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.

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.

DS4700 RAID controllers

shows the RAID controller indicator lights for the DS4700 Storage Subsystem. For complete information about the DS4700 Storage Subsystem,

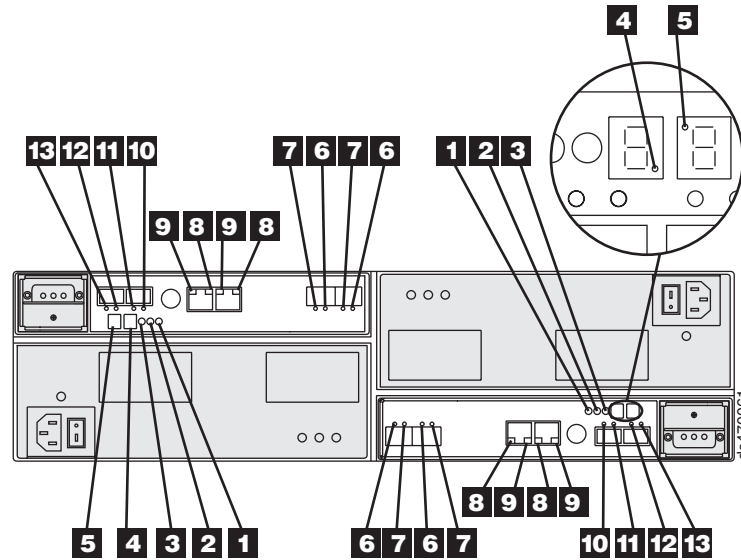refer to the *IBM System Storage DS4700 Storage Subsystem Installation, User's, and Maintenance Guide.*

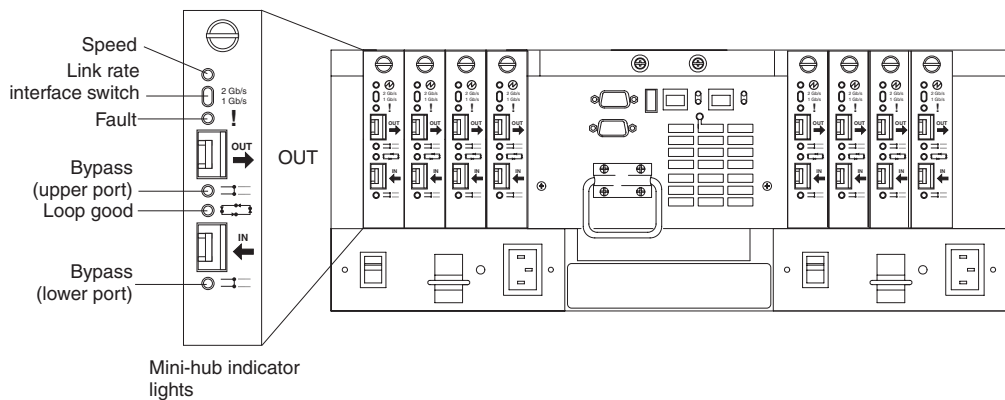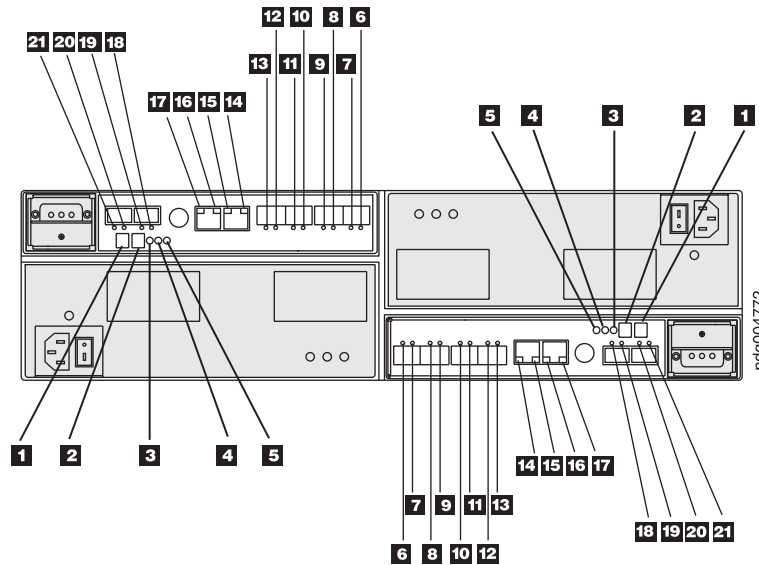*Figure 66. DS4700 RAID controller LEDs*

Table 26. Description of Figure 63

Number	Description
1	Service Action Allowed
2	Service Action Required
3	Cache Active
4	Diagnostic
5	Heartbeat
6	Host channel port 1 speed (data rate)
7	
8	Host channel port 2 speed (data rate)
9	
10	Host channel port 3 speed (data rate) (only Model 72)
11	
12	Host channel port 4 speed (data rate) (only Model 72)
13	
14	Ethernet Speed
15	Ethernet Activity
16	Ethernet Speed
17	Ethernet Activity
18	Host channel port 3 speed (data rate) (only Model 72)
19	
20	Host channel port 4 speed (data rate) (only Model 72)
21	

DS4800 RAID controllers

Figure 67 shows the RAID controller indicator lights for the DS4800 Storage Subsystem. For complete information about the DS4800 Storage Subsystem, refer to the *IBM System Storage DS4800 Storage Subsystem Installation, User's, and Maintenance Guide.*
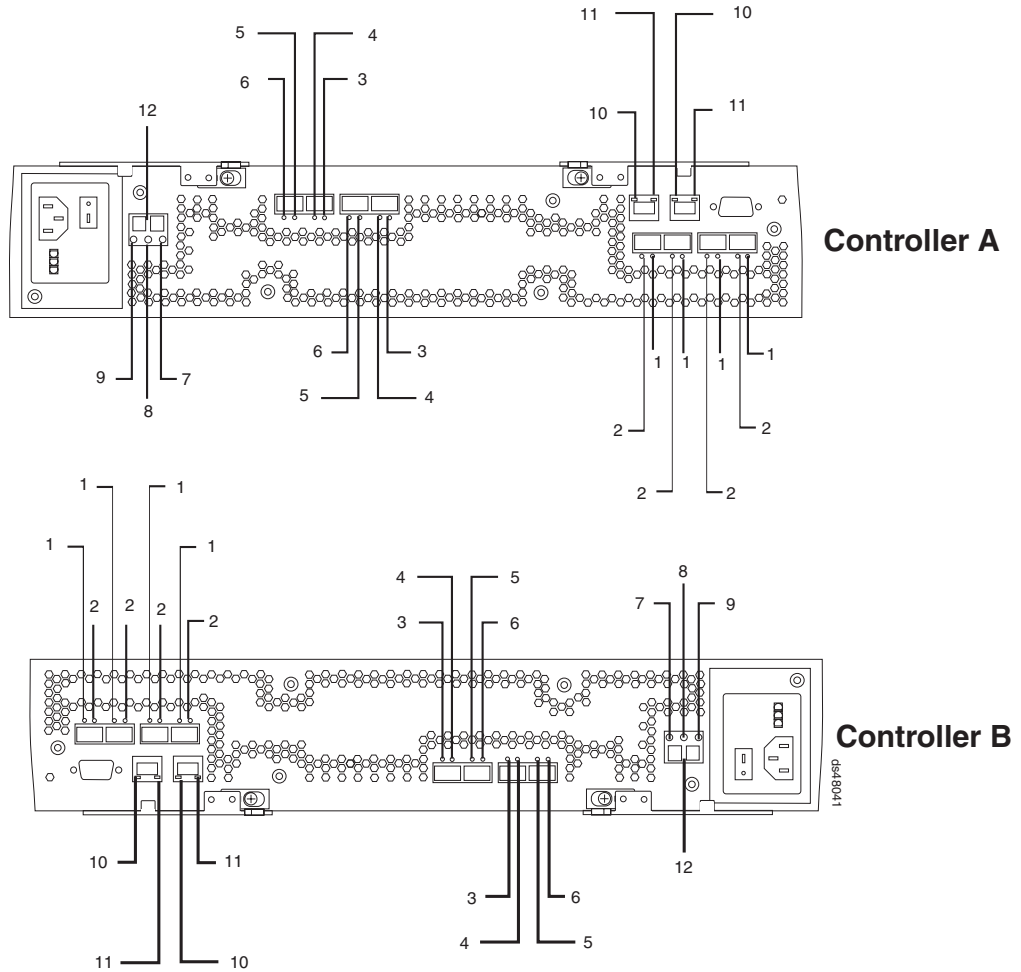
Figure 67. DS4800 RAID controller LEDs

Table 27. DS4800 RAID controller LEDs

Legend	LED	Color	Normal Status	Problem Status
1	Host Channel Speed – L1	Green LED	See Table 28 on page 129.	
2	Host Channel Speed – L2	Green LED		

Table 27. DS4800 RAID controller LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status
3	Drive Port Bypass (one LED per port)	Amber LED	Off	On = Bypass problem • An SFP module is inserted in the port and the connected fibre channel is either absent or not properly connected • The storage expansion enclosure connected to this port is not powered on • There is a problem with the fibre channel connection between this port and the fibre channel port of the connected ESM in the storage expansion enclosure.
4	Drive Channel Speed – L1	Green LED	See Table 28 on page 129.	
5	Drive Channel Speed – L2	Green LED		

Table 27. DS4800 RAID controller LEDs (continued)

Legend	LED	Color	Normal Status	Problem Status
6	Drive Port Bypass (one LED per port)	Amber LED	Off	On = Bypass problem • An SFP module is inserted in the port and the connected fibre channel is either absent or not properly connected • The storage expansion enclosure connected to this port is not powered on • There is a problem with the fibre channel connection between this port and the fibre channel port of the connected ESM in the storage expansion enclosure.
7	Service Action Allowed	Blue LED	Off	On = Safe to remove
8	Needs Attention	Amber LED	Off	On = Controller needs attention There is a controller fault or a controller is offline.
9	Cache Active	Green LED	On = Data in cache Off = No data in cache	Not applicable
10	Ethernet Link Speed	Green LED	Off = 10BASE-T On = 100BASE-T	Not applicable
11	Ethernet Link Activity	Green LED	Off = No link established On = Link established Blinking = Activity	Not applicable
12	Numeric Display (enclosure ID and Diagnostic Display)	Green and yellow seven-segment display	Diagnostic LED = off: Controller ID Diagnostic LED = on: Diagnostic code The Diagnostic LED is located on the Numeric Display.	

The L1 and L2 LEDs for each host and drive channel combine to indicate the
status and the operating speed of each host or drive channel.

Table 28. DS4800 host and drive channel LED definitions

LED 1	LED 2	Definition
Off	Off	When both LEDs for a host or drive channel are off, this indicates one or more of the following conditions: • The host or drive channel ports are bad. • An SPF module is inserted with no fibre channel cable attached. • No SFP module is inserted in one or both of the host or drive ports in the channel.
On	Off	The host or drive channel is operating at 1 Gbps.
Off	On	The host or drive channel is operating at 2 Gbps.
On	On	The host or drive channel is operating at 4 Gbps.

EXP500 ESM

Figure 68 shows the indicator lights for the EXP500 ESM.
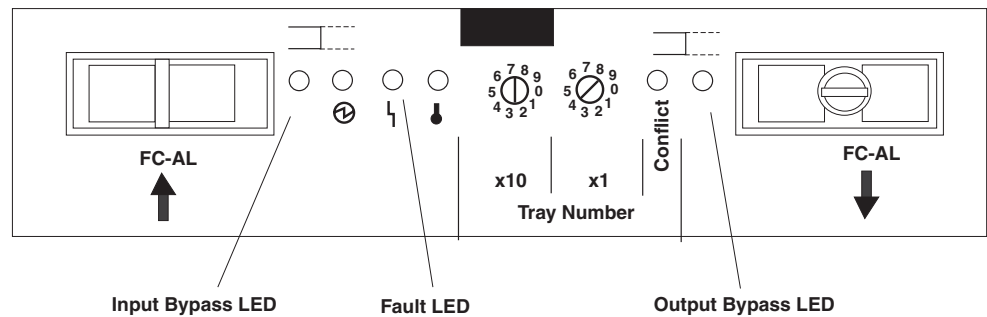
Figure 68. EXP500 ESM indicator lights

Table 29. EXP500 ESM indicator lights

Icon	Indicator Light	Color	Normal Operation	Problem Indicator	Possible condition indicated by the problem indicator
⌐_	Fault	Amber	Off	On	ESM failure **Note:** If fault is on, both In and Out should be in bypass.
⇉	Input Bypass	Amber	Off	On	Port empty • Mini-hub or GBIC failed, is loose, or is missing • Fiber-optic cables are damaged • No incoming signal detected
⇉	Output Bypass	Amber	Off	On	• Port empty • Mini-hub or GBIC failed, is loose, or is missing • Fiber-optic cables are damaged • No incoming signal detected, is loose, or is missing

DS4000 EXP700, DS4000 EXP710, and DS4000 EXP100 ESMs

The DS4000 EXP700, DS4000 EXP710, and DS4000 EXP100 ESMs and user controls are shown in Figure 69.
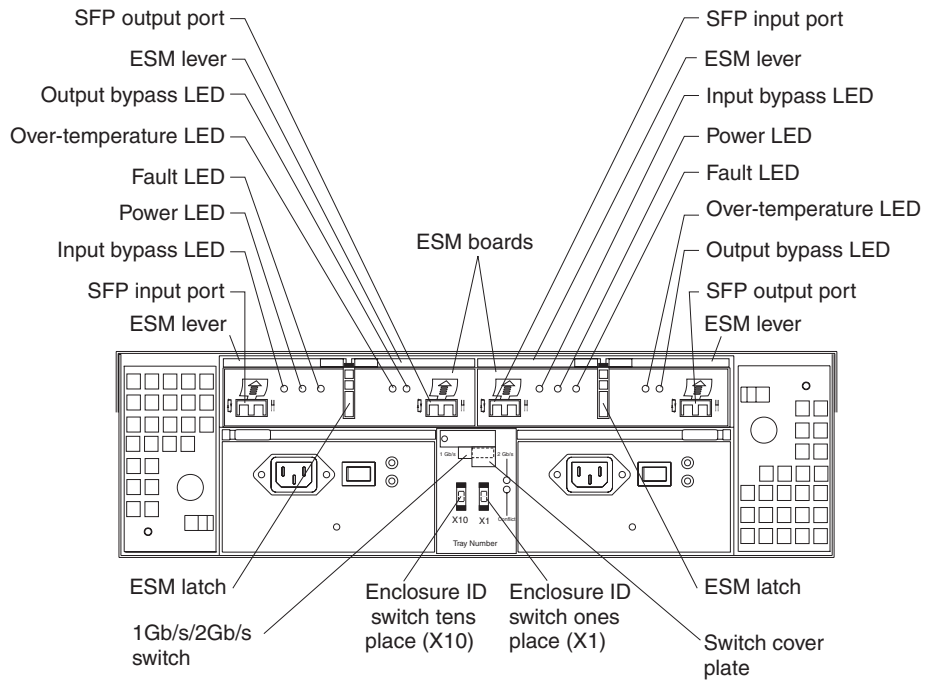
Figure 69. DS4000 EXP700, DS4000 EXP710, and DS4000 EXP100 ESMs and user controls

The following table provides diagnostic information on the ESM indicator lights.

Table 30. DS4000 EXP700, DS4000 EXP710, and DS4000 EXP100 indicator lights

Problem indicator	Component	Possible cause	Possible solutions
Amber LED is lit	Drive CRU	Drive failure	Replace failed drive.
	Fan CRU	Fan failure	Replace failed fan.
	ESM over-temperature LED	Subsystem is overheated	Check fans for faults. Replace failed fan if necessary.
		Environment is too hot	Check the ambient temperature around the expansion unit. Cool as necessary.
		Defective LED or hardware failure	If you cannot detect a fan failure or overheating problem, replace the ESM.
	ESM Fault LED	ESM failure	Replace the ESM. See your controller documentation for more information.
	ESM Bypass LED	No incoming signal detected	Reconnect the SFP modules and fibre channel cables. Replace input and output SFP modules or cables as necessary.
		ESM failure	If the ESM Fault LED is lit, replace the ESM.
	Front panel	General machine fault	A Fault LED is lit somewhere on the expansion unit (check for Amber LEDs on CRUs).
		SFP transmit fault	Check that the CRUs are properly installed. If none of the amber LEDs are lit on any of the CRUs, this indicates an SFP module transmission fault in the expansion unit. Replace the failed SFP module. See your storage-manager software documentation for more information.
Amber LED is lit and green LED is off	Power-supply CRU	The power switch is turned off or there is an ac power failure	Turn on all power-supply switches.
Amber and green LEDs are lit	Power-supply CRU	Power-supply failure	Replace the failed power-supply CRU.

Table 30. DS4000 EXP700, DS4000 EXP710, and DS4000 EXP100 indicator lights (continued)

Problem indicator	Component	Possible cause	Possible solutions
All green LEDs are off	All CRUs	Subsystem power is off	Check that all expansion-unit power cables are plugged in and the power switches are on. If applicable, check that the main circuit breakers for the rack are powered on.
		AC power failure	Check the main circuit breaker and ac outlet.
		Power-supply failure	Replace the power supply.
		Midplane failure	Contact an IBM technical-support representative to service the expansion unit.
Amber LED is flashing	Drive CRUs	Drive rebuild or identity is in process	No corrective action needed.
One or more green LEDs are off	Power supply CRUs	Power cable is unplugged or switches are turned off	Make sure the power cable is plugged in and the switches are turned on.
	All drive CRUs	Midplane failure	Replace the midplane (contact an IBM technical-support representative).
	Several CRUs	Hardware failure	Replace the affected CRUs. If this does not correct the problem, have the ESMs replaced, followed by the midplane. Contact an IBM technical-support representative.
	Front panel	Power-supply problem	Make sure that the power cables are plugged in and that the power supplies are turned on.
		Hardware failure	If any other LEDs are lit, replace the midplane. Contact an IBM technical-support representative.
Intermittent or sporadic power loss to the expansion unit	Some or all CRUs	Defective ac power source or improperly connected power cable	Check the AC power source. Re-seat all installed power cables and power supplies. If applicable, check the power components (power units or UPS). Replace defective power cables.
		Power-supply failure	Check the power supply Fault LED on the power supply. If the LED is lit, replace the failed CRU.
		Midplane failure	Have the midplane replaced.

Problem indicator	Component	Possible cause	Possible solutions
Unable to access drives	Drives and fibre channel loop	Incorrect expansion unit ID settings	Ensure that the fibre channel optical cables are undamaged and properly connected. Check the expansion unit ID settings. **Note:** Change switch position only when your expansion unit is powered off.
		ESM failure	Have one or both ESMs replaced.
Random errors	Subsystem	Midplane feature	Have the midplane replaced.

Troubleshooting the drive side

Always ensure that you are working on the loop side that is no longer active. Unplugging devices in a loop that is still being used by the host can cause loss of access to data.

There are two procedures to troubleshoot problems on the drive side: troubleshooting optical components and troubleshooting copper cables. If the components that make up the FC connections in the drive loops consists of optical FC cables and SFPs/GBICs, see "Troubleshooting optical components." If the components that make up the FC connections in the drive loops consist of copper FC cables, see "Troubleshooting FC copper cables" on page 136.

Note: The diagnostic wrap plug mentioned in these troubleshooting procedures is also known as a loopback adapter.

Troubleshooting optical components

To troubleshoot a problem in the drive side optical components, use the following procedure:

1. Disconnect the cable from the loop element that has the bypass indicator light on. See Figure 70 on page 134.
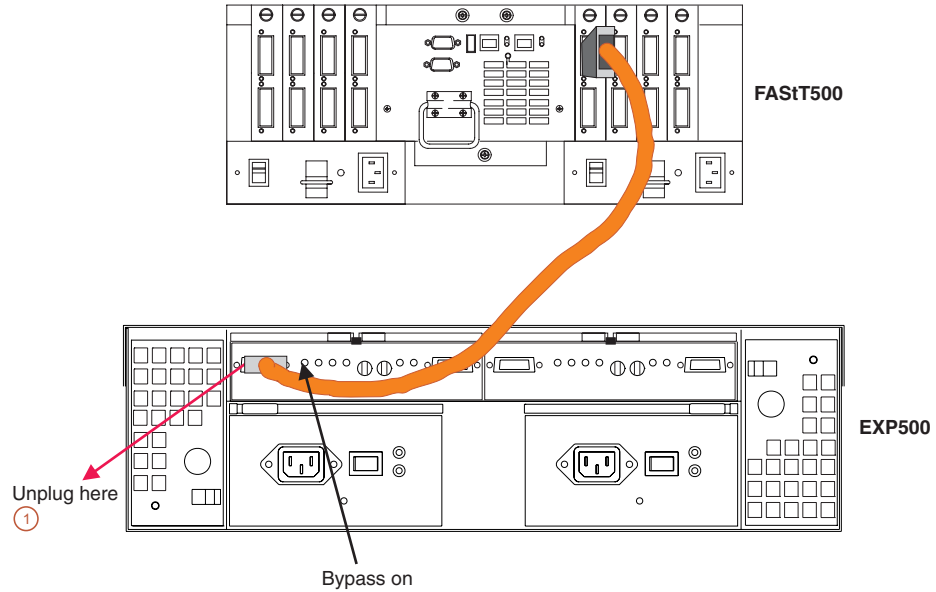
Figure 70. Disconnect cable from loop element

2. Insert a wrap plug in the element from which you disconnected the cable. See Figure 71.

   a. Is the bypass light still on? Replace the element (for example, a GBIC). The procedure is complete.
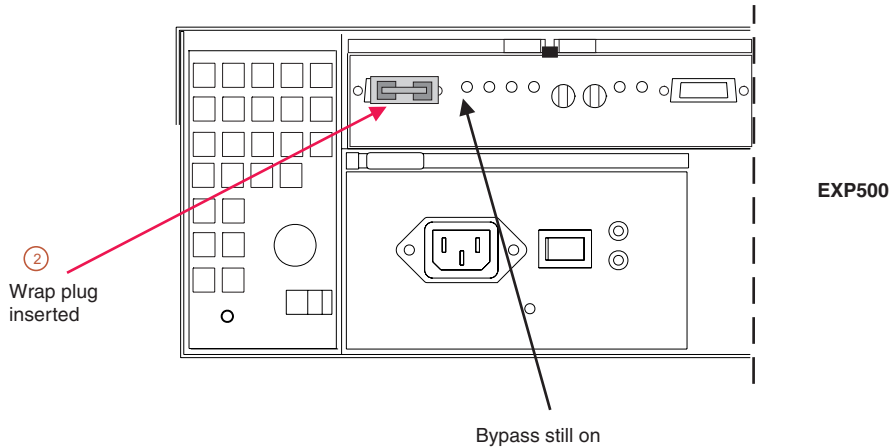
Figure 71. Insert wrap plug

   b. If the bypass light is now out, then this element is not the problem. Continue with step 3.

3. Reinsert the cable. Then unplug the cable at the other end.

4. Insert a wrap plug with an adapter onto the cable end. See Figure 72 on page 135.

   a. Is the bypass light still on? Replace the cable. The procedure is complete.

   b. If the bypass light is now out, then this element is not the problem. Continue with step 5.

FAStT500

Unplug here
③

EXP500

Replug cable

④
Insert Wrap with adapter onto cable end
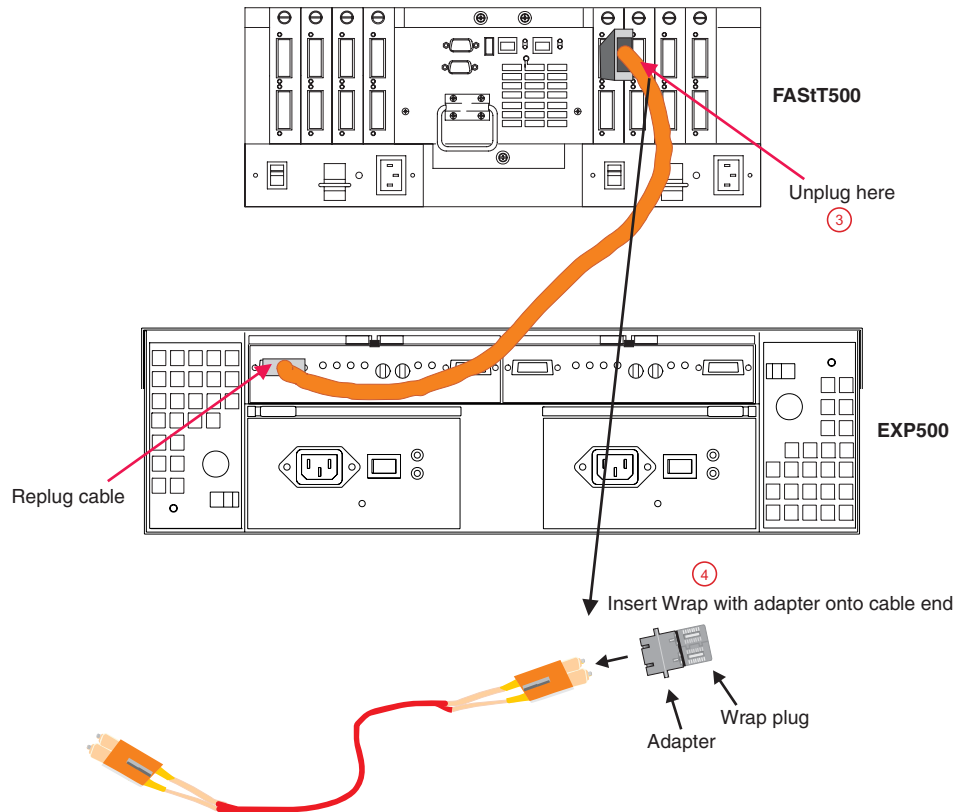
Wrap plug
Adapter

Figure 72. Insert wrap plug with adapter on cable end

5. As was shown in step 4, insert the wrap plug into the element from which the cable was removed in step 3. See Figure 73 on page 136.

   a. Is the bypass light still on? Replace the element (for example, an SFP or a GBIC). The procedure is complete.

   b. If the bypass light is now out, then this element is not the problem. In this fashion, keep moving through the loop until everything is replugged or until there are no more bypass or link down conditions.
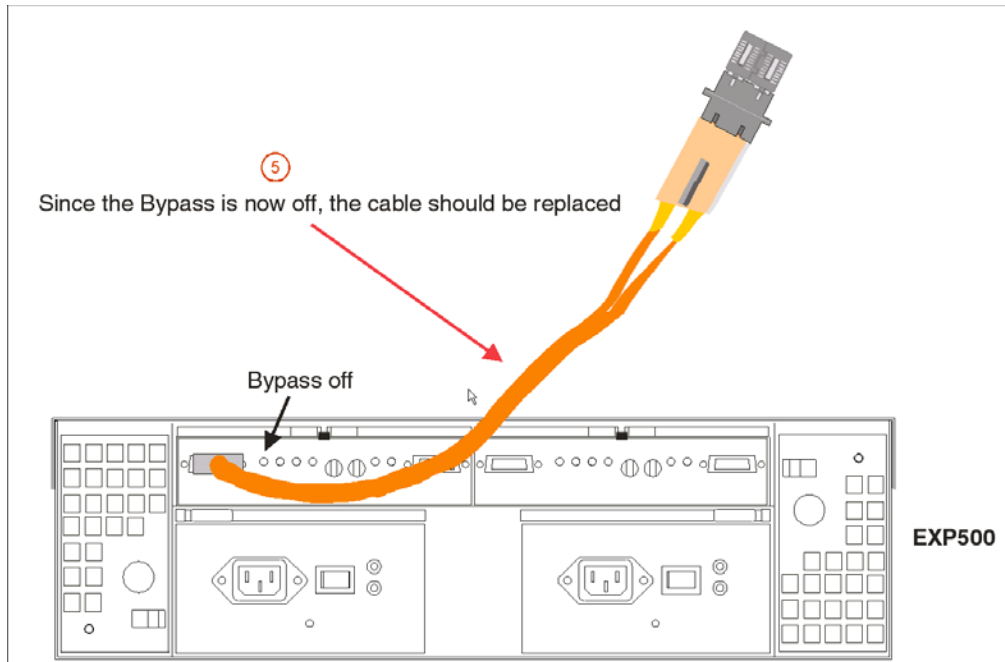
Figure 73. Insert wrap plug into element

Troubleshooting FC copper cables

Use this procedure to troubleshoot the connections between the ESM and controller and between ESMs.

1. Unplug one end of the FC copper cable in the loop element that has the bypass indicator light on. You can start at either cable end. For this example, start by unplugging the end that connects to the controller. See Figure 74.
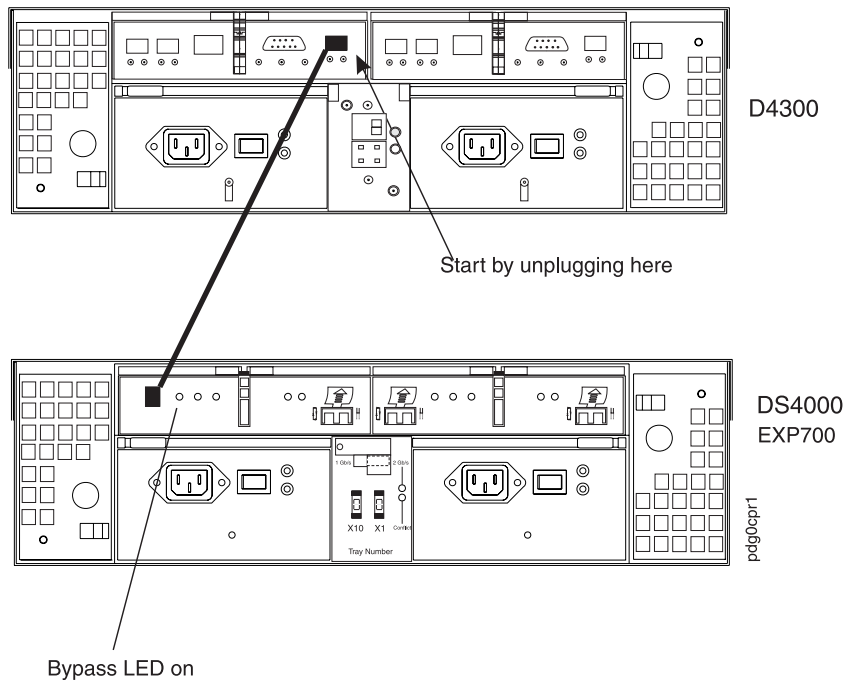
Figure 74. Copper cable and bypass light

2. Insert the FC copper cable wrap plug into the unplugged cable end. See Figure 75. Record the state of the port bypass light on the end where the FC copper cable is still inserted.

Record status of bypass light after wrap plug is inserted.
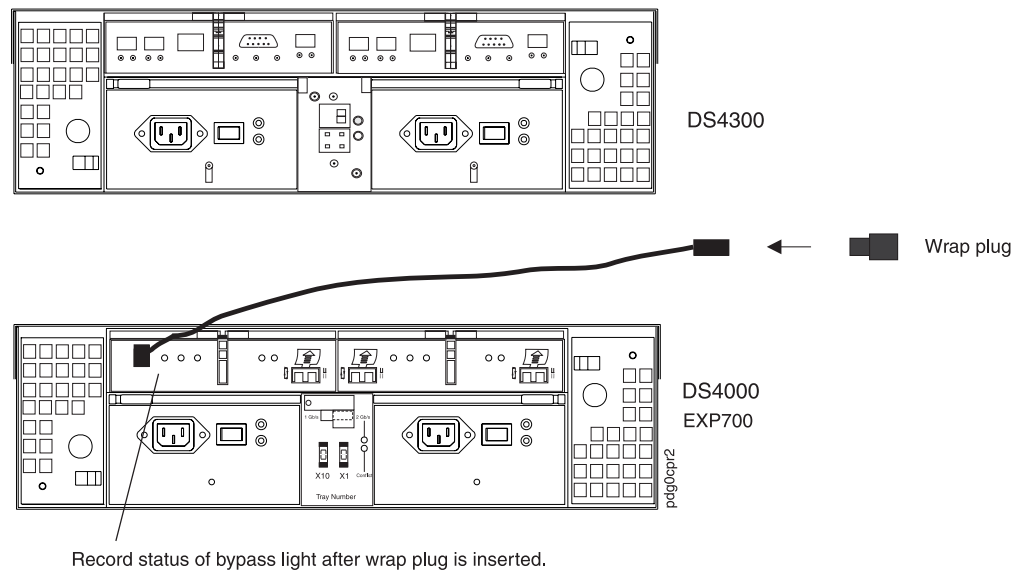
Figure 75. Inserting a wrap plug onto a copper cable

3. Remove the wrap plug and reinsert the FC copper cable into the port slot that you removed it from in Step 1 (in this example, the controller). Unplug the other end of the FC copper cable (in this example, the end that is inserted into the ESM).
4. Insert the FC copper cable wrap plug into the unplugged cable end. Record the state of the port bypass light on the end where the FC copper cable is still inserted.
5. Use the following table to determine which component of the drive loop link is causing the error. "A" and "B" stand for your hardware components. (In this example, A is the controller and B is the ESM; in some cases both A and B will be ESM).

Table 31. Diagnostic error condition truth table for copper cables

Case No.	Bypass LED at A	Bypass LED at B	Cause
1	On	On	Cable
2	On	Off	The controller is malfunctioning.
3	Off	On	The ESM is malfunctioning.
4	Off	Off	1. Check all of the links in the failing drive loops. 2. If no bad components were found, call IBM support to help troubleshoot marginal components.

Read Link Status (RLS) Diagnostics

A fibre channel loop is an interconnection topology used to connect storage subsystem components and devices. The DS4000 Storage Manager Version 8 or later software uses the connection between the host machine and each controller in the storage subsystem to communicate with each component and device on the loop.

During communication between devices, Read Link Status (RLS) error counts are detected within the traffic flow of the loop. Error count information is accumulated over a period of time for every component and device including:
- Drives
- ESMs
- Fibre channel ports

Error counts are calculated from a baseline, which describes the error count values for each type of device in the fibre channel loop. Calculation occurs from the time when the baseline was established to the time at which the error count information is requested.

The baseline is automatically set by the controller. However, a new baseline can be set manually in the Read Link Status Diagnostics window. For more information, see "How to set the baseline" on page 140.

Overview

Read Link Status error counts refer to link errors that have been detected in the traffic flow of a fibre channel loop. The errors detected are represented as a count (32-bit field) of error occurrences accumulated over time. The errors help to provide a coarse measure of the integrity of the components and devices on the loop.

The Read Link Status Diagnostics window retrieves the error counts and displays the controllers, drives, ESMs, and fibre channel ports in channel order.

By analyzing the error counts retrieved, it is possible to determine the components or devices within the fibre channel loop which might be experiencing problems communicating with the other devices on the loop. A high error count for a particular component or device indicates that it might be experiencing problems, and should be given immediate attention.

Error counts are calculated from the current baseline and can be reset by defining a new baseline.

Analyzing RLS Results

Analysis of the RLS error count data is based on the principle that the device immediately "downstream" of the problematic component should see the largest number of Invalid Transmission Word (ITW) error counts.

Note: Because the current error counting standard is vague about when the ITW count is calculated, different vendors' devices calculate errors at different rates. Analysis of the data must take this into account.

The analysis process involves obtaining an ITW error count for every component and device on the loop, viewing the data in loop order, and then identifying any

large jumps in the ITW error counts. In addition to the ITW count, the following error counts display in the Read Link Status Diagnostics window:

Error Count Type	Definition of error
Link Failure (LF)	When detected, link failures indicate that there has been a failure within the media module laser operation. Link failures might also be caused by a link fault signal, a loss of signal or a loss of synchronization.
Loss of Synchronization (LOS)	Indicates that the receiver cannot acquire symbol lock with the incoming data stream, due to a degraded input signal. If this condition persists, the number of Loss of Signal errors increases.
Loss of Signal (LOSG)	Indicates a loss of signal from the transmitting node, or physical component within the fibre channel loop. Physical components where a loss of signal typically occurs include the gigabit interface connectors, and the fibre channel fibre optic cable.
Primitive Sequence Protocol (PSP)	Refers to the number of N_Port protocol errors detected, and primitive sequences received while the link is up.
Link Reset Response (LRR)	A Link Reset Response (LRR) is issued by another N_Port in response to a link reset.
Invalid Cyclic Redundancy Check (ICRC)	Indicates that a frame has been received with an invalid cyclic redundancy check value. A cyclic redundancy check is performed by reading the data, calculating the cyclic redundancy check character, and then comparing its value to the cyclic check character already present in the data. If they are equal, the new data is presumed to be the same as the old data.

If you are unable to determine which component or device on your fibre channel loop is experiencing problems, save the RLS Diagnostics results and forward them to IBM technical support for assistance.

Running RLS Diagnostics

To start RLS Diagnostics, select the storage subsystem in the Subsystem Management Window; then either click **Storage Subsystem** -> **Run Read Link Status Diagnostics** from the main menu or right-click the selected subsystem and click **Run Read Link Status Diagnostics** from the menu. The Read Link Status Diagnostics window opens, displaying the retrieved error-count data. The following data is displayed:

Devices
> A list of all the devices on the fibre channel loop. The devices display in channel order, and within each channel they are sorted according to the devices position within the loop.

Baseline Time
> The date and time of when the baseline was last set.

Elapsed Time
> The elapsed time between when the Baseline Time was set, and when the read link status data was gathered using the Run option.

ITW   The total number of Invalid Transmission Word (ITW) errors detected on the fibre channel loop from the baseline time to the current date and time. ITW might also be referred to as the Received Bad Character Count.

> **Note:** This is the key error count to be used when analyzing the error count data.

LF   The total number of Link Failure (LF) errors detected on the fibre channel loop from the baseline time to the current date and time.

LOS The total number of Loss of Synchronization (LOS) errors detected on the fibre channel loop from the baseline time to the current date and time.

LOSG The total number of Loss of Signal (LOSG) errors detected on the fibre channel loop from the baseline date to the current date and time.

PSP The total number of Primitive Sequence Protocol (PSP) errors detected on the fibre channel loop from the baseline date to the current date and time.

ICRC The total number of Invalid Cyclic Redundancy Check (ICRC) errors detected on the fibre channel loop, from the baseline date to the current date and time.

How to set the baseline

Error counts are calculated from a baseline (which describes the error count values for each type of device in the fibre channel loop), from the time when the baseline was established to the time at which the error count information is requested.

The baseline is automatically set by the controller; however, a new baseline can be set manually in the Read Link Status Diagnostics window using the following steps:

Note: This option establishes new baseline error counts for ALL devices currently initialized on the loop.

1. Click **Set Baseline**. A confirmation window opens.
2. Click **Yes** to confirm baseline change. If the new baseline is successfully set, a success message is displayed indicating that the change has been made.
3. Click **OK**. The Read Link Status Diagnostics window opens.
4. Click **Run** to retrieve the current error counts.

How to interpret results

To interpret RLS results, perform the following actions:

1. Open the Read Link Status Diagnostics window.
2. Review the ITW column in the Read Link Status Diagnostics window and identify any unusual increase in the ITW counts.

   Example:

   The following shows the typical error-count information displayed in the Read Link Status Diagnostics window. In this example, the first window contains a list of the values after setting the baseline. The RLS diagnostic is run a short time later, and the result shows an increase in error counts at Controller B. This is probably due to either the drive right before (2/9), or more likely the ESM (Drive enclosure 2).

   Figure 76 on page 141 shows the RLS Status after setting the baseline.

Read Link Status Diagnostics

Select Run to gather the read link status data. The data displayed will show the change in the various error counts from the time when the baseline was last set. If you want to set a new baseline before gathering the data, select Set Baseline. For information on analyzing the data, refer to the online help.

Data gathered on (controller time): 11/14/01 3:08:45 PM

Devices	Baseline Time	Sampling Interval	ITW	LF	LOS	LOSG	PSP	ICRC
Drive Channel 4								
Controller in slot A	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive [2,1]	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive [2,2]	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive [2,3]	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive [2,4]	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive [2,5]	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive [2,6]	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive [2,7]	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive [2,8]	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive [2,9]	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Drive enclosure 2, E...	11/14/01 3:08:40 PM	00:00:05	0	0	0	0	0	0
Controller in slot B	11/14/01 3:08:40 PM	00:00:05	2	0	0	0	0	0

Run   Set Baseline...   Save As...   Close   Help

Figure 76. RLS Status after setting baseline

Figure 77 shows the RLS Status after running the diagnostic.

Read Link Status Diagnostics

Select Run to gather the read link status data. The data displayed will show the change in the various error counts from the time when the baseline was last set. If you want to set a new baseline before gathering the data, select Set Baseline. For information on analyzing the data, refer to the online help.

Data gathered on (controller time): 11/14/01 3:10:01 PM

Devices	Baseline Time	Sampling Interval	ITW	LF	LOS	LOSG	PSP	ICRC
Drive Channel 4								
Controller in slot A	11/14/01 3:08:40 PM	00:01:21	1785	0	0	0	0	0
Drive [2,1]	11/14/01 3:08:40 PM	00:01:21	0	0	0	0	0	0
Drive [2,2]	11/14/01 3:08:40 PM	00:01:21	0	0	0	0	0	0
Drive [2,3]	11/14/01 3:08:40 PM	00:01:21	0	0	0	0	0	0
Drive [2,4]	11/14/01 3:08:40 PM	00:01:21	0	0	0	0	0	0
Drive [2,5]	11/14/01 3:08:40 PM	00:01:21	0	0	0	0	0	0
Drive [2,6]	11/14/01 3:08:40 PM	00:01:21	0	0	0	0	0	0
Drive [2,7]	11/14/01 3:08:40 PM	00:01:21	0	0	0	0	0	0
Drive [2,8]	11/14/01 3:08:40 PM	00:01:21	0	0	0	0	0	0
Drive [2,9]	11/14/01 3:08:40 PM	00:01:21	0	0	0	0	0	0
Drive enclosure 2, E...	11/14/01 3:08:40 PM	00:01:21	32	0	0	0	0	0
Controller in slot B	11/14/01 3:08:40 PM	00:01:21	1814	0	0	0	0	0

Run   Set Baseline...   Save As...   Close   Help

Figure 77. RLS Status after diagnostic

Note: This is only an example and is not applicable to all situations.

Important: Because the current error counting standard is vague about when the ITW error count is calculated, different vendor's devices calculate at different rates. Analysis of the data must take this into account.

3. Click **Close** to return to the Subsystem Management window, and troubleshoot the problematic devices. If you are unable to determine what component is problematic, save your results and forward them to IBM technical support.

How to save Diagnostics results

For further troubleshooting assistance, save the Read Link Status results and forward them to technical support for assistance.

1. Click **Save As**. The Save As window opens.

2. Select a directory and type the file name of your choice in the **File name** field. You do not need to specify a file extension.
3. Click **Save**. A comma-delimited file containing the read link status results is saved.

Chapter 12. PD hints: Hubs and switches

You should be referred to this chapter from a PD map or indication. If this is not the case, refer back to Chapter 2, "Problem determination starting points," on page 3.

After you have read the relevant information in this chapter, return to the PD map that directed you here, either "Hub/Switch PD map 2" on page 14 or "Common Path PD map 2" on page 21.

Unmanaged hub

The unmanaged hub is used only with the type 3526 RAID controller. This hub does not contain any management or debugging aids other than the LEDs that give an indicator of port up or down.

Switch and managed hub

The switch and managed hub are used with FAStT500, FAStT200, DS4400, DS4500, DS4300, and DS4100 controllers. The following sections describe tests that can be used with the switch and managed hub.

Note: The following test commands apply specifically to the IBM SAN Fibre Channel Switch 2109 Model S16. The tests commands for your switch might differ slightly. Refer to your switch documentation for details.

Running crossPortTest

The `crossPortTest` verifies the intended functional operation of the switch and managed hub by sending frames from the transmitter for each port by way of the GBIC or fixed port and external cable to another port's receiver. By sending these frames, the `crossPortTest` exercises the entire path of the switch and managed hub.

A port can be connected to any other port in the same switch or managed hub, provided that the connection is of the same technology. This means that ShortWave ports can only be connected to ShortWave ports; LongWave ports can be connected only to LongWave ports.

Note: An error condition will be shown for any ports that are on the switch or managed hub but that are not connected. If you want more information on the `crossPortTest` and its options, see the Installation and Service Guide for the switch or managed hub you are using.

To repeat the results in the following examples, run the tests in online mode and with the `singlePortAlso` mode enabled. The test will run continuously until your press the Return key on the console being used to perform Ethernet connected management of the switch or managed hub.

To run, the test must find at least one port with a wrap plug or two ports connected to each other. If one of these criteria is not met, the test results in the following message in the telnet shell:

```
Need at least 1 port(s) connected to run this test.
```

The command syntax is `crossPortTest <nFrames>, <0 or 1>` where `<nFrames>` indicates the number of frames to run.

With `<nFrames>` set to 0, the test runs until you press Return.

With the second field set to 0, no single port wrap is allowed and two ports must be cross-connected. Figure 78 shows the preferred option, which works with either wrap or cross-connect. Figure 79 on page 145 shows the default parms, which work only with cross-connect.

```
myhub:admin> crossPortTest 0,1

Running Cross Port Test .......

Diags: (Q)uit, (C)ontinue, (S)tats, (L)og: s

Diagnostics Status:  Thu Aug 17 14:04:17 2000

port#:   0    1    2    3    4    5    6    7
diags:  OK   OK   OK   OK   OK   OK   OK   OK
state:  UP   UP   UP   UP   UP   DN   UP   DN

  lm0:   45035906 frTx      794716 frRx       280  LLI_errs.
  lm1:   40920918 frTx      404591 frRx       481  LLI_errs.
  lm2:   54308300 frTx     2317366 frRx        26  LLI_errs.
  lm3:   23820416 frTx       79106 frRx        15  LLI_errs.
  lm4:          0 frTx           0 frRx         0  LLI_errs.
  lm6:        599 frTx         599 frRx         0  LLI_errs.  <looped-6>

Central Memory OK
Total Diag Frames Tx: 1804
Total Diag Frames Rx: 2404
```

Return pressed

Wrapped port

Figure 78. crossPortTest—Wrap or cross-connect

```
myhub:admin> crossPortTest

Running Cross Port Test .......

Diags: (Q)uit, (C)ontinue, (S)tats, (L)og: s

Diagnostics Status:  Thu Aug 17 14:45:35 2000

port#:   0    1    2    3    4    5    6    7
diags:  OK   OK   OK   OK   OK   OK   OK   OK
state:  UP   UP   UP   UP   UP   UP   UP   DN

  lm0:    45042814 frTx     801524 frRx       280  LLI_errs.
  lm1:    40922700 frTx     406295 frRx       481  LLI_errs.
  lm2:    54316812 frTx    2326056 frRx        26  LLI_errs.
  lm3:    23820416 frTx      79106 frRx        15  LLI_errs.
  lm4:           0 frTx          0 frRx         0  LLI_errs.
  lm5:          48 frTx         48 frRx         0  LLI_errs.  <looped-6>
  lm6:          48 frTx         48 frRx         0  LLI_errs.  <looped-5>

Central Memory OK
Total Diag Frames Tx: 2265
Total Diag Frames Rx: 2865


Diags: (Q)uit, (C)ontinue, (S)tats, (L)og:
```

Return pressed   Port 6 connected by cable to port 5

Figure 79. crossPortTest—Cross-connect only

Alternative checks

In some rare cases, you might experience difficulty in locating the failed component after you have checked a path. This section gives alternative checking procedures to help resolve the problem.

Some of these checks require plugging and unplugging components. This could lead to other difficulties if, for instance, a cable is not plugged back completely. Therefore, when the problem is resolved, you should perform a path check to make sure that no other problems have been introduced into the path. Conversely, if you started with a problem and, after the unplugging and replugging, you end up at a non-failing point in the PD maps without any repairs or replacement, then the problem was probably a bad connection. You should go back to the original check, such as the SANsurfer check, and rerun it. If it now runs correctly, you can assume that you have corrected the problem (but it is a good idea to keep checking the event logs for further indications of problems in this area).

Figure 80 on page 146 shows a typical connection path.
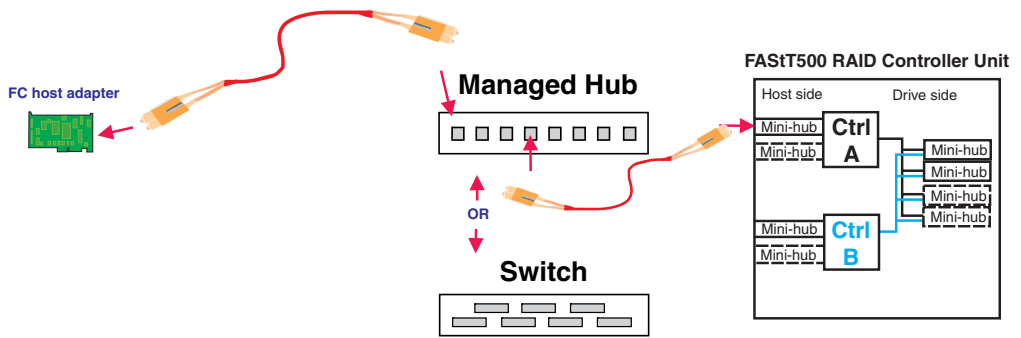
Figure 80. Typical connection path

In the `crossPortTest`, data is sourced from the managed hub or switch and travels the path outlined by the numbers 1, 2, and 3 in Figure 81. For the same path, the `sendEcho` function is sourced from the RAID controller and travels the path 3, 2, 1. Using both tests when problems are hard to find (for example, if the problems are intermittent) offers a better analysis of the path. In this case, the duration of the run is also important because enough data must be transferred to enable you to see the problem.
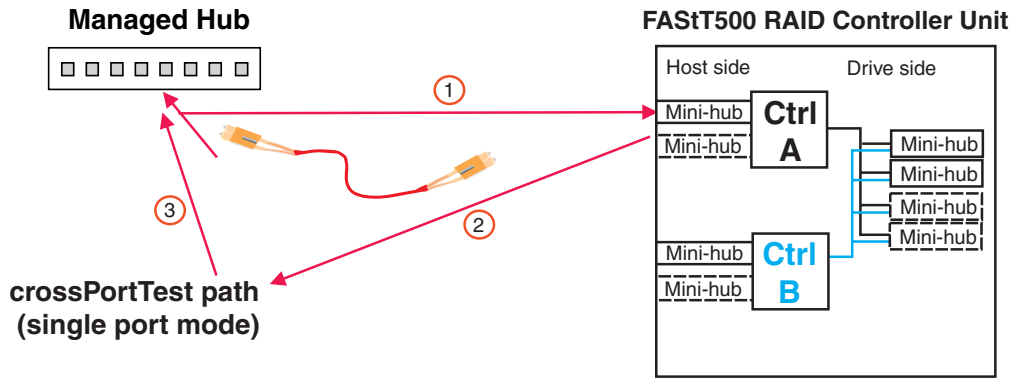
Figure 81. crossPortTest data path

Running crossPortTest and sendEcho path to and from the controller

In the case of wrap tests with the wrap plug, there is also dual sourcing capability by using `sendEcho` from the controller or `crossPortTest` from the managed hub or switch. shows these alternative paths.

crossPortTest path with wrap plug at cable end (single port mode)

FAStT500 RAID Controller Unit

sendEcho path with wrap plug at cable end
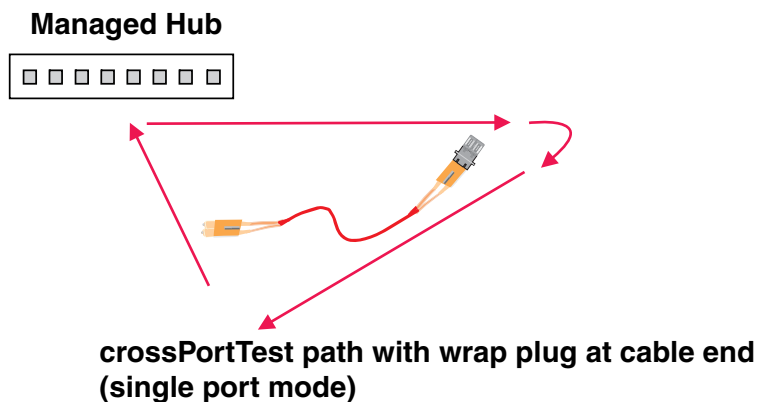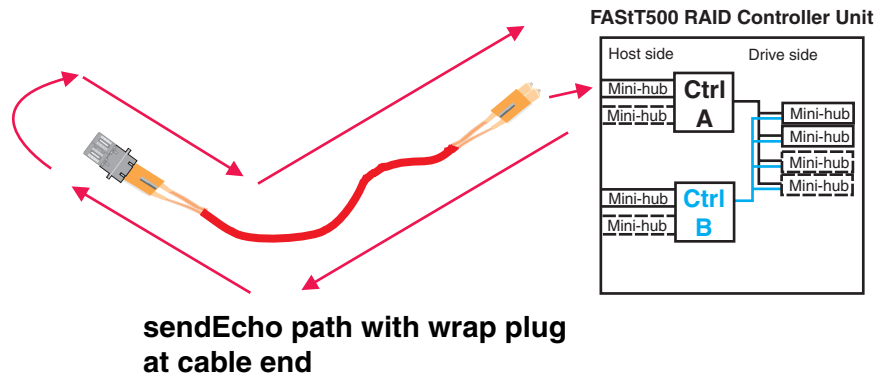
Figure 82. sendEcho and crossPortTest alternative paths

Chapter 13. PD hints: Wrap plug tests

You should be referred to this chapter from a PD map or indication. If this is not the case, refer back to Chapter 2, "Problem determination starting points," on page 3.

After you have read the relevant information in this chapter, return to "Single Path Fail PD map 1" on page 18.

The following sections illustrate the use of wrap plugs.

Running sendEcho and crossPortTest path to and from controller

Failed path of read/write buffer test

Install wrap plug to GBIC on mini-hub of controller A

FAStT500 RAID Controller Unit

Host side   Drive side

Mini-hub | **Ctrl**
Mini-hub | **A**
          Mini-hub
          Mini-hub
          Mini-hub
          Mini-hub
Mini-hub | **Ctrl**
Mini-hub | **B**
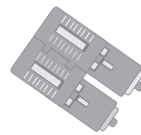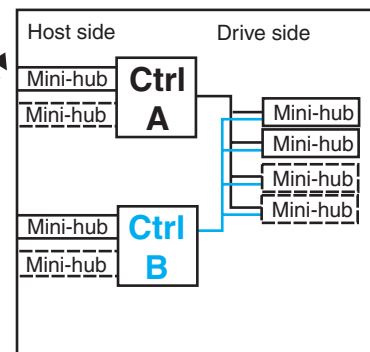
Figure 83. Install wrap plug to GBIC

Failed path of read/write buffer test

3526 Controller Unit

Ctrl A

Install wrap plug to MIA on controller A
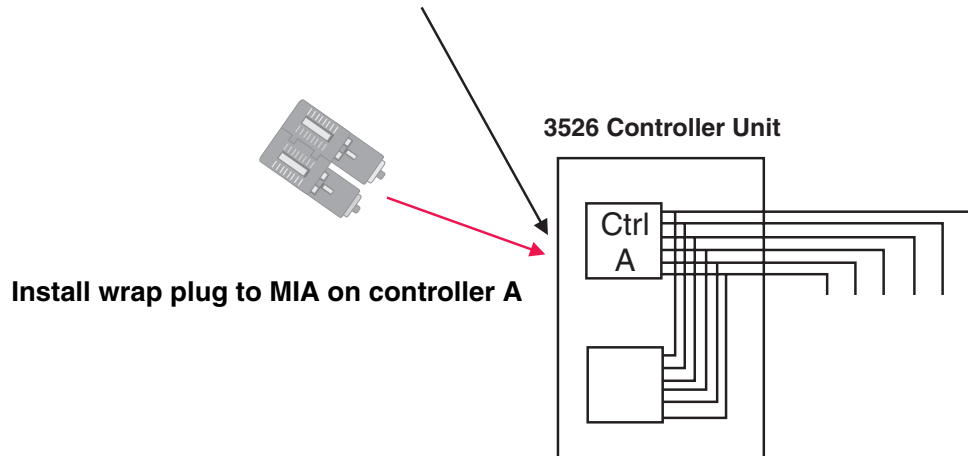
Figure 84. Install wrap plug to MIA

Alternative wrap tests using wrap plugs

There is dual sourcing capability with wrap tests using wrap plugs. Use `sendEcho` from the controller or `crossPortTest` from the managed hub or switch. See "Hub/Switch PD map 1" on page 13 for the information on how to run the `crossPortTest`. Figure 85 and Figure 86 on page 151 show these alternative paths.

FAStT500 RAID Controller Unit

Host side   *Drive side*

Mini-hub   **Ctlr A**
Mini-hub

Mini-hub
Mini-hub
Mini-hub
Mini-hub

Mini-hub   **Ctlr B**
Mini-hub

sendEcho path with wrap plug at cable end

Figure 85. sendEcho path

Managed Hub

crossPortTest path with wrap plug at cable end (single port mode)
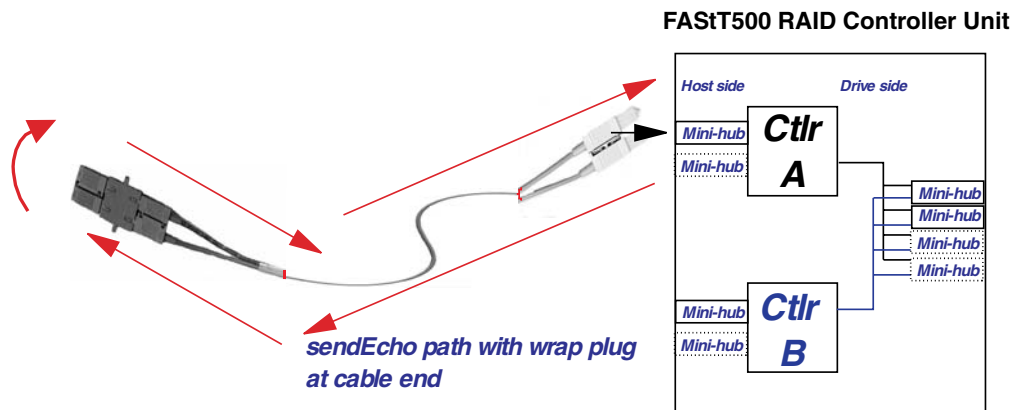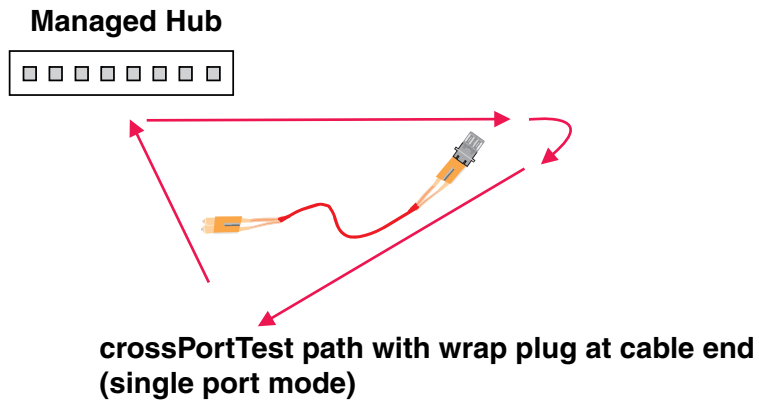
Figure 86. crossPortTest path

Chapter 14. Heterogeneous configurations

You should be referred to this chapter from a PD map or indication. If this is not the case, refer back to Chapter 2, "Problem determination starting points," on page 3.

The DS4000 Storage Manager Version 7 or later provides the capability to manage storage in an heterogeneous environment. This does introduce increased complexity and the potential for problems. This chapter shows examples of heterogeneous configurations and the associated configuration profiles from the DS4000 Storage Manager. These examples can assist you in identifying improperly configured storage by comparing the customer's profile with those supplied, assuming similar configurations.

It is very important that the Storage Partitioning for each host be assigned the correct host type (see Figure 87). If not, the host will not be able to see its assigned storage. The host port identifier that you assign a host type to is the HBA WW node name.
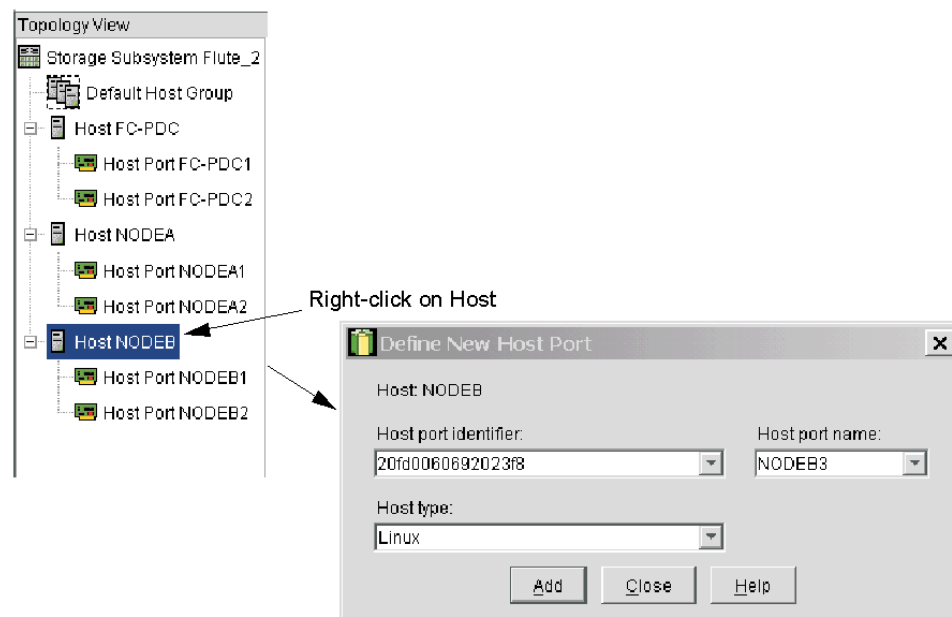
Figure 87. Host information

Configuration examples

Following are examples of heterogeneous configurations and the associated configuration profiles for the DS4000 Storage Manager Version 7.10 and above. For more detailed information, see the *DS4000 Storage Manager Concept guides* for your respective DS4000 Storage Manager version.

Windows cluster
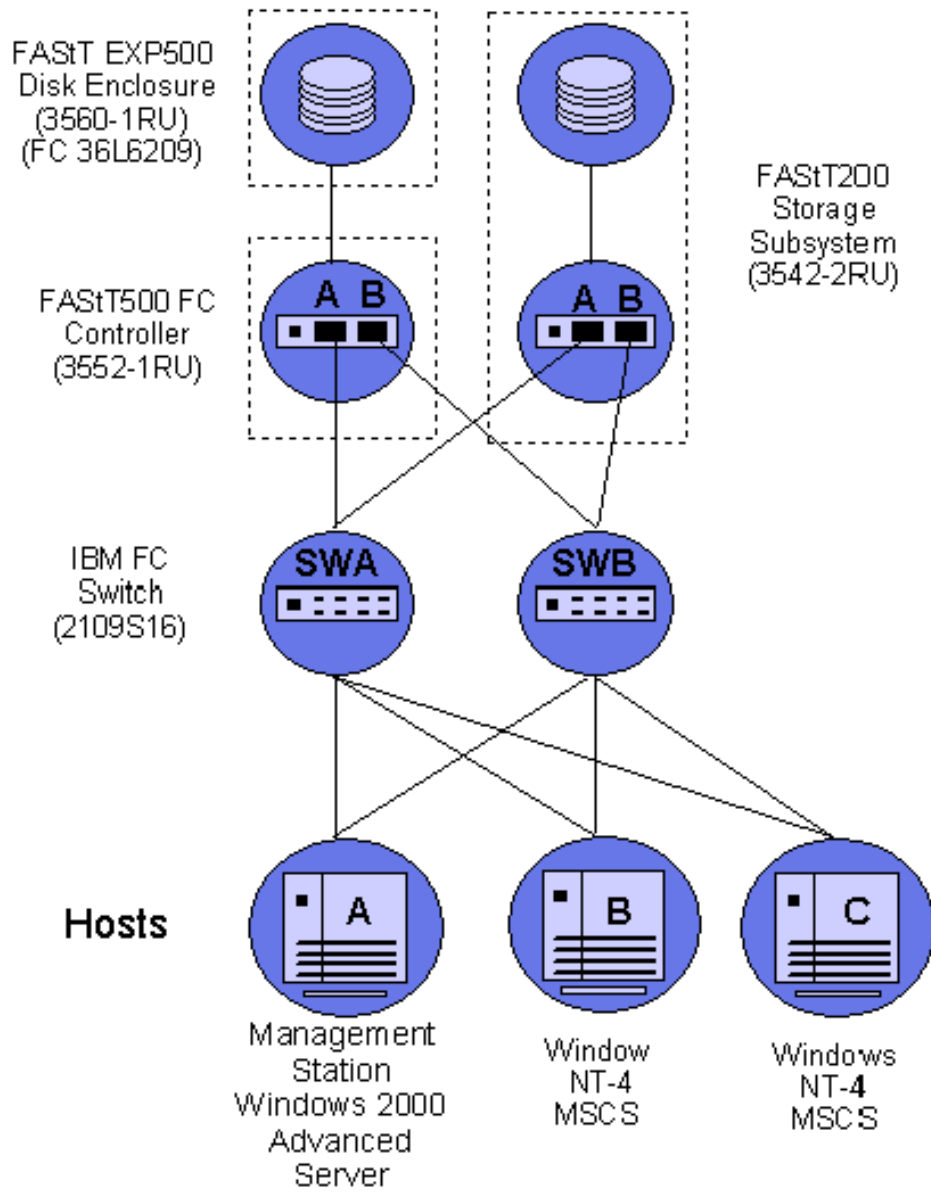
Figure 88. Windows cluster

Table 32. Windows cluster configuration example

	Network Management Type	**Partition**	**Storage Partitioning Topology**
Host A	Client Direct attached	Windows 2000 AS	Host Port A1 Type=Windows 2000 Non-Clustered Host Port A2 Type=Windows 2000 Non-Clustered
Host B	Host Agent Attached	Windows NT Cluster	Host Port B1 Type=Windows Clustered (SP5 or later) Host Port B2 Type=Windows Clustered (SP5 or later)

Table 32. Windows cluster configuration example (continued)

	Network Management Type	Partition	Storage Partitioning Topology
Host C	Host Agent Attached	Windows NT Cluster	Host Port C1 Type=Windows Clustered (SP5 or higher) Host Port C2 Type=Windows Clustered (SP5 or higher)

Heterogeneous configuration
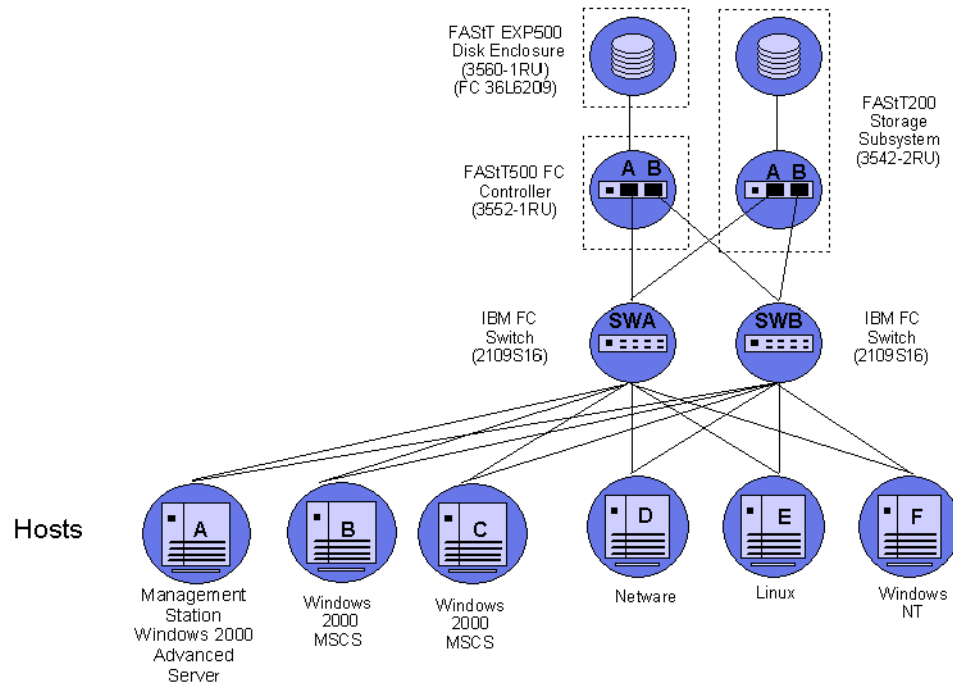
Figure 89. Heterogeneous configuration

Table 33. Heterogeneous configuration example

	Network Management Type	Partition	Storage Partitioning Topology
Host A	Client Direct attached	Windows 2000 AS	Host Port A1 Type=Windows 2000 Non-Clustered Host Port A2 Type=Windows 2000 Non-Clustered
Host B	Host Agent Attached	Windows 2000 Cluster	Host Port B1 Type=Windows Clustered Host Port B2 Type=Windows Clustered
Host C	Host Agent Attached	Windows 2000 Cluster	Host Port C1 Type=Windows Clustered Host Port C2 Type=Windows Clustered
Host D	Host Agent Attached	NetWare	Host Port D1/ Type=NetWare Host Port D2/Type=NetWare

Table 33. Heterogeneous configuration example (continued)

	Network Management Type	Partition	Storage Partitioning Topology
Host E	Host Agent Attached	Linux	Host Port E1/ Type=Linux Host Port E2/Type=Linux
Host F	Host Agent Attached	Windows NT	Host Port F1/Type=Windows NT Host Port F2/ Type=Windows NT

Chapter 15. Using the IBM Fast!UTIL utility

This chapter provides detailed configuration information for advanced users who want to customize the configuration of the following adapters:

- IBM fibre-channel PCI adapter (FRU 01K7354)
- IBM DS4000 host adapter (FRU 09N7292)
- IBM DS4000 FC2-133 host bus adapter (FRU 24P0962)

For more information about these adapters, see the *IBM System Storage*™; *DS4000 Hardware Maintenance Manual*.

You can configure the adapters and the connected fibre channel devices using the Fast!UTIL utility.

Attention: The IBM Fast!UTIL utility is not available on IBM BladeCenter® models.

Starting the Fast!UTIL utility

To access the Fast!UTIL utility, press Ctrl+Q (or Alt+Q for 2100) during the adapter BIOS initialization (it might take a few seconds for the Fast!UTIL menu to display). If you have more than one adapter, the Fast!UTIL utility prompts you to select the adapter you want to configure. After changing the settings, the Fast!UTIL utility restarts your system to load the new parameters.

Important: If the configuration settings are incorrect, your adapter will not function properly. Do not modify the default configuration settings unless you are instructed to do so by an IBM support representative or the installation instructions. The default settings are for a typical Microsoft Windows installation. See the adapter driver readme file for the appropriate operating system for required NVRAM setting modifications for that operating system.

Fast!UTIL options

This section describes the Fast!UTIL options. The first option on the **Fast!UTIL Options** menu is **Configuration Settings**. The settings configure the fibre-channel devices and the adapter to which they are attached.

Note: If your version of the Fast!UTIL utility has settings that are not discussed in this section, then you are working with down-level BIOS or non-supported BIOS. Update your BIOS version.

Host adapter settings

You can use this option to modify host adapter settings. The current default settings for the host adapters are described in this section.

Note: All settings for the IBM fibre-channel PCI adapter (FRU 01K7354) are accessed from the **Host Adapter Settings** menu option (see Table 34 on page 158). The DS4000 host adapter (FRU 09N7292) and the DS4000 FC2-133 host bus adapter (FRU 24P0962) offer additional settings available from the **Advanced Adapter Settings** menu option (see Table 35 on page 158 and

Table 36). Any settings for the fibre-channel PCI adapter (FRU 01K7354) not described in this section are described in "Advanced adapter settings" on page 160.

Table 34. IBM fibre-channel PCI adapter (FRU 01K7354) host adapter settings

Setting	Options	Default
Host adapter BIOS	Enabled or Disabled	Disabled
Execution throttle	1 - 256	256
Frame size	512, 1024, 2048	2048
Loop reset delay	0-15 seconds	8 seconds
Extended error logging	Enabled or Disabled	Disabled
Port down retry count	0-255	30

Table 35. DS4000 host adapter (FRU 09N7292) host adapter settings

Setting	Options	Default
Host adapter BIOS	Enabled or Disabled	Disabled
Frame size	512, 1024, 2048	2048
Loop reset delay	0-15 seconds	5 seconds
Adapter hard loop ID	Enabled or Disabled	Enabled
Hard loop ID	0-125	125
Connection Options	0, 1, 2, 3	3
Fibre channel tape support	Enabled or Disabled	Disabled

Table 36. DS4000 FC2-133 (FRU 24P0962) host bus adapter host adapter settings

Setting	Options	Default
Host adapter BIOS	Enabled or Disabled	Disabled
Frame size	512, 1024, 2048	2048
Loop reset delay	0-60 seconds	5 seconds
Adapter hard loop ID	Enabled or Disabled	Enabled
Hard loop ID	0-125	125
Spin up delay	Enabled or Disabled	Disabled
Connection Options	0, 1, 2, 3	2
Fibre channel tape support	Enabled or Disabled	Disabled
Data rate [for DS4000 FC2-133 host bus adapter (FRU 24P0962) only]	0, 1, 2	2

Host adapter BIOS
When this option is set to Disabled, the ROM BIOS code on the adapter is disabled, freeing space in upper memory. This setting must be enabled if you are starting from a fibre channel hard disk that is attached to the adapter. The default is Disabled.

Frame size
This setting specifies the maximum frame length supported by the adapter. The default size is 2048. If you are using F-Port (point-to-point) connections, the default is best for maximum performance.

Loop reset delay

> After resetting the loops, the firmware does not initiate any loop activity for the number of seconds specified in this setting. The default is 5 seconds.

Adapter hard loop ID

> This setting forces the adapter to use the ID specified in the Hard loop ID setting. The default is Enabled. (For DS4000 host adapter [FRU 09N7292] and DS4000 FC2-133 [FRU 24P0962] host bus adapter only.)

Hard loop ID

> When the adapter hard loop ID is set to Enabled, the adapter uses the ID specified in this setting. The default ID is 125.

Spin up delay

> When this setting is Enabled, the BIOS code waits up to 5 minutes to find the first drive. The default is Disabled.

Connection options

> This setting defines the type of connection (loop or point-to-point) or connection preference (see Table 37). The default is 3 for the DS4000 host adapter (FRU 09N7292) or 2 for the DS4000 FC2-133 host bus adapter (FRU 24P0962).

Table 37. Connection options for DS4000 host adapter (FRU 09N7292) and DS4000 FC2-133 host bus adapter (FRU 24P0962)

Option	Type of connection
0	Loop only
1	Point-to-point only
2	Loop preferred; otherwise, point-to-point
3 (for DS4000 host adapter [FRU 09N7292] only)	Point-to-point; otherwise, loop

Fibre channel tape support

> This setting is reserved for fibre channel tape support. The default is Disabled.

Data rate (for DS4000 FC2-133 host bus adapter (FRU 24P0962) only):

> This setting determines the data rate (see Table 38). When this field is set to 2, the DS4000 FC2-133 host bus adapter determines what rate your system can accommodate and sets the rate accordingly. The default is 2.

Table 38. Data rate options for DS4000 FC2-133 host bus adapter (FRU 24P0962)

Option	Data Rate
0	1 Gbps
1	2 Gbps
2	Auto select

Note: Adapter settings and default values might vary, based on the version of BIOS code installed for the adapter.

Selectable boot settings

When you set this option to **Enabled**, you can select the node name from which you want to start (boot) the system. The node starts from the selected fibre channel

hard disk, ignoring any IDE hard disks attached to your server. When this option is set to **Disabled**, the Boot ID and Boot LUN parameters have no effect.

The BIOS code in some new systems supports selectable boot, which supersedes the Fast!UTIL selectable boot setting. To start from a fibre channel hard disk attached to the adapter, select the attached fibre channel hard disk from the system BIOS menu.

Note: This option applies only to disk devices; it does not apply to CDs, tape drives, and other nondisk devices.

Restore default settings

You can use this option to restore the adapter default settings.

Note: The default NVRAM settings are the adapter settings that were saved the last time an NVRAM update operation was run from the BIOS Update Utility program (option U or command line /U switch). If the BIOS Update Utility program has not been used to update the default NVRAM settings since the adapter was installed, the factory settings are loaded.

Raw NVRAM data

This option displays the adapter nonvolatile random access memory (NVRAM) contents in hexadecimal format. This is a troubleshooting tool; you cannot modify the data.

Advanced adapter settings

You can use this option to modify the advanced adapter settings. The current default settings for the adapter are described in this section.

Note: The **Advanced Adapter Settings** menu option is available only for the DS4000 host adapter (FRU 09N7292) (see Table 39) and the DS4000 FC2-133 (FRU 24P0962) host bus adapter (FRU 24P0962) (see Table 40 on page 161). All settings for the IBM fibre-channel PCI adapter (FRU 01K7354) are accessed from the **Host Adapter Settings** menu option.

Table 39. DS4000 host adapter (FRU 09N7292) advanced adapter settings

Setting	Options	Default
Execution throttle	1-256	256
LUNs per target	0, 8, 16, 32, 64, 128, 256	0
Enable LIP reset	Yes or No	No
Enable LIP full login	Yes or No	Yes
Enable target reset	Yes or No	Yes
Login retry count	0-255	30
Port down retry count	0-255	30
Extended error logging	Enabled or Disabled	Disabled
RIO Operation Mode	0, 5	0
Interrupt Delay Timer	0-255	0

Table 40. DS4000 FC2-133 (FRU 24P0962) host bus adapter advanced adapter settings

Setting	Options	Default
Execution throttle	1-256	256
LUNs per target	0, 8, 16, 32, 64, 128, 256	0
Enable LIP reset	Yes or No	No
Enable LIP full login	Yes or No	Yes
Enable target reset	Yes or No	Yes
Login retry count	0-255	30
Port down retry count	0-255	30
Extended error logging	Enabled or Disabled	Disabled
RIO Operation Mode	0, 5	0
Interrupt Delay Timer	0-255	0

Execution throttle
>   This setting specifies the maximum number of commands running on any
>   one port. When a port reaches its execution throttle, the Fast!UTIL utility
>   does not run any new commands until the current command is completed.
>   The valid options for this setting are 1 through 256. The default (optimum)
>   is 256.

LUNs per target (for IBM fibre-channel PCI adapter [FRU 01K7354])
>   This setting specifies the number of LUNs per target. Multiple logical unit
>   number (LUN) support is typically for redundant array of independent
>   disks (RAID) enclosures that use LUNs to map drives. The default is 8. For
>   NetWare, set the number of LUNs to 32.

**LUNs per target (for DS4000 host adapter [FRU 09N7292] and DS4000 FC2-133
host bus adapter [FRU 24P0962]**
>   This setting specifies the number of LUNs per target. Multiple logical unit
>   number (LUN) support is typically for redundant array of independent
>   disks (RAID) enclosures that use LUNs to map drives. The default is 0. For
>   NetWare, set the number of LUNs to 32.

Enable LIP reset
>   This setting determines the type of loop initialization process (LIP) reset
>   that is used when the operating system initiates a bus reset routine. When
>   this option is set to **Yes**, the device driver initiates a global LIP reset to
>   clear the target device reservations. When this option is set to **No**, the
>   device driver initiates a global LIP reset with full login. The default is **No**.

Enable LIP full logon
>   This setting instructs the ISP chip to log into all ports after any LIP. The
>   default is Yes.

Enable target reset
>   This setting enables the device drivers to issue a Target Reset command to
>   all devices on the loop when a SCSI Bus Reset command is issued. The
>   default is Yes.

Login retry count
>   This setting specifies the number of times the software tries to log in to a
>   device. The default is 30 retries.

Port down retry count

    This setting specifies the number of times the software retries a command to a port that is returning port-down status. The default is 30 retries.

Extended error logging

    This option provides additional error and debugging information to the operating system. When this option is set to **Enabled**, events are logged into the Windows NT Event Viewer or Windows 2000 Event Viewer (depending on the environment you are in). The default is Disabled.

RIO operation mode

    This setting specifies the reduced interrupt operation (RIO) modes, if supported by the software device driver. RIO modes enable posting multiple command completions in a single interrupt (see Table 41). The default is 0.

Table 41. RIO operation modes for DS4000 host adapter (FRU 09N7292) and DS4000 FC2-133 host bus adapter (FRU 24P0962)

Option	Operation mode
0	No multiple responses
5	Multiple responses with minimal interrupts

Interrupt delay timer

    This setting contains the value (in 100-microsecond increments) used by a timer to set the wait time between accessing (DMA) a set of handles and generating an interrupt. The default is 0.

Scan fibre channel devices

Use this option to scan the fibre channel loop and list all the connected devices by loop ID. Information about each device is listed, for example, vendor name, product name, and revision. This information is useful when you are configuring your adapter and attached devices.

Fibre channel disk utility

Attention: Performing a low-level format removes all data on the disk.

Use this option to scan the fibre channel loop bus and list all the connected devices by loop ID. You can select a disk device and perform a low-level format or verify the disk media.

Loopback data test

Use this option to verify the adapter basic transmit and receive functions. A fibre channel loop back connector option must be installed into the optical interface connector on the adapter before starting the test.

Select host adapter

Use this option to select, configure, or view a specific adapter if you have multiple adapters in your system.

ExitFast!UTIL option

After you complete the configuration, use the ExitFast!UTIL option to close the menu, and then restart the system.

Chapter 16. Frequently asked questions about the DS4000 Storage Manager

This chapter contains answers to frequently asked questions (FAQs) in the following areas:
- "Global Hot Spare (GHS) drives"
- "Auto Code Synchronization (ACS)" on page 166
- "Storage partitioning" on page 169
- "Miscellaneous" on page 170

Global Hot Spare (GHS) drives

What is a Global Hot Spare?

A Global Hot Spare is a drive within the storage subsystem that has been defined by the user as a spare drive. The Global Hot Spare is to be used in the event that a drive that is part of an array with redundancy (RAID 1, 3, 5 array) fails. When the fail occurs, and a GHS drive is configured, the controller will begin reconstructing to the GHS drive. Once the reconstruction to the GHS drive is complete, the array will be promoted from the Degraded state to the Optimal state, thus providing full redundancy again. When the failed drive is replaced with a good drive, the copyback process will start automatically.

What is reconstruction and copyback?

Reconstruction is the process of reading data from the remaining drive (or drives) of an array that has a failed drive and writing that data to the GHS drive. Copyback is the process of copying the data from the GHS drive to the drive that has replaced the failed drive.

What happens during the reconstruction of the GHS?

During the reconstruction process, data is read from the remaining drive (or drives) within the array and used to reconstruct the data on the GHS drive.

How long does the reconstruction process take?

The time to reconstruct a GHS drive will vary depending on the activity on the array, the size of the failed array, and the speed of the drives.

What happens if a GHS drive fails while sparing for a failed drive?

If a GHS drive fails while it is sparing for another drive, and another GHS is configured in the array, a reconstruction process to another GHS will be done.

If a GHS fails, and a second GHS is used, and both the originally failed drive and the failed GHS drive are replaced at the same time, how will the copyback be done?

The controller will know which drive is being spared by the GHS, even in the event that the first GHS failed and a second GHS was used. When the original failed drive is replaced, the copyback process will begin from the second GHS.

If the size of the failed drive is 9Gbyte, but only 3Gbytes of data have been written to the drive, and the GHS is an 18Gbyte drive, how much is reconstructed?

The size of the array determines how much of the GHS drive will be used. For example, if the array has two 9Gbyte drives, and the total size of all logical drives is 18Gbyte, then 9Gbytes of reconstruction will occur, even if only 3Gbytes of data exist on the drive. If the array has two 9Gbyte drives, and the total size of all logical drives is 4Gbytes, then only 2Gbytes of reconstruction will be done to the GHS drive.

How can you determine if a Global Hot Spare (GHS) is in use?

The Global Hot Spare is identified in the DS4000 Storage Manager by the following icon:

If a drive fails, which GHS will the controller attempt to use?

The controller will first attempt to find a GHS on the same channel as the failed drive; the GHS must be at least as large as the configured capacity of the failed drive. If a GHS does not exist on the same channel, or if it is already in use, the controller will check the remaining GHS drives, beginning with the last GHS configured. For example, if the drive at location 1:4 failed, and if the GHS drives were configured in the following order, 0:12, 2:12, 1:12, 4:12, 3:12, the controller will check the GHS drives in the following order, 1:12, 3:12, 4:12, 2:12, 0:12.

Will the controller search all GHS drives and select the GHS drive closest to the configured capacity of the failed drive?

No. The controller will use the first available GHS that is large enough to spare for the failed drive.

Can any size drive be configured as a GHS drive?

At the time a drive is selected to be configured as a GHS, it must be equal or larger in size than at least one other drive in the attached drive enclosures that is not a GHS drive. However, it is strongly recommended that the GHS have at least the same capacity as the target drive on the subsystem.

Can a GHS that is larger than the drive that failed act as a spare for the smaller drive?

Yes.

Can a 9Gbyte GHS drive spare for an 18Gbyte failed drive?

A GHS drive can spare for any failed drive, as long as the GHS drive is at least as large as the configured capacity of the failed drive. For example, if the failed drive is an 18Gbyte drive with only 9Gbyte configured as part of an array, a 9Gbyte drive can spare for the failed drive.

However, to simplify storage management tasks and to prevent possible data loss in case a GHS is not enabled because of inadequate GHS capacity, it is strongly recommended that the GHS have at least the same capacity as the target drive on the subsystem.

What happens if the GHS drive is not large enough to spare for the failed drive?

If the controller does not find a GHS drive that is at least as large as the configured capacity of the failed drive, a GHS will not be activated, and, depending on the array state, the LUN will become degraded or failed.

What action should be taken if all drives in the array are now larger than the GHS drive?

Ideally, the GHS drive will be replaced with a drive as large as the other drives in the array. If the GHS drive is not upgraded, it will continue to be a viable spare as long as it is as large as the smallest configured capacity of at least one of the configured drives within the array.

The previous two questions describe what might happen in this case. It is strongly recommended that you upgrade the GHS to the largest capacity drive.

How many GHS drives can be configured in an array?

The maximum number of GHS drives for the DS4000 Storage Manager Versions 7 or later, is fifteen per subsystem.

How many GHS drives can be reconstructed at the same time?

Controller firmware versions 3.x and older will only allow for one reconstruction process per controller to occur at the same time. An additional requirement is that in order for two reconstruction processes to occur at the same time, the LUNs affected cannot be owned by the same controller. For example, if a drive in LUN_1 and a drive in LUN-4 fail, and both LUNs are owned by Controller_A, then only one reconstruction will occur at a time. However, if LUN-1 is owned by Controller_A, and LUN-4 is owned by Controller_B, then two reconstruction process will occur at the same time. If multiple drives fail at the same time, the others will be queued after the currently-running reconstruction completes.

Once the GHS reconstruction has started, and the failed drive is replaced, does the reconstruction of the GHS stop?

The reconstruction process will continue until complete, and then begin a copyback to the replaced drive.

What needs to be done to a GHS drive that has spared for a failed drive after the copyback to the replaced drive has been completed?

Once the copyback to the replaced drive is complete, the GHS drive will be immediately available as a GHS. There is no need for the user to do anything.

Does the GHS have to be formatted before it can be used?

No. The GHS drive will be reconstructed from the other drive (or drives) within the LUN that had a drive fail.

What happens if a GHS drive is moved to a drive-slot that is part of LUN, but not failed?

When the GHS drive is moved to a drive-slot that is not failed and is part of a LUN, the drive will be spun up, marked as a replacement of the previous drive, and reconstruction started to the drive.

Can a GHS drive be moved to a drive-slot occupied by a faulted drive that is part of a LUN?

Yes. In this case, the GHS drive will now be identified as a replacement for the failed drive, and begin a copyback or reconstruction, depending on whether a GHS drive was activated for the faulted drive.

What happens if a GHS drive is moved to an unassigned drive-slot, and the maximum GHS drives are already configured?

Once the maximum number of GHS drives have been configured, moving a GHS drive to an unassigned drive-slot will cause the GHS drive to become an unassigned drive.

What happens if a drive from a LUN is accidentally inserted into a GHS drive slot?

Once a drive is inserted into a slot configured as a GHS, the newly inserted drive will become a GHS, and the data previously on the drive will be lost. Moving drives in or out of slots configured as GHS drives must be done very carefully.

How does the controller know which drive slots are GHS drives?

The GHS drive assignments are stored in the dacStore region of the Sundry drives.

Auto Code Synchronization (ACS)

What is ACS?

ACS is a controller function that is performed during the controller Start-Of-Day (SOD) when a foreign controller is inserted into an array, at which time the Bootware (BW) and Appware (AW) versions will be checked and synchronized, if needed.

What versions of FW support ACS?

ACS was first activated in controller FW version 3.0.x, but the LED display was added to controller FW version 03.01.x and later.

How to control if ACS is to occur?

ACS will occur automatically when a foreign controller is inserted, or during a power-on, if bit 1 is set to 0 (zero) and bit 2 is set to 1 (one) in NVSRAM byte offset 0x29. If these bits are set appropriately, the newly inserted controller will

check the resident controller BW and AW versions with its own, and if different, will begin the synchronization process.

Bit 1 = 0	Auto Code Synchronization will occur only if the newly inserted controller is a foreign controller (a different controller from the one that was previously in the same slot).
Bit 2 = 1	Enable Automatic Code Synchronization (ACS)

What is a resident controller and what is a foreign controller?

A controller is considered to be resident if it is the last controller to have completed a SOD in that slot and has updated the dacStore on the drives. A foreign controller is one that is not recognized by the array when powered on or inserted.

Example A: In a dual controller configuration that has completed SOD, both controllers are considered to be resident. If the bottom controller is removed, and a new controller is inserted, the new controller will not be known by the array and will be considered foreign, because it is not the last controller to have completed a SOD in that slot.

Example B: In a dual controller configuration that has completed SOD, both controllers are considered to be resident. If controller Y is removed from the bottom slot, and controller Z is inserted into the bottom slot, controller Z will be considered foreign until it has completed the SOD. If controller Z is then removed and controller Y is reinserted, controller Y will be considered foreign because it is not the last controller to have completed the SOD in that slot.

What happens if a single controller configuration is upgraded to dual controller?

If a controller is inserted into a slot that has not previously held a controller since the array was cleared, ACS will not be invoked. This is because there is no previous controller information in the dacStore region to use for evaluating the controller as being resident or foreign.

When will ACS occur?

Synchronization will occur only on power cycles and controller insertion, not on resets. During the power-on, the foreign controller will send its revision levels to the resident controller and ask if ACS is required. The resident controller will check NVSRAM settings and, if ACS is enabled, will then check the revision numbers. A response is then sent to the foreign controller, and if ACS is not required, the foreign controller will continue its initialization. If ACS is required, a block of RPA cache will be allocated in the foreign controller and the ACS process will begin.

Which controller determines if ACS is to occur?

The NVSRAM bits of the resident controller will be used to determine whether synchronization is to be performed. The controller being swapped in will always request synchronization, which will be accepted or rejected based on the NVSRAM bits of the resident controller.

What is compared to determine if ACS is needed?

The entire code revision number will be used for comparison. Both the BW and AW versions will be compared, and, if either are different, both the BW and AW will be erased and rewritten. The number of separate loadable partitions is also compared; if different, the code versions are considered to be different without considering the revision numbers.

How long will the ACS process take to complete?

The ACS process will begin during the Start-Of-Day process, or between 15 and 30 seconds after power-up or controller insertion. The ACS process for Series 3 controller code will take approximately three minutes to complete. As the code size increases, the time to synchronize will also increase. Once ACS is complete, do not remove the controllers for at least three minutes, in case NVSRAM is also synchronized during the automatic reset.

What will happen if a reset occurs before ACS is complete?

It is important that neither of the controllers are reset during the ACS process. If a reset occurs during this process, it is likely that the foreign controller will no longer boot or function correctly, and it might have to be replaced.

Is NVSRAM synchronized by ACS?

NVSRAM synchronization is not part of ACS, but is checked with dacStore on the drives every time the controller is powered on. The synchronization is not with the alternate controller, but with the NVSRAM as written to dacStore for the controller slot. Each controller, slot-A and slot-B, have individual NVSRAM regions within dacStore. The update process takes approximately five seconds, does not require a reset, and synchronizes the following NVSRAM regions: UserCfg, NonCfg, Platform, HostData, SubSys, DrvFault, InfCfg, Array, Hardware, FCCfg, SubSysID, NetCfg, Board.

Note: No LED display will be seen during the synchronization of the NVSRAM.

What is the order of the synchronization?

Both the BW and AW are synchronized at the same time. NVSRAM will be checked and synchronized during the automatic reset following the ACS of the controller code.

Will the controller LEDs flash during ACS?

The function to flash the LEDs during ACS was first enabled in controller Firmware version 03.01.01.01. If the foreign controller has a release prior to 03.01.01.01, the LED display will not be seen during ACS. The controller being updated controls the LED synchronization display.

What is the LED display sequence?

If the foreign controller has a Firmware version equal to or newer than 03.01.01.01, the LEDs will be turned on from right to left, and then turned off left to right. This sequence will continue until the ACS process is complete.

Is a reset required after ACS is complete?

When the ACS process is complete, the controller will automatically reset.

What is the ACS sequence for controllers with AW prior to 03.01.01.01?

If the foreign controller has AW prior to 03.01.01.01, the LED display will not be displayed. In this case, the controllers should not be removed or reset for at least 15 minutes. Once the foreign controller has reset, the controller will be ready for use within two minutes.

Will ACS occur if the controller is cold swapped?

Yes, providing the NVSRAM bits are set to allow ACS to occur.

What happens if both controllers are cold swapped?

If both controllers are cold swapped (that is, if both are foreign), the controller with the higher FW version number will be loaded onto the alternate controller. This is simply a numerical comparison. For example, if controller A is 03.01.01.08, and controller B is 03.01.01.11, then controller A will be upgraded to 03.01.01.11. The NVSRAM will be updated from dacStore.

What sequence of events should be expected during ACS?

If ACS is enabled, the process will begin about 30 seconds after the controller is inserted or powered on. When ACS begins, the SYM1000 and the foreign controller fault lights will begin to flash, and the controller LEDs will begin to turn on one at a time from right to left, then off left to right. This process will continue for approximately three minutes until the ACS process is complete. Once the ACS process is complete, the foreign controller will reset automatically and during the reset, the NVSRAM will be checked, and updated if needed. The entire process will take approximately five minutes to complete.

Storage partitioning

Does the Storage Partitions feature alleviate the need to have clustering software at the host end?

No. Clustering software provides for the movement of applications between hosts for load balancing and failover. Storage Partitions just provides the ability to dedicate a portion of the storage to one or more hosts. Storage partitions should work well with clustering in that a cluster of hosts can be grouped as a Host Group to provide access to the same storage as needed by the hosts in that cluster.

If I have two hosts in a host group sharing the same logical drives, and both hosts trying to modify the same data on the same logical drive, how are conflicts resolved?

This is one of the primary value adds of clustering software. Clustering software comes in two flavors:
- Shared Nothing - In this model, clustered hosts partition the storage between the hosts in the cluster. In this model, only one host at a time obtains access to a particular set of data. In the event load balancing or a server failure dictates, the cluster software manages a data ownership transition of the set of data to another host. Microsoft MSCS is an example.

- Shared Clustering - In this model, clustered hosts all access the same data concurrently. The cluster software provides management of locks between hosts that prevents two hosts from accessing the same data at the same time. Sun Cluster Server is an example.

Note: In the DS4000 Storage Manager version 7 client, you cannot change the default host type until the Write Storage Partitioning feature is disabled.

How many partitions does the user really get?

By default, the user has one partition always associated with the default host group. Therefore, when the user enables additional partitions, up to 8 for example, they are technically getting eight partitions in addition to the "default" partition. When you enable additional partitions, move any logical drives that are in the default host group into the new partition.

Why should I not use the default host group's partition?

You can potentially run into logical drive/LUN collisions if you replace a host port in a host without using the tools in the Definitions window to associate the new host port with the host.

Furthermore, there is no read/write access control on logical drives that are located in the same partition. For Microsoft Windows operating systems, data corruption occurs if a logical drive is mounted on more than two systems without the presence of middleware, such as Cluster Service, to provide read/write access locking.

Example: You have Host 1 mapped to logical drive Fred using LUN 1. There is also a logical drive George, which is still part of the Default Host Group that uses LUN 1. If you replace a host adapter in Host 1 without associating the new host adapter with Host 1, then Host 1 will now have access to logical drive George, instead of logical drive Fred, through LUN 1. Data corruption can occur.

Miscellaneous

What is the best way to identify which NVSRAM file version has been installed on the system when running in the controller?

In the DS4000 Storage Manager, use the profile command. The NVSRAM version is included in the board/controller area.

Alternatively, in the "subsystem management" window, right-click the storage subsystem and select **Download** -> **NVSRAM**. The NVSRAM version is displayed.

When using arrayPrintSummary in the controller shell, what does *synchronized* really mean and how is it determined?

The term *synchronized in the shell* has nothing to do with firmware or NVSRAM. Simply put, *synchronized* usually means the controllers have successfully completed SOD in an orderly manner and have synchronized cache. A semaphore is passed back and forth between the controllers as one or more of the controllers are going through SOD. If this semaphore gets stuck on one controller, or if a controller does not make it through SOD, the controllers will not come up synchronized.

One way the semaphore can get stuck is if a LUN or its cache cannot be configured. In addition, if a controller has a memory parity error, the controllers will not be synchronized. There have been cases where one controller states the controllers are synchronized while its alternate states that they are not. One cause of this is that a LUN might be 'locked' by the non-owning controller; this can sometimes be fixed by turning off bit 3 of byte 0x29 in NVSRAM (Reserve and Release).

The DS4000 Storage Manager shows the nodes in the "enterprise" window with either IP address or machine name. Why is this not consistent?

The DS4000 Storage Manager tries to associate a name with each host node, but if one is not found, then the IP address is used. The inconsistency occurs because the client software cannot resolve the IP address to a name, or the user has manually added a host node by IP address.

Why do you see shared fibre drives twice during text setup of NT/W2K? The UTM does not seem protected (because you can create/delete the partition).

The UTM is only necessary if the Agent software is installed on a host. If you are direct-attached (network-attached) to a module, you do not need the Agent. This, in turn, means you do not need the UTM LUN. RDAC is what 'hides' the UTM from the host and creates the failover nodes. If RDAC is not installed on an operating system, then the UTM will appear to be a normal disk (either 20 Mbytes or 0 MBytes) to the operating system. However, there is no corresponding data space "behind" the UTM; the controller code write-protects this region. The controller will return an error if an attempt is made to write to this nonexistent data region. The error is an ASC/ASCQ of 21/00 - Logical block address out of range, in the Event Viewer.

For Linux operating systems, the UTM LUN is not required and should not be present for a Linux Host.

If RDAC is not installed on a host, and NVSRAM offset 0x24 is set to 0, then you will see each LUN twice (once per controller). This is necessary because most HBAs need to see a LUN 0 on a controller in order for the host to come up. You should only be able to format one of the listed devices by using the node name which points to the controller that really owns the disk. You will probably get an error if you try to format a LUN through the node pointing to the non-owning controller. The UTM is "owned" by both controllers as far as the controller code is concerned, so you will probably be able to format or partition the UTM on either node.

In short, if RDAC is not installed, the UTM will appear to be a regular disk to the host. Also, you will see each disk twice. In this case, it is up to the user to know not to partition the UTM, and to know which of the two nodes for each device is the true device.

How can you determine from the MEL, which node has caused problems (that is, which node failed the controller)?

You cannot tell which host failed a controller in a multi-host environment. You need to use the host Event Log to determine which host is having problems.

When RDAC initiates a Path failure and sets a controller to passive, why does the status in the "enterprise" window of the DS4000 Storage Manager shows the subsystem as optimal?

This is a change in the design from older code which should prove to be a useful support tool once we get used to it. A 'failed' controller which shows as passive in the EMW window, but which has been failed by RDAC, indicates that no hardware problem could be found on the controller. This type of state implies that we have a problem in the path to the controller, not with the controller itself. In short, a bad cable, hub, GBIC, and so on, on the host side is probably why the failover occurred. Hopefully, this will minimize the number of controllers which are mistakenly returned as bad.

(NT/W2K) What is the equivalent for symarray (NT) with the DS4000 Storage Manager W2K?

rdacfltr is the "equivalent" of symarray. However, symarray was a class driver, whereas rdacfltr is a Low level filter driver. rdacfltr will report Event 3 (configuration changes) and Event 18 (failover events) information. Any errors which are not of this type (such as check conditions) will be reported by W2K's class driver. These errors will be logged by the (disk) class driver. ASC/ASCQ codes and SRB status information should appear in the same location in these errors. The major difference is this break up of errors in W2K, but the error information should be available under one of these two sources in the Event Log.

Chapter 17. pSeries supplemental problem determination information

If a problem occurs in the fibre channel environment, you will need a number of pieces of information to successfully correct the problem. This chapter discusses fibre channel environment-specific problems on IBM pSeries servers as well as 6227, 6228, 6239, and 5716 HBAs. If you experience problems with the AIX system, see your AIX documentation.

For detailed information about installation and configuration, see the *installation and users guide* that is specific to your fibre channel environment at:

www-03.ibm.com/servers/storage/support/disk

Nature of fibre channel environment problems

In the complex and diverse fibre channel environment, a wide variety of problems can be encountered. These problems might include, but are not limited to the following list:

- A Gigabit Fibre Channel PCI Adapter in an AIX system has a hardware defect.
- The device driver for a Gigabit Fibre Channel PCI Adapter in an AIX system has a hardware defect.
- The device driver for a Gigabit Fibre Channel PCI Adapter has been incorrectly installed or is exhibiting incorrect behavior.
- A port in a fibre channel switch is defective, incorrectly zoned, or blocked.
- Ports in a fibre channel switch have been rezoned and the **cfgmgr** command has not been run to set up the new configuration parameters.
- A fibre channel adapter has been replaced and zoning or DS4000 storage partitioning has not been updated.
- A port adapter in a Disk Storage Subsystem has a hardware defect.
- A fibre channel cable connector is not properly seated, dirty, or defective.

As can be seen in the above list, problems can be encountered anywhere throughout the fibre channel configuration. Sometimes the problem is distinctly reported by, and at the failing component. Often, however, the AIX system host, as the initiator, detects and reports the error condition. As a result, fibre channel errors reported by the AIX system must be analyzed carefully to determine the true origin of the failure.

Note: Do not pursue problem determination by Field Replaceable Unit (FRU) replacement in the AIX system unless the problem is isolated to this host component.

Requirements before starting problem determination

The following system administrators might be needed to perform the problem determination procedures:

- AIX system administrator
- DS4000 disk subsystem administrator
- Fiber Channel switch administrator

Note: If the host is connected directly to the Storage Subsystem, a Fiber Channel switch administrator is not needed.

Verify that all the AIX fiber channel drivers and adapter firmware are at the minimum requirements, or a higher level, by checking the DS4000 Storage Manager readme file for your operating system. To download the readme file, complete the following steps:

1. Access the following Web site:

   www-03.ibm.com/servers/storage/support/disk

2. Click the link for your storage subsystem.
3. When the subsystem page opens, click the **Download** tab.
4. When the download page opens, click the link for Storage Manager.
5. When the next page opens, click the **Storage Mgr** tab. A table displays.
6. In the table, find the entry for IBM DS4000 Storage Manager for AIX, and click corresponding link under the **Current Versions and Readmes** column.

Fibre channel environment problem determination procedures

This section provides basic problem-determination procedures for the fibre-channel environment. These procedures are intended to help isolate problems. Because of the complexity of the environment, a single fibre-channel problem can result in a large volume of error reports in the AIX system. Carefully analyze these logged errors to find the error that represents the original root cause. In addition, while fibre-channel-environment problems are often reported by the AIX system, indiscriminate replacement of the Gigabit Fibre Channel PCI Adapter *is not* the recommended problem-determination procedure.

For detailed installation and configuration information, see the *installation and users guide* for your fibre-channel environment.

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

Note: It is important that you clearly understand the topology of your configuration.

Host adapter firmware and drivers

Use the procedures provided in this section to identify problems with the host adapter firmware and drivers.

Step 1. Verify that host adapter firmware and drivers are at the current levels.

To verify that your fibre adapter firmware is the most current version, go to:

www-03.ibm.com/servers/storage/disk/ds4000/index.html

To verify that your required AIX drivers are the most current versions, go to:

www-03.ibm.com/servers/eserver/support/unixservers/aixfixes.html

Table 42. Required drivers

Driver	Description
devices.fcp.disk.rte	Required for any FC attachment to an AIX system.
devices.common.IBM.fc.rte	Required for any FC attachment to an AIX system.
devices.pci.df1000f7.com	Required for any FC attachment to an AIX system.
devices.pci.df1000f7.rte	Required for the 6227 adapter.
devices.pci.df1000f7.diag	Required for the 6227 adapter.
devices.pci.df1000f9.rte	Required for the 6228 adapter.
devices.pci.df1000f9.diag	Required for the 6228 adapter.
devices.pci.df1080f9.rte	Required for the 6239 adapter.
devices.pci.df1080f9.diag	Required for the 6239 adapter.
devices.pci.df1000fa.rte	Required for the 5716 adapter.
devices.pci.df1000fa.diag	Required for the 5716 adapter. The 5716 adapter *is not* supported on AIX 5.1 or earlier versions.
devices.pci.77101223.com	Required for the BladeCenter JS20 Qlogic adapter.
devices.pci.77101223.rte	Required for the BladeCenter JS20 Qlogic adapter.
devices.pci.77101223.diag	Required for the BladeCenter JS20 Qlogic adapter.
devices.fcp.disk.array.rte	Required for DS4000 support. This is an RDAC driver.
devices.fcp.disk.array.diag	Required for DS4000 support. This is an RDAC driver.

Step 1.1. Determine what fibre adapters are connected or should be connected to the DS4000. Verify that the fibre adapters are available to the host and are logged into the fibre switch.

For a host connection, run the following command:

```
#lsdev –C | grep fcs
```

The output should be similar to the following example:

```
fcs0      Available 1Z-08        FC Adapter
fcs1      Available 1n-08        FC Adapter
```

When specific information about an adapter is recorded, but it is unavailable to the system, the adapter is in a *defined state*. If the adapter is in a defined state or the adapter is not showing up at the host, run the following command:

```
# rmdev –dl fcsx
# cfgmgr
```

If the adapter is still unavailable at the host, call 1-800-IBMSERV (1-800-4267378) and open a hardware call on the host fibre adapter.

Step 1.2 Verify that the host adapters are logged into the fibre switch.

Determine if the world wide port names (WWPNs) for verification are logged into the switch, and also verify the firmware version of the adapter:

Run the following command:

```
 #lscfg –vl fcs0
```

The output should be similar to the following example:

```
fcs0             U0.1-P2-I4/Q1  FC Adapter

        Part Number.................00P4295
        EC Level....................A
        Serial Number...............1E3420A01D
        Manufacturer................001E
        Feature Code/Marketing ID...5704
        FRU Number..................    00P4297
        Device Specific.(ZM)........3
        Network Address.............10000000C93681EE
      (This is the wwpn as seen by the switch)
        ROS Level and ID............02E01035
        Device Specific.(Z0)........2003806D
        Device Specific.(Z1)........00000000
        Device Specific.(Z2)........00000000
        Device Specific.(Z3)........03000909
        Device Specific.(Z4)........FF601032
        Device Specific.(Z5)........02E01035
        Device Specific.(Z6)........06631035
        Device Specific.(Z7)........07631035
        Device Specific.(Z8)........20000000C93681EE
        Device Specific.(Z9)........HS1.00X5
        Device Specific.(ZA)........H1D1.00X5  (firmware version)
        Device Specific.(ZB)........H2D1.00X5
        Device Specific.(YL)........U0.1-P2-I4/Q1
```

For the IBM Fibre Channel Switch documentation, go to:

http://www.ibm.com/servers/storage/support/san/index.html

Step 1.3 Check the attachment of the fibre adapter for a direct connection.

Run the following command:

```
# lsattr -El fscsi0
```

The output should be similar to the following example:

```
**=>attach       al   How this adapter is CONNECTED       False
dyntrk       no      Dynamic Tracking of FC Devices      True
fc_err_recov fast_fail FC Fabric Event Error RECOVERY Policy True
```

```
scsi_id      0x1        Adapter SCSI ID                  False
sw_fc_class  3          FC Class for Fabric              True

**al=arbitrated loop
```

Step 2. Check the multiple dar devices for a single DS4000 Disk Subsystem.

Run the following command:

```
#lsdev –C | grep dar
```

The output should be similar to the following example:

```
dar0      Available              1742     DS4500 Disk Array Router
```

If the RDAC driver was not installed or was installed unsuccessfully, other FC array information will be displayed with the output shown above but not the DS4500 dar. To resolve this problem, reinstall the RDAC driver. See Table 42 on page 175 for a complete list of the required drivers.

Step 2.1 Verify that the RDAC driver is functioning properly,

Run the following command:

```
 # fget_config -Av
```

```
---dar0---
```

The output should be similar to the following example:

```
User array name = 'IBM'
dac0 ACTIVE dac2 ACTIVE

Disk      DAC    LUN Logical Drive
utm             31
hdisk2    dac2     0 Fibre-Raid0-0B
hdisk3    dac0     1 Fibre-Raid0-1B
hdisk4    dac2     2 Fibre-Raid0-2B
hdisk5    dac0     3 Fibre-Raid0-3B
hdisk6    dac2     4 Fibre-Raid0-4B
hdisk7    dac0     5 Fibre-Raid0-5B
hdisk8    dac2     6 Fibre-Raid0-6B
hdisk9    dac0     7 Fibre-Raid0-7B
```

Note: A single disk subsystem shows a single dar device to each host configured. As shown above in the **fget** command output, there are two disk array controllers (dac) for each dar, and both should show as active.

If there are multiple dar devices present for a single subsystem; perform the following tasks:

1. Check the fibre switch zoning.

   Rules for your AIX system can be found in the readme document for your subsystem. To locate and download the readme for your subsystem, go to:

   http://www.ibm.com/servers/storage/support/

   For instructions on how to download the readme for your subsystem, go to 174.

2. Verify that there is at least one LUN mapped to the host.

Use the SMclient Mappings view to review the LUN mapping, and verify that the WWPN's for the host adapters are configured correctly in the DS4000 Storage Manager.

To open the SMclient Mappings view, perform the following steps:

a. Perform one of the following steps:

- Right click one of the host ports, and then click **Show All Host Port Information**.

- Select the Storage Subsystem menu from the toolbar, and then click **View** -> **Profile**. A new window opens.

b. Click the **Mappings** tab, and then scroll down to **TOPOLOGY DEFINITIONS**. All the hosts and adapter worldwide port names are displayed.

After the problem has been identified and resolved, run the following commands:

```
# rmdev –dl darX –R     (run this command for each dar device)
# rmdev –dl dacX          (run this command for each dac device)
# rmdev –dl fcsX –R     (run this command for each fcs device)
# cfgmgr
```

Step 3. Check whether the dar is showing as dacNONE.

You should not see any dacNONE array controllers.

Step 3.1 Verify that the WWPNs for both controllers are logged in the Fibre Channel switch.

If a fibre adapter in the host or the DS4000 *is not* logged in the switch, there might be a physical cabling problem, defective fiber cable, or defective fiber component within the adapter. To see the Switch documentation, go to:

http://www.ibm.com/servers/storage/support/san/index.html

Using the Storage Manager Client, the WWPN's for the controllers can viewed in the Storage Subsystem Profile.

1. Select the **Storage Subsystem** menu from the toolbar.

2. Click **View** -> **Profile**. A new window opens.

3. Click the **Controllers** tab, and then scroll down to view the WWPN's for each controller port.

If the dac device is available to the host, use the following command to verify the WWPNs:

```
#lsattr –EL dac0
```

The output should be similar to the following example:

```
passive_control no                   Passive controller     False
alt_held_reset  no                   Alternate held in reset False
controller_SN   1T44566835           Controller serial number False
ctrl_type       1815                 Controller Type        False
cache_size      2048                 Cache Size in MBytes    False
scsi_id         0x10400              SCSI ID                False
lun_id          0x0                  Logical Unit Number    False
utm_lun_id      0x001f000000000000   Logical Unit Number    False
location                             Location Label         True
```

```
ww_name         0x202400a0b8111252 World Wide Name          False  (WWPN)
node_name       0x200400a0b8111252 FC Node Name             False
GLM_type        low                GLM type                 False
```

Step 3.2 Determine the host adapter world wide port name.

Run the following command:

```
Lscfg –vl fcsx
```

Note: The x represents the number of the fcs device. See the output example in 175

Step 3.3 Verify that the RDAC driver is functioning properly.

Run the following command:

```
 # fget_config -Av   ---dar0
```

The output should look similar to the following example:

```
User array name = 'IBM'
dac0 ACTIVE dac2 ACTIVE

Disk      DAC    LUN Logical Drive
utm              31
hdisk2    dac2    0 Fibre-Raid0-0B
hdisk3    dac0    1 Fibre-Raid0-1B
hdisk4    dac2    2 Fibre-Raid0-2B
hdisk5    dac0    3 Fibre-Raid0-3B
hdisk6    dac2    4 Fibre-Raid0-4B
hdisk7    dac0    5 Fibre-Raid0-5B
hdisk8    dac2    6 Fibre-Raid0-6B
hdisk9    dac0    7 Fibre-Raid0-7B
```

A single disk subsystem should show a single disk array router (dar) device to each host configured. As seen in the preceding **fget** command output, there should be two dac devices for each dar device, and both should be seen as active. A single disk subsystem shows a single dar device to each host configured. As seen in the preceding **fget** command output, there are two dac devices for each dar, and both should show as active.

After the problem has been identified and resolved, run the following commands:

```
rmdev –dl darx –R for all dar devices.
rmdev –dl dacx for all dac devices.
rmdev –dl fcsx –R for all fcs devices
cfgmgr
```

Step 4. Verify that the hdisks are showing up correctly with the fget_config –Av command and the lsdev –Cc disk command, or both.

Use the SMclient to verify that the created LUNs are mapped to this host. Select the **Mappings View** tab next to the **Logical/Physical View** tab. On the right side of the window, verify that the Logical Drive Name is displayed and that the Accessible By column lists the correct host. If the mappings are not displayed, then map the previously created LUNs. In the Mappings view (in the upper left side of

the window), you will see undefined mappings. Right click an undefined mapping, and then select **define additional mapping**, run the **cfgmgr** command on the host to display the newly mapped LUNs.

If the LUNs do not display or are displayed but are inaccessible by the host, there might be some type of reservation on the LUN. You can locate, and then clear Persistent Reservations from the SMclient, if you are certain that the LUN is not in use by another host. Use extreme caution in clearing reservations when the LUN is configured to be seen by the Host Group. Select Maintenance -> **Persistent Reservation** from the toolbar, and then select the **Advanced** tab.

Step 5. Verify that the fget_config –Av command displays all the correct (expected) output from the DS4000.

Make sure that all the information shown below is correct.

- All drivers and firmware are installed and current.
- The DS4000 controllers and host adapters are logged in the switches and are zoned correctly.
- The Switch firmware is the current (near the latest) or latest available version.
- The zoning is verified and correct.

  For more information, go to the following IBM Web site:

  http://www.ibm.com/servers/storage/support/san/index.html
- The host world wide port names are configured correctly in the SMclient.
- The DS4000 firmware is current (latest version).
- All AIX errors are being logged in the AIX errpt (error log) file.

  Note: Call 1-800-IBM-SERV (1-800-IBM-7378) to open a service call with IBM Hardware Support to analyze the AIX error logs.
- All event errors are being logged in the SMclient Major Event Log. Open a service call with hardware support to analyze the event log 1-800-IBM-SERV

  Note: Call 1-800-IBM-SERV (1-800-IBM-7378) to open a service call with IBM Hardware Support to analyze the event log.

Appendix A. 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 43 associates each document in the DS4000 Storage Manager Version 9 library with its related common user tasks.

Table 43. 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 44 associates each document in the DS4800 Storage Subsystem library with its related common user tasks.

Table 44. 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 45 associates each document in the DS4700 Storage Subsystem library with its related common user tasks.

Table 45. 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 46 associates each document in the DS4500 (previously FAStT900) Fibre Channel Storage Server library with its related common user tasks.

Table 46. 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 47 associates each document in the DS4400 (previously FAStT700) Fibre Channel Storage Server library with its related common user tasks.

Table 47. 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 48 associates each document in the DS4300 (previously FAStT600) Fibre Channel Storage Server library with its related common user tasks.

Table 48. 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 49 associates each document in the DS4200 Express Storage™ Subsystem library with its related common user tasks.

Table 49. 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 50 associates each document in the DS4100 (previously FAStT100) SATA Storage Server library with its related common user tasks.

Table 50. 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 51 associates each of the following documents with its related common user tasks.

Table 51. 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 52 associates each of the following documents with its related common user tasks.

Table 52. 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 B. Accessibility

This section provides information about alternate keyboard navigation, which is a DS4000 Storage Manager accessibility feature. Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

By using the alternate keyboard operations that are described in this section, you can use keys or key combinations to perform Storage Manager tasks and initiate many menu actions that can also be done with a mouse.

Note: In addition to the keyboard operations that are described in this section, the DS4000 Storage Manager 9.14, 9.15, and 9.16 software installation packages for Windows include a screen reader software interface. To enable the screen reader, select Custom Installation when using the installation wizard to install Storage Manager 9.14, 9.15, or 9.16 on a Windows host/management station. Then, in the Select Product Features window, select Java Access Bridge in addition to the other required host software components.

Table 53 defines the keyboard operations that enable you to navigate, select, or activate user interface components. The following terms are used in the table:

- *Navigate* means to move the input focus from one user interface component to another.
- *Select* means to choose one or more components, typically for a subsequent action.
- *Activate* means to carry out the action of a particular component.

Note: In general, navigation between components requires the following keys:

- **Tab** - Moves keyboard focus to the next component or to the first member of the next group of components
- **Shift-Tab** - Moves keyboard focus to the previous component or to the first component in the previous group of components
- **Arrow keys** - Move keyboard focus within the individual components of a group of components

Table 53. DS4000 Storage Manager alternate keyboard operations

Short cut	Action
F1	Open the Help.
F10	Move keyboard focus to main menu bar and post first menu; use the arrow keys to navigate through the available options.
Alt+F4	Close the management window.
Alt+F6	Move keyboard focus between dialogs (non-modal) and between management windows.

Table 53. DS4000 Storage Manager alternate keyboard operations (continued)

Short cut	Action
Alt+ underlined letter	Access menu items, buttons, and other interface components by using the keys associated with the underlined letters. For the menu options, select the Alt + underlined letter combination to access a main menu, and then select the underlined letter to access the individual menu item. For other interface components, use the Alt + underlined letter combination.
Ctrl+F1	Display or conceal a tool tip when keyboard focus is on the toolbar.
Spacebar	Select an item or activate a hyperlink.
Ctrl+Spacebar (Contiguous/Non-contiguous) AMW Logical/Physical View	Select multiple drives in the Physical View. To select multiple drives, select one drive by pressing Spacebar, and then press Tab to switch focus to the next drive you want to select; press Ctrl+Spacebar to select the drive. If you press Spacebar alone when multiple drives are selected then all selections are removed. Use the Ctrl+Spacebar combination to deselect a drive when multiple drives are selected. This behavior is the same for contiguous and non-contiguous selection of drives.
End, Page Down	Move keyboard focus to the last item in the list.
Esc	Close the current dialog (does not require keyboard focus).
Home, Page Up	Move keyboard focus to the first item in the list.
Shift+Tab	Move keyboard focus through components in the reverse direction.
Ctrl+Tab	Move keyboard focus from a table to the next user interface component.
Tab	Navigate keyboard focus between components or select a hyperlink.
Down arrow	Move keyboard focus down one item in the list.
Left arrow	Move keyboard focus to the left.
Right arrow	Move keyboard focus to the right.
Up arrow	Move keyboard focus up one item in the list.

Notices

This publication was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.

INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this publication to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product, and use of those Web sites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Trademarks

The following terms are trademarks of International Business Machines Corporation in the United States, other countries, or both:

IBM
IBMLink™
AIX
AT®
BladeCenter

@server server
ESCON®
Express Storage
FICON®
FlashCopy®
IntelliStation®
Netfinity
PC/XT™
POWER
POWER4+
pSeries
Predictive Failure Analysis®

S/390®
SP2®
System Storage
TotalStorage
xSeries®
XT™

Intel® and Pentium III are trademarks of Intel Corporation in the United States, other countries, or both.

Microsoft, Windows, and Windows NT are trademarks of Microsoft Corporation in the United States, other countries, or both.

Java and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

QLogic and the QLogic logo are registered trademarks of QLogic Corporation.

Other company, product, or service names may be the trademarks or service marks of others.

Important notes

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

CD 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.

Maximum memory may require replacement of the standard memory with an optional memory module.

IBM makes no representation or warranties regarding non-IBM products and services that are ServerProven®, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. These products are offered and warranted solely by third parties.

Unless otherwise stated, IBM makes no representations or warranties with respect to non-IBM products. Support (if any) for the non-IBM products is provided by the third party, not IBM.

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

Battery return program

This product may contain a sealed lead acid, nickel cadmium, nickel metal hydride, lithium, or 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, see http://www.ibm.com/ibm/environment/products/batteryrecycle.shtml or contact your local waste disposal facility.

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

In the Netherlands, the following applies.

For Taiwan: Please recycle batteries.

廢電池請回收

Product recycling and disposal

This unit contains materials such as circuit boards, cables, electromagnetic compatibility gaskets, and connectors which may contain lead and copper/beryllium alloys that require special handling and disposal at end of life. Before this unit is disposed of, these materials must be removed and recycled or discarded according to applicable regulations. IBM offers product-return programs

in several countries. Information on product recycling offerings can be found on IBM's Internet site at www.ibm.com/ibm/environment/products/prp.shtml.

IBM encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. IBM offers a variety of programs and services to assist equipment owners in recycling their IT products. Information on product recycling offerings can be found on IBM's Internet site at www.ibm.com/ibm/environment/products/prp.shtml.

Notice: This mark applies only to countries within the European Union (EU) and Norway.

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.

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

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

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 non-recommended modification of the product, including the fitting of non-IBM option cards.

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

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

Taiwan electrical emission statement

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

Japanese Voluntary Control Council for Interference (VCCI) statement

この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に
基づくクラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を
引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求
されることがあります。

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.

Index

Numerics

6228
   problem determination 26
6228 HBA
   troubleshooting 6

A

Additional Sense Code Qualifier (ASCQ)
   values 68
Additional Sense Codes (ASC) values 68
AIX
   problem determination 26
auto code synchronization (ACS) 166

B

battery return 195
boot-up delay 97

C

Class A electronic emission notice 196
comments, how to send xxvi
common path configurations 63
Concepts Guide 181
configuration debugging 83
configuration types
   debugging example sequence 83
   diagnostics and examples 83
   type 1 79
   type 2 81
controller diagnostics 105
controller units
   DS4100, DS4200, DS4300, DS4400,
      DS4500, DS4700, DS4800 99
copper cables
   troubleshooting 136
Copy Services Guide 181
crossPortTest 143, 149

D

disposal 195
documentation
   DS4000 181
   DS4000 Storage Manager 181
   DS4000-related documents 189, 190
   DS4100 SATA Storage Server 188
   DS4200 Express Storage
      Subsystem 187
   DS4300 Fibre Channel Storage
      Server 186
   DS4400 Fibre Channel Storage
      Server 185
   DS4500 Fibre Channel Storage
      Server 184
   DS4700 Storage Subsystem 183
   DS4800 Storage Subsystem 182

Drive enclosures
   EXP500, EXP710 103
DS4000 documentation 181
DS4000 Hardware Maintenance
   Manual 189, 190
DS4000 Problem Determination
   Guide 189, 190
DS4000 Quick Start Guide 189, 190
DS4000 Storage Manager
   auto code synchronization 166
   controller diagnostics 105
   documentation 181
   FAQs 163
   global hot spare (GHS) drives 163
   overview 4
   related documents 189, 190
   storage partitioning 169
DS4000/FAStT product renaming xxi
DS4100 SATA Storage Server library 188
DS4200 Exoress Storage Subsystem
   library 187
DS4300 Fibre Channel Storage Server
   library 186
DS4400 Storage Server library 185
DS4500 Fibre Channel Storage Server
   library 184
DS4700 Storage Subsystem library 183
DS4800 Storage Subsystem library 182

E

electronic emission Class A notice 196
Event Monitor 4

F

Fast!UTIL
   options
      advanced adapter settings 160
      raw NVRAM data 160
      restore default settings 160
      scan fibre channel devices 162
      scan Loopback Data Test 162
      select host adapter 162
   settings
      host adapter settings 157
      options 157
      selectable boot settings 159
   starting 157
   using 157
FAStT/DS4000 product renaming xxi
FCC Class A notice 196
fibre cables
   troubleshooting 133
fire suppression xxv
FRU code table 78

G

global hot spare (GHS) drives 163
glossary 199

H

hardware service and support xxv
heterogeneous configurations 153
host adapter firmware and driver levels,
   problem determination procedure 175

I

IBM Safety Information 189, 190
IBM System Storage; DS4000 EXP700
   environmental services monitor
      location 130
   user controls 130

L

loopback data test 91

M

Migration Guide 181

N

notes, important 194
notices
   electronic emission 196
   FCC, Class A 196
   used in this book xii
   used in this document xxiii

P

passive RAID controller 87
PD hints
   common path/single path
      configurations 63
   configuration types 79
   drive side hints 111
   hubs and switches 143
   passive RAID controller 87
   performing sendEcho tests 91
   RAID controller errors in the
      Windows event log 65
   Read Link Status (RLS)
      Diagnostics 138
   tool hints 95
   wrap plug tests 149
problem determination
   6228 HBA 26
   AIX 26
   before starting 4
   controller diagnostics 105

Readers' Comments — We'd Like to Hear from You

IBM System Storage DS4000
Problem Determination Guide

Publication No. GC27-2076-00

We appreciate your comments about this publication. Please comment on specific errors or omissions, accuracy, organization, subject matter, or completeness of this book. The comments you send should pertain to only the information in this manual or product and the way in which the information is presented.

For technical questions and information about products and prices, please contact your IBM branch office, your IBM business partner, or your authorized remarketer.

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute your comments in any way it believes appropriate without incurring any obligation to you. IBM or any other organizations will only use the personal information that you supply to contact you about the issues that you state on this form.

Comments:

Thank you for your support.

Submit your comments using one of these channels:
• Send your comments to the address on the reverse side of this form.

If you would like a response from IBM, please fill in the following information:

Name   Address

Company or Organization

Phone No.   E-mail address

IBM®

Fold and Tape   **Please do not staple**   Fold and Tape

NO POSTAGE
NECESSARY
IF MAILED IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL   PERMIT NO. 40   ARMONK, NEW YORK

POSTAGE WILL BE PAID BY ADDRESSEE

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

Fold and Tape   **Please do not staple**   Fold and Tape

IBM ®

Printed in USA