IBM TotalStorage DS4000 Storage Manager Version 9

IBM

Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux

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> **Note:**
>
> Before using this information and the product it supports, be sure to read the general information in "Notices" on page 203.

Fifth Edition (January 2006)

This edition applies to DS4000 Storage Manager Version 9.1x software release levels and to all subsequent releases and modifications until otherwise indicated in new editions.

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About this document

Throughout this document, ″Storage Manager Version 9″ and ″9.1x″ refer to all host software release levels: Storage Manager versions 9.10, 9.12, 9.14, 9.15 and 9.16. References to other Storage Manager versions refer exclusively to those releases.

This document provides information about how to plan, install, configure, and work with IBM®® TotalStorage® DS4000 Storage Manager Version 9.1x in each of the following Intel®® processor-based operating systems:

- Windows®® 2000 Server/Advanced Server with Service Pack 4
- Windows Server 2003 with Service Pack 1
- Novell NetWare 6.0 and 6.5
- Red Hat Enterprise Linux® Advanced Server 3.0 (RHEL AS 3)
- Red Hat Enterprise Linux Advanced Server 4.0 (RHEL AS 4)
- SuSE Linux Enterprise Server 8 (SLES 8)
- SuSE Linux Enterprise Server 9 (SLES 9)
- Conectiva Linux Enterprise Edition Powered by United Linux
- VMware ESX Server 2.5.1, 3.0

Important: Check the Storage Manager readme files for any updates to the list of supported operating systems.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Overview

Use this document to perform the following tasks:

- Determine the hardware and software that you will require to install the storage management software.
- Integrate the necessary hardware components into your network.
- Install the DS4000 Storage Manager software.
- Upgrade controller firmware, if necessary.
- Identify storage management features that are unique to your installation.

Notes:

1. You can use Storage Manager 9.16 to manage storage subsystems with controller firmware versions 05.xx.xx.xx through 6.16.xx.xx. However, controller firmware versions 06.16.xx.xx, 06.15.xx.xx, and 06.14.xx.xx and associated NVSRAM currently support *only* the following DS4800 storage subsystems:
   - DS4800; Machine Type 1815; Model Numbers 88x, 84x and 82x
2. Controller firmware version 06.12.xx.xx and associated NVSRAM support the following DS4000 storage subsystems:
   - DS4100 Standard (base) Option; Machine Type 1724; Model Number 100
   - DS4100 Single-Controller Unit (SCU) Option; Machine Type 1724; Model Number 1SX
   - DS4300 Turbo Option; Machine Type 1722; Model Numbers 60U and 60X
   - DS4300 Standard (base) Option; Machine Type 1722; Model Numbers 60U and 60X
   - DS4400; Machine Type 1742; Model Numbers 1RU and 1RX

3. There is currently no controller firmware version 6.1x.xx.xx for the following DS4000 storage subsystems:

- DS4300 - Single controller model (Machine Type 1722 model number 6LU/6LX)
- FAStT200
- FAStT500

Please contact your IBM reseller or representative regarding any future availability of 6.1x.xx.xx controller firmware for these DS4000 storage subsystems.

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 and storage administrators who are responsible for installing storage administration software. Readers should have knowledge of Redundant Array of Independent Disks (RAID), Small Computer System Interface (SCSI), Fibre Channel, and SATA technology. They should also have working knowledge of the applicable operating systems that are used with the management software.

DS4000 Storage Subsystem installation tasks - General overview

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

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

Table 2. Where to find DS4000 installation and configuration procedures

	Installation task	Where to find information or procedures
1	Plan the installation	• DS4000 Storage Manager Concepts Guide • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux • DS4100 Storage Server Installation, User's, and Maintenance Guide • DS4300 Fibre Channel Storage Server Installation and User's Guide • DS4400 Fibre Channel Storage Server Installation and Support Guide • DS4500 Fibre Channel Storage Server Installation and Support Guide • DS4800 Storage Subsystem Installation, User's, and Maintenance Guide
2	Mount the DS4000 storage subsystem in the rack	• DS4800 Installation, User's, and Maintenance Guide • DS4400 and DS4500 Rack Mounting Instructions • DS4300 Rack Mounting Instructions • DS4100 Installation, User's and Maintenance Guide
3	Mount the DS4000 EXP storage expansion unit in the rack	• DS4000 EXP100 Storage Expansion Unit Installation, User's and Maintenance Guide • DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide • DS4000 EXP810 Storage Expansion Enclosures Installation, User's, and Maintenance Guide • FAStT EXP500 Installation and User's Guide
4	Route the storage expansion unit Fibre Channel cables	• DS4100 Fibre Channel Cabling Instructions • DS4300 Fibre Channel Cabling Instructions • DS4400 Fibre Channel Cabling Instructions • DS4500 Fibre Channel Cabling Instructions • DS4800 Installation, User's, and Maintenance Guide
5	Route the host server Fibre Channel cables	• DS4100 Fibre Channel Cabling Instructions • DS4300 Fibre Channel Cabling Instructions • DS4400 Fibre Channel Cabling Instructions • DS4500 Fibre Channel Cabling Instructions • DS4800 Installation, User's, and Maintenance Guide

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

	Installation task	Where to find information or procedures
6	Power up the subsystem	• DS4100 Storage Server Installation, User's, and Maintenance Guide • DS4300 Fibre Channel Storage Server Installation and User's Guide • DS4400 Fibre Channel Storage Server Installation and Support Guide • DS4500 Fibre Channel Storage Server Installation and Support Guide • DS4800 Storage Subsystem Installation, User's, and Maintenance Guide
7	Configure DS4000 network settings	• DS4100 Storage Server Installation, User's, and Maintenance Guide • DS4300 Fibre Channel Storage Server Installation and User's Guide • DS4400 Fibre Channel Storage Server Installation and Support Guide • DS4500 Fibre Channel Storage Server Installation and Support Guide • DS4800 Storage Subsystem Installation, User's, and Maintenance Guide
8	Zone the fabric switch (SAN-attached only)	• DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux • DS4000 Storage Manager Copy Services Guide (describes switch zoning for the Remote Mirror Option) • See also the documentation provided by the switch manufacturer
9	Install DS4000 Storage Manager software on the management station	• DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux • DS4000 Storage Manager online help (for post-installation tasks)
10	Install host software (failover drivers) on host server	
11	Start DS4000 Storage Manager	
12	Set the DS4000 Storage Manager clock	
13	Set the DS4000 Storage Manager host default type	

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

	Installation task	Where to find information or procedures
14	Verify DS4000 subsystem health	• DS4100 Storage Server Installation, User's, and Maintenance Guide • DS4300 Fibre Channel Storage Server Installation and User's Guide • DS4400 Fibre Channel Storage Server Installation and Support Guide • DS4500 Fibre Channel Storage Server Installation and Support Guide • DS4800 Storage Subsystem Installation, User's, and Maintenance Guide

15	Enable DS4000 Storage Manager premium feature keys	**Copy Services premium features**
		    DS4000 Storage Manager Copy Services Guide
		
		FC/SATA Intermix premium feature
		    DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview
		
		Storage Partitioning (and general premium features information)
		    • DS4000 Storage Manager Concepts Guide
		    • DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER
		    • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux

16	Configure arrays and logical drives	• DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on POWER • DS4000 Storage Manager Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux • DS4000 Storage Manager online help
17	Configure host partitions	
18	Verify host access to DS4000 storage	

How this document is organized

Chapter 1, "Introduction," on page 1 provides an overview of IBM DS4000 Storage Manager Version 9.1x and describes storage subsystem management methods, configuration types, types of installations, and installation requirements.

Chapter 2, "Preparing for installation," on page 41 discusses preparing for a network installation, including setting up a Dynamic Host Configuration Protocol/Boot Protocol (DHCP/BOOTP) server on Windows 2000, Windows Server 2003, Linux, and UNIX®® platforms. It also describes other setup tasks.

Chapter 3, "Installing Storage Manager software in a standard Windows configuration," on page 59 provides installation instructions for Windows 2000, and Windows 2000 Server software components in a standard (noncluster) environment.

Chapter 4, "Installing Storage Manager software in a Windows cluster server environment," on page 67 provides installation instructions for Windows 2000, and Windows 2000 Server software in a cluster server environment.

Chapter 5, "Installing Storage Manager software in a Linux configuration," on page 81 provides installation instructions for the storage management software in a Linux operating system environment.

Chapter 7, "Using DS4000 with a VMware ESX Server configuration," on page 101 provides installation instructions for the storage management software in a VMware ESX Server operating system environment.

Chapter 8, "Completing storage management installation and configuration," on page 109 discusses completion of Storage Manager software on Windows 2000, Windows 2000 Server, and Linux platforms. It provides details on the following tasks:

- Starting the Enterprise Management window
- Performing an automatic discovery of storage subsystems
- Adding devices
- Setting up alert notifications
- Downloading firmware and nonvolatile storage random access memory (NVSRAM)
- Creating arrays and logical drives
- Other storage subsystem management tasks

Chapter 9, "Completing storage management tasks for Windows hosts," on page 133 provides information about adding and deleting logical drives, using the hot_add and SMdevices utilities, starting and stopping the host-agent software, and uninstalling Storage Manager components in Windows 2000 and Windows 2000 Server operating system environments.

Appendix A, "Installing previous Storage Manager versions in a NetWare configuration," on page 141 provides installation instructions for the storage management software in standard (noncluster) and cluster server configurations in the NetWare operating system environment.

Appendix B, "Installing Storage Manager 9.10 Client," on page 161 provides installation instructions specifically for Storage Manager 9.10 for Windows 2000, and Windows 2000 Server software components.

Appendix C, "Operating system limitations," on page 169 describes Windows 2000/Windows Server 2003, Linux, and VMware ESX Server operating system limitations and other operating system issues.

Appendix D, "Storage subsystem and controller information record," on page 183 provides a data sheet template that you can use to create a controller information record.

Appendix E, "Host bus adapter settings," on page 185 provides information on host bus adapter settings for different operating systems.

Appendix F, "Additional DS4000 documentation," on page 193 provides an overview of the DS4000 storage subsystem product libraries, as well as other related documents.

Appendix G, "Accessibility," on page 201 provides information about accessibility features, which help a user who has a physical disability (such as restricted mobility or limited vision) to use software products successfully

Notices that this document uses

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

- **Notes®:** 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.

Getting information, help, and service

If you need help, service, or technical assistance or just want more information about IBM and 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, 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 take these steps to try to solve the problem yourself:

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

  www.ibm.com/pc/support/

- Use an IBM discussion forum on the IBM Support 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 publications that are provided with your system and software. The documentation that is packaged with your system also describes diagnostic tests that you can perform.

Most xSeries and IntelliStation systems, operating systems, and programs come with documentation 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

You can find information about your IBM @server xSeries or IntelliStation system and preinstalled software, if any, in the documentation that comes with your system. That documentation includes printed documents, online documents, readme files, and help files.

See the troubleshooting information in your system documentation for instructions for using the diagnostic programs. The troubleshooting information or the diagnostic programs might tell you that you need additional or updated device drivers or other

software. IBM maintains pages on the World Wide Web where you can get the latest technical information and download device drivers and updates. To access these pages, go to the following Web site:

www.ibm.com/pc/support/

Follow the instructions at the Web site to find the information you are looking for.

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/

Web sites

Locate up-to-date information about DS4000 Disk Storage Subsystems and DS4000 Storage Manager, including documentation and the most recent software, firmware, and NVSRAM downloads at the following Web sites.

IBM xSeries servers
> Find IBM xSeries information:
>
> www.ibm.com/eserver/xseries/

DS4000 Disk Storage Subsystems
> Find the latest information about all of the IBM DS4000 Disk Storage Subsystems:
>
> www.ibm.com/servers/storage/disk/ds4000/

IBM TotalStorage products
> Find information about all IBM TotalStorage products:
>
> www.ibm.com/servers/storage/

TotalStorage DS4000 interoperability matrix
> Find the latest information about operating system and host bus adapter (HBA) support, clustering support, storage area network (SAN) fabric support, and Storage Manager feature support:
>
> www.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

IBM Service
> Find service information for your IBM products:
>
> www.ibm.com/pc/support/

DS4000 technical support
> Find DS4000 software downloads, hints and tips, documentation, parts information, and host bus adapter support:
>
> www.ibm.com/servers/storage/support/disk/
>
> If you click **Profile** from the support page, you can create a customized support page. The support page has many sources of information and ways for you to solve problems, including how to:
> - Diagnose problems, using the IBM Online Assistant.
> - Download the latest device drivers and updates for your products.
> - View Frequently Asked Questions (FAQ).

- View hints and tips to help you solve problems.
- Participate in IBM discussion forums.
- Set up e-mail notification of technical updates about your products.

Premium feature activation
Enable a premium feature by using the online tool:

www-912.ibm.com/PremiumFeatures/jsp/keyInput.jsp

IBM Publications Center
Order IBM publications:

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

Software service and support

Through the IBM Support Line, for a fee, you can get telephone assistance with usage, configuration, and software problems with xSeries servers, IntelliStation workstations and appliances.

Find the products that are supported by Support Line in your country or region:

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

Find more information about Support Line and other IBM services:

www.ibm.com/services/

Find support telephone numbers:

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.

Find support telephone numbers at the following Web site:

www.ibm.com/planetwide/

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

How to send your comments

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

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

- **E-mail**

Submit your comments electronically to the following email address:

starpubs@us.ibm.com

- **Readers' Comment Form**

  Fill out the Readers' Comments form (RCF) at the back of this document and return it by mail or give it to an IBM representative.

- **Mail**

  If the RCF has been removed, you can send your comments to the following address:

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

Chapter 1. Introduction

IBM DS4000 Storage Manager version 9.1x host software supports the new features that are incorporated into all releases of controller firmware version 06.1x.xx.xx, and manages DS4000 storage subsystems with all generally-released controller firmware versions (05.xx.xx.xx to 6.1x.xx.xx).

Note: DS4800 Fibre Channel storage subsystems require controller firmware 06.16.xx.xx, 06.15.xx.xx or 06.14.xx.xx.

This document provides information on how to prepare, install, configure, and start the IBM TotalStorage DS4000 Storage Manager host management software and controller firmware in the following operating system environments:

- Windows® 2000 Server/Advanced Server with Service Pack 4
- Windows Server 2003 with Service Pack 1
- Red Hat Enterprise Linux Advanced Server 3.0 (RHEL AS 3)
- Red Hat Enterprise Linux Advanced Server 4.0 (RHEL AS 4)
- SuSE Linux Enterprise Server 8 (SLES 8)
- SuSE Linux Enterprise Server 9 (SLES 9)
- VMware ESX Server 2.5.2

Note: For analogous information regarding AIX, HP-UX, Solaris, and Linux on POWER host operating systems, see the *IBM TotalStorage DS4000 Storage Manager 9 Installation and Support Guide for AIX®, HP-UX, Solaris and Linux on POWER™*.

Consult your IBM resellers or representatives for any future support of additional operating system environments. Also, check the Storage Manager 9.1x readme files for the most recent info about supported operating systems.

Readme files and concepts

Before you install DS4000 Storage Manager software, consult the following documentation:

- "Storage Manager readme files"
- "Storage Manager Concepts Guide" on page 2

Storage Manager readme files

Read these first.

Important: Updated readme files contain the latest device driver versions, firmware levels and other information that supersedes this document.

To access the most recent DS4000 Storage Manager readme files, complete the following steps:

1. Go to the following Web site:

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

2. Click the link for your storage subsystem (for example, **DS4800**).

3. When the subsystem support page opens, click the **Download** tab, then click the **Storage Manager, firmware, HBA and tools (including readmes)** link.

4. When the download page opens, click the **Storage Mgr** tab. A table displays.

5. In the table, find the listing for the Storage Manager packages for your operating system, then click on the corresponding **v9.1x** link in the **Current® Versions and Readmes** column.

Storage Manager Concepts Guide

IBM TotalStorage DS4000 Storage Manager Concepts Guide

Use this reference document to become familiar with the terminology and the features of the DS4000 Storage Manager software. This document is available on the DS4000 Storage Manager installation CD and at the Web site listed above.

Supported controller firmware

All of the controller firmware versions that are listed in Table 3 are available free-of-charge.

Note: Each DS4000 storage subsystem supports only a certain set of DS4000 controller firmware code thread. Please see Table 3 to find out which controller firmware code thread is applicable for each DS4000 storage subsystem model.

In the table, the most recent client code software and controller firmware versions are indicated in **bold** text. To ensure the highest level of compatibility and error-free operation, ensure that the controller firmware for your DS4000 Storage Subsystem is the latest firmware version for the storage subsystem model.

Note: The information in this table might be superseded by information that is included in the latest Storage Manager readme file for your operating system. Always check for the latest readme files online by following the instructions in "Readme files and concepts" on page 1.

See "New features and enhancements" on page 5 for new features that are associated with the 06.1x.xx.xx controller firmware.

Table 3. Machine types, supported controller firmware, and supported storage management software

Product name	Machine type	Model	Supported controller firmware version	Supported storage manager software version
IBM TotalStorage® DS4800Storage Subsystem	1815	82A/H 84A/H 88A/H	06.14.xx.xx, 06.15.xx.xx, **06.16.xx.xx**	9.14, 9.15, **9.16**
IBM TotalStorage DS4100 Storage Subsystem (Base Model)	1724	100	**06.12.xx.xx**	8.42, 9.10, 9.12, 9.14, 9.15, **9.16**
IBM TotalStorage DS4100 Storage Subsystem (Single Controller Model)	1724	1SC 1S	**06.12.xx.xx**	

Table 3. Machine types, supported controller firmware, and supported storage management software (continued)

Product name	Machine type	Model	Supported controller firmware version	Supported storage manager software version
IBM TotalStorage DS4500 Disk Storage Subsystem	1742	90X 90U	5.30.xx.xx 5.40.xx.xx 5.41.xx.xx (supports EXP100 only) **06.12.xx.xx**	8.3, 8.4, 8.41, 8.42, 9.10, 9.12, 9.14, 9.15, **9.16**
IBM TotalStorage DS4400 Disk Storage Subsystem (no longer available for purchase)	1742	1RU 1RX	5.00.xx.xx 5.20.xx.xx 5.21.xx.xx 5.30.xx.xx 5.40.xx.xx **6.12.xx.xx**	8.0, 8.2, 8.21, 8.3, 8.41, 8.42, 9.10, 9.12, 9.14, 9.15, **9.16**
IBM TotalStorage DS4300 Disk Storage Subsystem (Single Controller)	1722	6LU 6LX	**5.34.xx.xx**	8.41.xx.03 or later, 8.42, 9.10, 9.12, 9.14, 9.15, **9.16**
IBM TotalStorage DS4300 Disk Storage Subsystem (Base Model)		60U 60X	5.33.xx.xx 5.34.xx.xx 5.40.xx.xx **6.12.xx.xx**	8.3, 8.4, 8.41, 8.42, 9.10, 9.12, 9.14, 9.15, **9.16**
IBM TotalStorage DS4300 Disk Storage Subsystem (Turbo Model)		60U 60X	5.41.xx.xx (supports EXP100 only) **6.12.xx.xx**	
IBM Netfinity® FAStT500 RAID Controller Enclosure Unit (no longer available for purchase)	3552	1RU 1RX	4.x, 5.00.xx.xx 5.20.xx.xx 5.21.xx.xx **5.30.xx.xx**	7.0, 7.01, 7.02, 7.10, 8.0, 8.2, 8.21, 8.3, 8.41, 8.42, 9.10, 9.12, 9.14, 9.15, **9.16**
IBM FAStT200 High Availability (HA) Storage Subsystem (no longer available for purchase)	3542	2RU 2RX	4.x, 5.20.xx.xx **5.30.xx.xx**	7.02, 7.10, 8.0, 8.2, 8.21, 8.3, 8.41, 8.42, 9.10, 9.12, 9.14, 9.15, **9.16**
IBM FAStT200 Storage Subsystem (no longer available for purchase)	3542	1RU 1RX	4.x, 5.20.xx.xx **5.30.xx.xx**	7.02, 7.10, 8.0, 8.2, 8.21, 8.3, 8.41, 8.42, 9.10, 9.12, 9.14, 9.15, **9.16**
IBM Netfinity Fibre Channel RAID Controller Unit (no longer available for purchase)	3526	1RU 1RX	**4.x**	7.0, 7.01, 7.02, 7.10, 8.0, 8.2, 8.21, 8.3, 8.41, 8.42, 9.10, **9.12**

Table 3. Machine types, supported controller firmware, and supported storage management software (continued)

Product name	Machine type	Model	Supported controller firmware version	Supported storage manager software version

Important:

1. Controller firmware versions 06.16.xx.xx, 06.15.xx.xx, and 06.14.xx.xx support only DS4800 Storage Subsystems. All other DS4000 storage subsystems currently run firmware versions 6.12.xx.xx or earlier.

2. Controller firmware 06.16.xx.xx is required to support DS4000 EXP810 storage expansion enclosures. It does not support EXP100 storage expansion enclosures. **Do not** download 06.16.xx.xx into DS4000 storage subsystems that have EXP100 enclosures attached. If controller firmware 06.16.xx.xx is activated, the storage subsystem will not recognize the drives in EXP100 enclosures, causing loss of data availability to the RAID arrays and logical drives that are defined in those drives. Use controller firmware version 06.15.xx.xx if you have EXP100 storage expansion enclosures attached, or plan to attach them in the future.

3. EXP710 storage expansion enclosures are supported with controller firmware versions 06.15.xx.xx and 06.16.xx.xx.

4. Storage subsystem firmware must be at version 04.xx.xx.xx or later (05.xx.xx.xx or later for Windows host operating systems) to be managed with Storage Manager versions 9.1x.

5. Storage subsystems with controller firmware version 04.00.02.xx through 4.01.xx.xx must be managed with Storage Manager 8.x.

6. Controller firmware level 06.12.xx.xx supports EXP100 SATA storage expansion enclosures with the following storage subsystems:

   * DS4100 and DS4300 Base models
   * DS4300 Turbo models
   * DS4400
   * DS4500

   If you want to upgrade to 06.12.xx.xx and your controller firmware level is currently 05.41.1x.xx, you must first upgrade to firmware version 05.41.5x.xx (provided on the CD that is shipped with the EXP100, or from your IBM support representative.) After your firmware is at level 05.41.5x.xx, you can then upgrade to 06.12.xx.xx.

7. Firmware levels 5.40.xx.xx and earlier provide support for EXP500 and EXP700 storage expansion enclosures only. For EXP710 support, firmware versions 06.1x.xx.xx or later are required.

8. Some firmware versions support intermixing Fibre Channel and SATA storage expansion enclosures in the same DS4000 storage subsystem, if the DS4000 FC/SATA Intermix premium feature option is enabled. See "FC/SATA Intermix premium feature" on page 10 for more information about FC/SATA Intermix. Contact your IBM service representative for more information about purchasing the premium feature.

Storage Manager online help and diagnostics

When you finish the installation process, refer to the following online help systems:

* Enterprise Management window help

  Learn more about working with the entire management domain.

* Subsystem Management window help

  Learn more about managing individual storage subsystems.

You can access these help systems from within the Storage Manager client. Open an Enterprise Management or Subsystem Management window, then click **Help** or press **F1**.

After you install IBM DS4000 Storage Manager, consider installing the Qlogic® SANsurfer® Storage Management Suite. You can use this diagnostic application to verify the status of the fibre channel connections before you use the storage subsystem.

The Qlogic SANsurfer program files are located on the IBM DS4000 Storage Manager Version 9.1x CD. On the CD, find the files that are associated with your particular host operating system. Documentation is provided in the Qlogic SANsurfer online help.

Notes:

1. Qlogic SANsurfer replaces IBM FAStT Management Suite Java™ (FAStT MSJ), and serves the same function as FAStT MSJ.

2. You can also find the Qlogic SANsurfer program files on the DS4000 support Web site:

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

3. For more information about Qlogic SANsurfer, see *IBM TotalStorage DS4000 Problem Determination Guide.*

Note: If your DS4000 storage subsystem is in a SAN environment, connected to a fibre channel host bus adapter (HBA) in the host server, consider purchasing one of the following software applications. Each is helpful for SAN management and troubleshooting.

- IBM Tivoli® SAN Manager
- McData SANavigator

New features and enhancements

DS4000 Storage Manager 9.16 supports controller firmware versions 4.01.xx.xx - 06.16.xx.xx.

DS4000 Storage Manager 9.16 (with controller firmware 06.16.xx.xx) provides support for attachment of the DS4000 EXP710 storage expansion enclosure and the new EXP810 storage expansion enclosures to DS4800 storage subsystems.

DS4000 Storage Manager 9.16 supports *automatic ESM firmware synchronization* with the new EXP810 storage expansion enclosure. When you install a new ESM into an existing EXP810, in a DS4000 storage subsystem that supports automatic ESM firmware synchronization, this feature resolves firmware mismatch conditions by automatically synchronizing the firmware in the new ESM with the firmware in the existing ESM.

Note: For information about supported host operating system versions and requirements, see the Storage Manager readme file for your operating system. See section "Readme files and concepts" on page 1 for steps for finding the readme files online.

FAStT product renaming

IBM is in the process of renaming some FAStT family products. For a reference guide that identifies each new DS4000 product name with its corresponding FAStT product name, see "FAStT product renaming" on page xiv.

Controller firmware 6.16: New features

With controller firmware version **6.16.xx.xx**, you can connect DS4000 EXP810 and EXP710 storage expansion enclosures to DS4800 storage subsystems.

Controller firmware version 6.16.xx.xx supports:

- DS4800 storage subsystem (only)
- EXP810 and EXP710 storage expansion enclosures (only)
- All of the features listed in "Controller firmware 6.14 and 6.15: New features," "Controller firmware 6.12: New features," and "Controller firmware 6.10: New features" on page 7, with the following exception:

  Exception: Controller firmware version 6.16.xx.xx does not support the DS4000 Fibre Channel/SATA Intermix premium feature.

  Attention: Controller firmware 06.16.xx.xx does not support EXP100 storage expansion enclosures. **Do not** download it into DS4000 storage subsystems that have EXP100 enclosures attached. After the 06.16.xx.xx controller firmware is activated, the DS4000 storage subsystem will not recognize the drives in EXP100 enclosures, causing loss of data availability to the RAID arrays and logical drives that are defined in those drives.

Controller firmware 6.14 and 6.15: New features

With controller firmware version **6.15.xx.xx**, the DS4800 storage subsystem utilizes all of the available data cache memory installed in each controller blade for I/O caching. (With controller firmware version 06.14.xx.xx, the DS4800 uses only the first 1 GB of the installed data cache memory per controller for I/O caching.)

Controller firmware versions 6.14.xx.xx and 6.15.xx.xx support:

- DS4800 storage subsystem (only)
- All of the features listed in "Controller firmware 6.12: New features" and "Controller firmware 6.10: New features" on page 7.

Controller firmware 6.12: New features

Controller firmware **6.12.xx.xx** and later versions all of the features listed in "Controller firmware 6.10: New features" on page 7 in addition to the following new features:

DS4000 FC/SATA Intermix update: Premium Feature Key
DS4000 Storage Manager 9.1x with controller firmware 06.12.xx.xx (and later) supports enabling of the DS4000 FC/SATA Intermix premium feature using a Premium Feature Key.

For more information about using the Intermix premium feature, including configuration and set-up requirements, see the *IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview.*

New DS4000 Storage Manager installation option
DS4000 Storage Manager 9.1x with controller firmware 06.12.xx.xx (and later) features an installation wizard that enables you to automatically install Storage Manager software packages on your host server.

Note: Using the DS4000 Storage Manager installation wizard requires a system with a graphics card installed. You still have the option of installing the stand-alone host software packages manually. All of the packages are included with the installation CD.

Support for DS4100 standard (base) SATA Storage Subsystems
Storage Manager 9.1x with controller firmware 06.12.xx.xx (and later) supports DS4100 Standard (Base) SATA Storage Subsystems.

DS4000 Storage Manager usability enhancements
DS4000 Storage Manager 9.12 and later versions feature the following usability enhancements:
- Storage Partitioning wizard, which helps you easily create storage partitions
- Task Assistant, which helps guide you through common enterprise and subsystem management tasks
- Ability to extract SMART data for SATA drives

Controller firmware 6.10: New features

Controller firmware **6.10.xx.xx** and later versions support the following new features:

Enhanced Remote Mirroring
In addition to Metro Mirroring, IBM DS4000 Storage Manager version 9.1x with controller firmware level 6.10.11.xx (and later) also supports Global Copy and Global Mirroring Remote Mirror options. Please see the *IBM TotalStorage DS4000 Storage Manager Version 9 Copy Services User's Guide* for more information.

Note: The terms "Enhanced Remote Mirror Option," "Metro/Global Remote Mirror Option," "Remote Mirror," "Remote Mirror Option," and "Remote Mirroring" are used interchangeably throughout this document, the SMclient, and the online help system to refer to remote mirroring functionality.

Parallel hard drive firmware download
You can now download drive firmware packages to multiple drives simultaneously, which minimizes downtime. In addition, all files that are associated with a firmware update are now bundled into a single firmware package. See the Subsystem Management window online help for drive firmware download procedures.

Notes:
1. Drive firmware download is an offline management event. You must schedule downtime for the download because I/O to the storage subsystem is not allowed during the drive firmware download process.
2. Parallel hard drive firmware download is not the same thing as concurrent download.

Staged controller firmware download
You can now download the DS4000 controller firmware and NVSRAM to DS4300 Turbo and DS4500 Storage Subsystem for later activation.

Depending on your firmware version, DS4000 storage subsystem model, and host operating system, the following options might be available:

- Controller firmware download with immediate activation only
- Controller firmware download with the option to activate the firmware at a later time

Note: Staged controller firmware download is not supported on DS4400 storage subsystems.

Subsystem Management Window menu enhancements
Troubleshooting, recovery and maintenance tools are now under the Advanced heading in the Subsystem Management window. The following submenus are available:

- Maintenance
- Troubleshooting
- Recovery

Full command-line interface capability
All of the options that are available in SMclient are also available using either the script editor in the Enterprise Management window, or using your preferred command-line interface. For more information about using the command-line interface, see the Enterprise Management window online help.

Support for DS4300 Standard (Base) Fibre Channel Storage Subsystems
Storage Manager 9.1x with controller firmware 6.10.xx.xx (and later) supports DS4300 Standard (Base) Fibre Channel Storage Subsystems.

Note: The FC/SATA Intermix and Enhanced Remote Mirroring premium features are not supported at this time with the DS4300 Standard (Base) Storage Subsystem.

DS4000 FC/SATA Intermix premium feature
Storage Manager 9.1x with controller firmware 6.10.xx.xx (and later) supports the DS4000 FC/SATA Intermix premium feature. This premium feature supports the concurrent attachment of Fibre Channel and SATA storage expansion enclosures to a single DS4000 controller configuration.

With controller firmware 6.10.xx.xx and later versions, the FC/SATA Intermix premium feature is enabled using NVSRAM.

For more information about using the Intermix premium feature, including configuration and set-up requirements, see the *IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview*.

Support for DS4000 EXP710 storage expansion enclosures
Storage Manager 9.1x with controller firmware 6.10.xx.xx (and later) supports DS4000 EXP710 storage expansion enclosures.

Increased support for DS4000 EXP100 SATA storage expansion enclosures
DS4000 EXP100 SATA storage expansion enclosures are now supported with DS4400 Fibre Channel Storage Subsystems.

Also, the DS4100 storage subsystem now supports up to seven EXP100 SATA storage expansion enclosures.

DS4000 Storage Manager usability enhancements
DS4000 Storage Manager 9.10 and later versions feature the following usability enhancements:

- One-click collection of support data, drive diagnostic data, drive channel state management, controller 'service mode,' and the ability to save host topology information
- Improved media error handling for better reporting of unreadable sectors in the DS4000 Storage Subsystem event log, and persistent reporting of unreadable sectors

See the Storage Manager online help for more information.

Premium features

The following premium features can be enabled on DS4000 subsystems by purchasing a premium feature key:
- FlashCopy
- Enhanced Remote Mirror Option
- VolumeCopy
- Storage Partitioning
- FC/SATA Intermix

The FlashCopy, VolumeCopy, Remote Mirroring, and Storage Partitioning premium features are described in the following section

The FC/SATA Intermix premium feature is described in "FC/SATA Intermix premium feature" on page 10.

FlashCopy
This feature supports the creation and management of FlashCopy logical drives. A FlashCopy logical drive is a logical point-in-time image of another logical drive, called a base logical drive, that is in the storage subsystem. A FlashCopy is the logical equivalent of a complete physical copy, but you create it much more quickly and it requires less disk space.

Because a FlashCopy is a host addressable logical drive, you can perform backups using the FlashCopy while the base logical drive remains online and user-accessible. In addition, you can write to the FlashCopy logical drive to perform application testing or scenario development and analysis. The maximum number of FlashCopy logical drives allowed is one-half of the total number of logical drives supported by your controller model.

Enhanced Remote Mirror Option
The Enhanced Remote Mirror Option provides online, real-time replication of data between storage subsystems over a remote distance.

In the event of a disaster or unrecoverable error at one storage subsystem, the Enhanced Remote Mirror Option enables you to promote a second storage subsystem to take over responsibility for normal I/O operations.

Notes:
1. With DS4000 controller firmware versions earlier than 6.1x.xx.xx, you cannot use the Enhanced Remote Mirror Option. However, you can use a previous version of the Remote Mirror Option. See *IBM TotalStorage DS4000 Storage Manager Copy Services User's Guide* for more information about the different versions.
2. **Exception:** You cannot use the Remote Mirror Option or the Enhanced Remote Mirror Option with DS4000 controller firmware versions 5.41.xx.xx or 5.42.xx.xx, or with the DS4100 storage subsystem.

VolumeCopy

The VolumeCopy feature is a firmware-based mechanism for replicating logical drive data within a storage array. This feature is designed as a system management tool for tasks such as relocating data to other drives for hardware upgrades or performance management, backing up data, or restoring FlashCopy logical drive data.

Users submit VolumeCopy requests by specifying two compatible drives. One drive is designated as the Source and the other as the Target. The VolumeCopy request is persistent so that any relevant result of the copy process can be communicated to the user.

Note: The terms VolumeCopy and Logical Drive Copy are used interchangeably throughout this document, the DS4000 Storage Manager client program GUI, and online help.

Storage Partitioning

Storage Partitioning allows you to present all of a storage subsystem's defined logical drives to a SAN, through several different partitions. This is done by *mapping* each logical drive to a LUN number (0 - 255) in each of the defined partitions.

A given logical drive can be mapped to only one partition at a given time. In a given storage partition, the mapped logical drives are accessible only to the host server or servers whose Fibre Channel HBA host ports are defined in that storage partition. This feature allows the DS4000 storage subsystem to act as a multiple virtual storage subsystem to the host servers.

Storage Partitioning also allows multiple hosts that use different operating systems, with their own unique disk storage subsystem settings, to connect to the same DS4000 storage subsystem at the same time. This is known as a *heterogeneous host environment*.

FC/SATA Intermix premium feature

The IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix premium feature supports the concurrent attachment of Fibre Channel and SATA storage expansion enclosures to a single DS4000 controller configuration.

With this FC/SATA Intermix premium feature, the following storage subsystems can support the attachment of DS4000 EXP700 and EXP710 Fibre Channel storage expansion enclosures, and DS4000 EXP100 SATA storage expansion enclosures, concurrently:

- DS4800 (with controller firmware 06.15.xx.xx, and 06.14.xx.xx only)
- DS4500
- DS4400
- DS4300 Turbo

In this way, the FC/SATA Intermix premium feature enables you to create and manage distinct arrays that are built from either Fibre Channel disks or SATA disks, and allocate logical drives to the appropriate applications using a single DS4000 storage subsystem.

See your IBM technical service representative for information regarding future DS4000 storage subsystem support for the FC/SATA Intermix premium feature.

For important information about using the Intermix premium feature, including configuration and set-up requirements, see the *IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview*.

Enabling the DS4000 FC/SATA Intermix premium feature

Storage Manager 9.1x currently supports the DS4000 FC/SATA Intermix premium feature with all 06.1x.xx.xx controller firmware versions **(except 06.16.xx.xx)**. However, depending on which level of the controller firmware is installed on your storage subsystem, you need to follow different procedures to enable the premium feature.

DS4000 controller firmware version 6.10.xx.xx

On storage subsystems using DS4000 controller firmware version 6.10.xx.xx, the DS4000 FC/SATA Intermix premium feature is enabled with an NVSRAM file.

Download the appropriate NVSRAM version, as described in the *IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview*, to enable the DS4000 FC/SATA Intermix premium feature.

DS4000 controller firmware versions 6.12.xx.xx, 6.14.xx.xx, and 6.15.xx.xx

On storage subsystems using DS4000 controller firmware versions 6.12.xx.xx, 6.14.xx.xx, or 6.15.xx.xx and later, the DS4000 FC/SATA Intermix premium feature is enabled using a premium feature key.

Install the DS4000 FC/SATA Intermix Premium Feature Key, as described in the *IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview*, to enable the DS4000 FC/SATA Intermix premium feature.

Upgrading DS4000 controller firmware on systems when FC/SATA Intermix is already enabled

Complete the following steps if you are currently using DS4000 controller firmware 6.10.xx.xx, want to upgrade to 6.12.xx.xx or later, and you already have the FC/SATA Intermix premium feature enabled.

Complete the following steps to upgrade the controller firmware to 6.12.xx.xx or later:

1. Use the instructions in the DS4000 FC/SATA Intermix premium feature activation card to generate the premium feature key file.
2. Upgrade the controller firmware and NVSRAM to 06.12.xx.xx or a later version.

   Note: After the firmware is upgraded, the recovery guru will display the error "premium feature out-of-compliance." The premium feature that is out-of-compliance is the DS4000 FC/SATA Intermix premium feature. You will not be able to create any arrays or logical drives or modify the LUNs until after you complete step 3.

3. Enable the DS4000 FC/SATA Intermix premium feature using the premium feature key file. This restores the DS4000 subsystem to full functionality.

Storage Manager 9.1x limitations

For the latest information, you can also refer to the Limitations and Prerequisites section in the Storage Manager readme file for your operating system.

To access the most recent DS4000 Storage Manager readme files, see "Readme files and concepts" on page 1.

Limitations:

1. Storage Manager 9.1x-level controller firmware version 06.1x.xx.xx and corresponding NVSRAM are not supported on the following storage subsystems.

   - FAStT200 (3542, all models)
   - FAStT500 (3552, all models)
   - DS4300 single-controller (SCU) storage subsystems

   Therefore, the Storage Manager features that are specific to version 06.1x.xx.xx firmware are unavailable for these DS4000 servers.

   However, IBM recommends that you use Storage Manager 9.16 host software to manage these DS4000 servers, but use controller firmware versions 5.3x.xx.xx. For more information about which controller firmware to use with your specific configuration, see Table 3 on page 2.

2. DS4000 controller firmware versions 06.16.xx.xx, 06.15.xx.xx and 06.14.xx.xx support DS4800 storage subsystems only.

3. DS4000 controller firmware version 06.16.xx.xx does not support EXP100 storage expansion enclosures.

Terms to know

For information on terminology, see the Help section of the Storage Manager Enterprise Management window, the Storage Subsystem Management window, or the glossary on page 205.

It is important to understand the distinction between the following two terms when you read this document.

Management station

A management station is a system that is used to manage the DS4000 storage subsystem. You can attach it to the storage subsystem using either of the following methods:

- Through a TCP/IP Ethernet connection to the controllers in the storage subsystem (out-of-band method)
- Through a TCP/IP connection to the host-agent software that is installed on a host computer, which in turn is directly attached to the storage subsystem through the fibre-channel I/O path (in-band method)

See "Storage subsystem management methods" on page 16 for more information.

Host computer

A host computer is a server that is directly attached to the DS4000 storage subsystem through a fibre-channel I/O path. This system is used to perform the following tasks:

- Serve data (typically in the form of files) from the storage subsystem
- Function as a connection point to the storage subsystem for a remote-management station

Notes:

1. The terms host and host computer are used interchangeably throughout this document.

2. A host computer can also function as a management station.

IBM DS4000 Storage Manager Version 9.1x software for Windows

The Storage Manager Version 9.1x software package contains the following software components for Windows 2000 and Windows Server 2003.

- Install the following component on both the host and on the management station.
  - Storage Manager 9.1x Client (SMclient)
- Install the following components only on the host:
  - Redundant Disk Array Controller (RDAC)
  - Storage Manager 9.1x Agent (SMagent)
  - Storage Manager 9.1x Utility (SMutil)

Note: Servers with AMD, AMD64 or Intel EM64T processor architecture do not have Storage Manager 9.1x host software support when their operating systems are written in AMD64 or EM64T native code. If the IA-32 version of the operating system is installed and is running in compatibility mode on the AMD64 or EM64T servers, then you can use the appropriate IA-32 software package. Contact your IBM resellers or representatives for the latest information about Storage Manager 9.1x host software support for AMD64 or EM64T.

Storage Manager Client

The Storage Manager Client (SMclient) component provides the graphical user interface (GUI) for managing storage subsystems. The SMclient contains two main components:

- **Enterprise Management**. Use the Enterprise Management component to add, remove, and monitor storage subsystems within the management domain.
- **Subsystem Management**. Use the Subsystem Management component to manage the components of an individual storage subsystem.

The Event Monitor is a separate program that is bundled with the SMclient. If enabled, it monitors storage subsystems whenever the Enterprise Management window is closed. It runs continuously in the background and can send alert notifications in the event of a critical problem.

Note: You must enable the Event Monitor if you intend to use automatic ESM firmware synchronization.

Automatic ESM firmware synchronization is supported with Storage Manager 9.16 in conjunction with the EXP810 storage expansion enclosure. When you install a new ESM into an existing storage expansion enclosure, in a DS4000 storage subsystem that supports automatic ESM firmware synchronization, this feature automatically synchronizes the firmware in the new ESM with the firmware in the existing ESM.

Redundant disk array controller

The redundant disk array controller (RDAC) contains the multi-path device driver that is necessary to provide controller failover support when a component on the fibre-channel I/O path fails. For RDAC in Storage Manager 9.1x and later, a maximum of four end-to-end fibre-channel paths from the host to the storage subsystems are supported.

Storage Manager Agent

The Storage Manager Agent (SMagent) provides a management conduit for the SMclient to configure and monitor the subsystem through the fibre-channel I/O path. The agent also provides local or remote access to the SMclient depending on whether the client is installed on the host or in a network management station over the TCP/IP network.

Storage Manager Utility

The Storage Manager Utility (SMutil) dynamically defines and maps new logical drives to the operating system. This software package contains the following components:

- **hot_add utility.** The hot_add utility enables you to register newly created logical drives with the operating system. For more information, see "Using the hot_add utility" on page 136.
- **SMdevices utility.** The SMdevices utility enables you to associate storage subsystem logical drives with operating-system device names. For more information, see "Using the SMdevices utility" on page 136.
- **SMrepassist utility**. The SMrepassist utility enables you to flush cached data before creating a FlashCopy or VolumeCopy.

  Note: This is a Windows-only utility. Unmount the file system when using other operating systems.
  For more information, see "Using the SMrepassist utility" on page 137.

IBM DS4000 Storage Manager Version 9.1x software for NetWare

Although controller firmware version 06.16.xx.xx supports DS4000 storage subsystem attachment to a NetWare host, Storage Manager 9.16 is *not* currently supported on NetWare management stations.

To manage a DS4000 storage subsystem with controller firmware 6.16.xx.xx that is connected to a NetWare host server, you must install the Windows version of the Storage Manager 9.16 SMclient program in a Microsoft Windows management station, and make an out-of-band management connection to the DS4000 storage subsystem. See the appropriate sections in this document for procedures that describe how to install the SMclient program in a Windows management station.

You can install DS4000 Storage Manager versions 9.10 through 9.15 on NetWare hosts to manage DS4000 storage subsystems with controller firmware version 6.15.xx.xx or earlier. For information about installing DS4000 Storage Manager versions 9.10 through 9.15 on a NetWare operating system, see the following section:

Appendix A, "Installing previous Storage Manager versions in a NetWare configuration," on page 141

IBM DS4000 Storage Manager Version 9.1x software for Linux

DS4000 Storage Manager 9.1x packages are available for three types of Linux operating systems on the product CD and Internet site. These packages are for servers with Intel architecture 32-bit (IA-32) or 64-bit (IA-64) processors only.

Note: Storage Manager 9.16 now supports AMD64 and EM64T Linux RHEL 4 and SLES 9 servers running x86_64 Linux kernels (AMD64 or EM64T native

code), in addition to the previously-supported Intel Itanium 64 bit processor architecture (IA64) Linux operating systems.

This document describes two different Storage Manager 9.16 host software packages for Linux:

- Storage Manager 9.16 host software package for the 32 bit x86 (32 bit) *and* x86_64 (AMD64 and EM64T) processor architecture Linux operating systems
- Storage Manager 9.16 host software package for Intel Itanium 64 bit processor architecture (IA64) Linux operating systems only

For information about Storage Manager 9.16 for the third type of Linux operating system that is supported with DS4000 storage subsystems, Linux for POWER servers, see *IBM TotalStorage DS4000 Storage Manager 9 Installation and Support Guide for AIX, HP-UX, Solaris, and Linux on POWER*.)

The Storage Manager Version 9.1x software package contains the following software components for Linux:

- The following components on both the host and management station:
  - Storage Manager Runtime (SMruntime)
  - Storage Manager 9.1x Client (SMclient)
- Install the following components only on the host.
  - Storage Manager Utility (SMutil)
  - Storage Manager RDAC (SMRDAC) or Qlogic SANsurfer
  - Storage Manager Agent (SMagent)

Management station components

Install the following components on both the host and management station.

Storage Manager Runtime (SMruntime)
This component contains the Java runtime environment that is necessary to install the other software packages.

Storage Manager 9.1x Client (SMclient)
This component is necessary if you intend to manage the storage subsystem from a host computer or a management station.

Host components

Install the following components only on the host.

Storage Manager Utility (SMutil)
SMutil is packaged with the SMclient package and contains the hot_add and SMdevices utilities.

Storage Manager Redundant disk array controller (RDAC)
RDAC provides multipath failover/failback capability. The RDAC component requires that you install the non-failover version of the Fibre Channel HBA device driver. Therefore, do not install RDAC if you plan to use the Fibre Channel HBA failover driver as the multipath failover driver. (If you do not install RDAC, you must install Qlogic SANsurfer.)

Restrictions: If you have logical drives that are created on DS4000 storage subsystems with controller firmware 05.3x.xx.xx or earlier installed, you must use the Fibre Channel HBA failover device driver as the multipath driver instead of RDAC.

> **Note:** RDAC is not packaged with the other software components in the Storage Manager package for Linux operating systems. Also, there is a different version of RDAC for each Linux kernel version, so check the latest readme file to make sure that you have the correct version for your Linux kernel. To access the most recent DS4000 Storage Manager readme files, see "Readme files and concepts" on page 1.

Storage Manager Agent (SMagent)
SMagent is necessary if you intend to use the host-agent (in band) management method. You must install RDAC before installing SMagent.

Recommendation: In a Linux environment, you should manage DS4000 storage subsystems using the direct (out-of-band) method.

Qlogic SANsurfer
Qlogic SANsurfer is required if you do not install RDAC, and plan to use the Fibre Channel HBA failover device driver as the multipath driver instead of RDAC. (If you installed RDAC, Qlogic SANsurfer is optional.)

Qlogic SANsurfer is used to configure failover information for the Linux Fibre Channel HBA failover device drivers.

Notes:

1. The Qlogic SANsurfer QLremote agent is automatically installed with the Qlogic SANsurfer software. The QLremote agent does not need to run if you are not working with Qlogic SANsurfer. If the agent starts, you must stop it if you do not want it to run.

2. In a Linux environment that uses Qlogic SANsurfer and the Fibre Channel HBA failover driver, you must manage the DS4000 storage subsystem using the direct (out-of-band) management method.

Storage subsystem management methods

Storage Manager software provides the following two methods for managing storage subsystems:

- The host-agent (in-band) management method
- The direct (out-of-band or Ethernet) management method

> **Note:**
>
> - You must make direct (out-of-band) management connection to the DS4000 storage subsystem in order to obtain the correct host type. The correct host type will allow the DS4000 storage subsystem to configure itself properly for the operating system of the host server. After you do so, and depending on your particular site requirements, you can use either or both management methods. The management methods you select will determine where you will need to install the software components.
> - To optimize DS4000 storage subsystem management availability and access, IBM recommends that you configure both host-agent (in-band) and direct (out-of-band) management connections. If you use both types of management connections and either connection fails, you can still manage your storage subsystem using the other connection.
> - If you establish management connections from multiple management stations or hosts to the same DS4000 storage subsystems, it is best practice to have only one active management connection to the DS4000 storage subsystem at a time, even though eight simultaneous active management sessions are supported in a given DS4000 storage subsystem.
> - Storage Manager 9.1x supports only the direct (out-of-band) management method for use with the Linux operating system when you do not use Linux RDAC.

Host-agent (in-band) management method

When you use the host-agent (in-band) management method, you manage the storage subsystems through the fibre-channel I/O path to the host. The management information can either be processed in the host or passed to the management station through the network connection, as shown in Figure 1 on page 18.

Managing storage subsystems through the host-agent has the following advantages:

- You do not need to run Ethernet cables to the controllers.
- Yo do not need a Dynamic Host Configuration Protocol/Bootstrap Protocol (DHCP/BOOTP) server to connect the storage subsystems to the network.
- You do not need to perform the controller network configuration tasks that are described in Chapter 2, "Preparing for installation," on page 41.
- You only need to specify a host name or IP address for the host instead of for the individual controllers in a storage subsystem. Storage subsystems that are attached to the host are automatically discovered.

Managing storage subsystems through the host-agent has the following disadvantages:

- The host-agent requires a special logical drive, called an *access logical drive,* to communicate with the controllers in the storage subsystem. Therefore, you are limited to configuring one less logical drive than the maximum number that is allowed by the operating system and the host adapter that you are using.
- If the connection through the fibre channel is lost between the host and the subsystem, you cannot manage or monitor the subsystem.

Important: If your host already has the maximum number of logical drives configured, either use the direct-management method or give up a logical drive for use as the access logical drive. For more information, see "Number of supported logical drives" on page 39.

The access logical drive is also referred to as the *Universal Xport Device*.
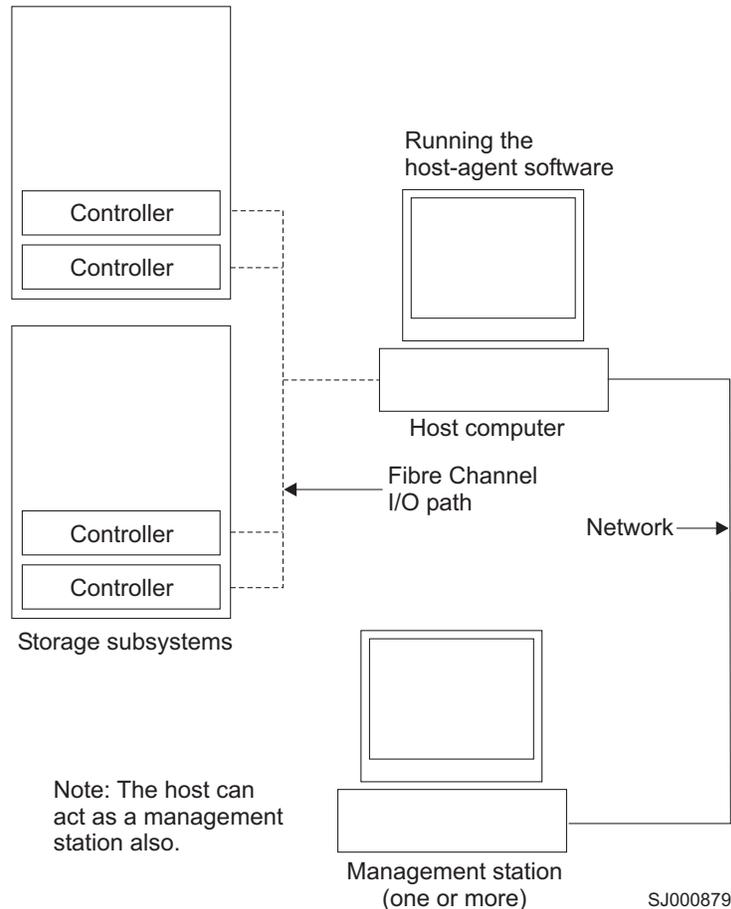
Figure 1. Host-agent (in-band) managed storage subsystems

Required host-agent (in-band) management activities

Perform the following activities to establish host-agent (in-band) management connections.

1. Make fibre channel connections between the DS4000 and host computer.
2. Install TCP/IP on the host computer and establish a host IP address. (See "Preparing a network installation" on page 45 for instructions for host-managed systems.)
3. Install the HBA device driver, SMRuntime (if required), SMclient, RDAC, and SMagent on the host server.
4. Make sure that the Storage Manager Agent Service starts successfully.
5. Open the SMclient Enterprise window and add the IP address of the host server to the management domain. All DS4000 devices recognized by the host computer will be displayed in the management window.

Key installation requirements:
1. Use a fibre channel HBA device driver
2. Install RDAC before you install SMagent (depending on your operating system).
3. Install SMagent and start the Storage Manager Agent Service successfully.

Direct-management (out-of-band) method

When you use the direct-management (out-of-band) method, you manage storage subsystems directly over the network through a TCP/IP Ethernet connection to each controller. To manage the storage subsystem through the Ethernet connections, you must define the IP address and host name for each controller. Each of the storage subsystem controllers must be connected to an Ethernet network through a cable connected to the RJ-45 connector, as shown in Figure 2 on page 21.

Managing storage subsystems using the direct-management (out-of-band) method has the following advantages:

- The Ethernet connections to the controllers enable you to manage storage subsystems that are connected to a host running any of the operating systems that Storage Manager supports through an SMclient management station.
- You do not need an access logical drive to communicate with the controllers. You can configure the maximum number of logical drives that are supported by the operating system and the host adapter that you are using.
- You can manage and troubleshoot the storage subsystem when there are problems with the fibre-channel links.

Managing storage subsystems using the direct-management (out-of-band) method has the following disadvantages:

- You need two Ethernet cables to connect the storage subsystem controllers to a network.
- When adding devices, you must specify an IP address or host name for each controller.
- Network preparation tasks are required and you might need a DHCP/BOOTP server. For a summary of the preparation tasks, see Chapter 2, "Preparing for installation," on page 41.

    Important: To avoid DHCP/BOOTP server and network tasks, assign static IP addresses to the controller or use the controller default TCP/IP addresses (see Table 4).

Defining controller TCP/IP addresses

Table 4 shows the default settings storage subsystem controllers with firmware version 05.00.xx.xx or later:

Table 4. Default controller TCP/IP addresses

Controller	IP address	Subnet mask
All DS4000 subsystems:		255.255.255.0
A	192.168.128.101	
B	192.168.128.102	
DS4800 only: (in addition to Ethernet ports A and B)		
A2 (port 2)	192.168.129.101	
B2 (port 2)	192.168.129.102	

Note: The DS4800 has four Ethernet ports: two on each controller blade (**A**, **B**, **A2** and **B2**).

In order to change the DS4000 storage subsystem controller default TCP/IP address, you must first make a direct management connection to the storage subsystem using the default TCP/IP addresses.

If the DS4000 storage subsystem controllers have firmware version 05.4x.xx.xx or later, you can use the DS4000 Storage Manager Client Program to change the controller default TCP/IP address. Complete the following steps in the Subsystem Management window of the DS4000 storage subsystem for which you want to define new controller TCP/IP addresses:

1. Right-click the controller icon and select **Change -> Network Configuration** from the pull-down menu.
2. When the **Change Network Configuration** window opens, select the appropriate controller tab in the window and enter the appropriate TCP/IP address information for both controller A and B.
3. Click **OK** to apply the new TCP/IP address.

   Important: Make sure that the new TCP/IP address information is correct because you will not be able to make direct management connection to the storage subsystem again via the controller default TCP/IP addresses once they are changed to different values.

4. Close the **Subsystem Management** window.
5. In the **Enterprise Management** window, delete the storage subsystem entry with the default TCP/IP addresses.
6. Wait about five minutes, and then re-establish management connection to the storage subsystem using the new TCP/IP addresses.

   Note: You might want to ping the new addresses first to make sure that there is a good network connection to the controllers before adding the storage subsystem into the Enterprise management window.

Important: If you are not able to use the controller default TCP/IP address to assign the static TCP/IP address, see the IBM support Web site at:

www.ibm.com/pc/support/

At the Web site, see Retain Tip [#]H171389 Unable To Setup Networking Without DHCP/BOOTP.

Example of direct-managed (out-of-band) storage subsystem

Figure 2 on page 21 shows a system in which storage subsystems are managed by using the direct-management (out-of-band) method.
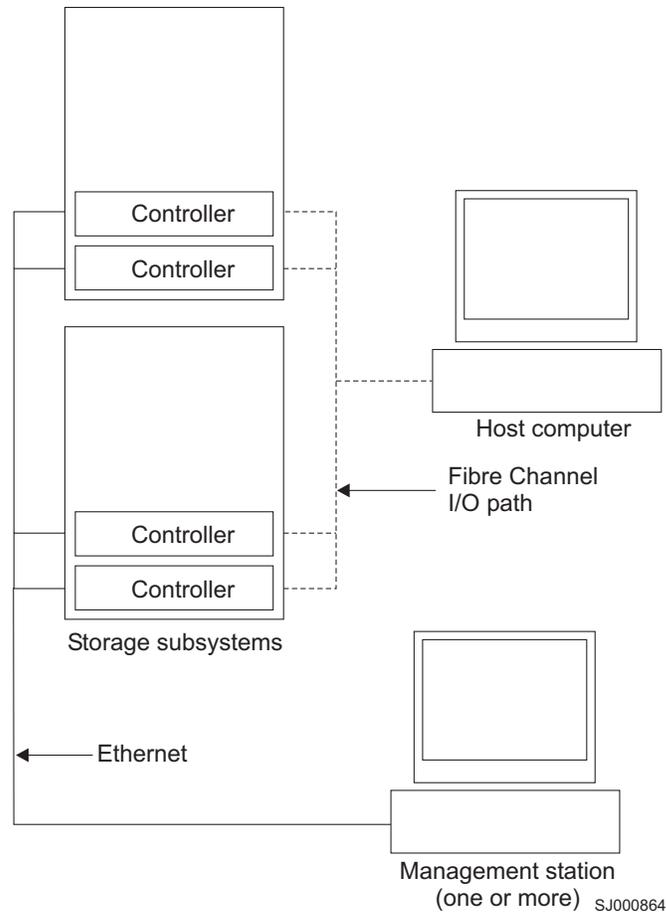
Figure 2. Direct-management (out-of-band) storage subsystems

Required direct-management (out-of-band) management activities

1. Make Ethernet connections between the DS4000 and the Ethernet network.
2. Follow instructions located at "Preparing a network installation" on page 45 for directly managed systems. Assign IP addresses to the DS4000 controllers.
3. Install SMruntime (if required) and SMclient.
4. Open the GUI and add the IP addresses for the DS4000 controllers (A and B). If you have multiple DS4000 storage subsystems, add the IP address of each to the domain.

Reviewing a sample network

Figure 3 on page 22 shows an example of a network that contains both a directly-managed storage subsystem (Network A) and a host-agent-managed storage subsystem (Network B).

Directly-managed storage subsystem: Network A is a directly-managed storage subsystem. Network A contains the following components:
- A DHCP/BOOTP server
- A network management station (NMS) for Simple Network Management Protocol (SNMP) traps

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

Note: If the controllers static TCP/IP addresses or default TCP/IP addresses are used, you do not need to setup the DHCP/BOOTP server.

Host-agent-managed storage subsystem: Network B is a host-agent-managed storage subsystem. Network B contains the following components:
- A host that is connected to a storage subsystem through a fibre-channel I/O path
- A management station that is connected by an Ethernet cable to the host computer
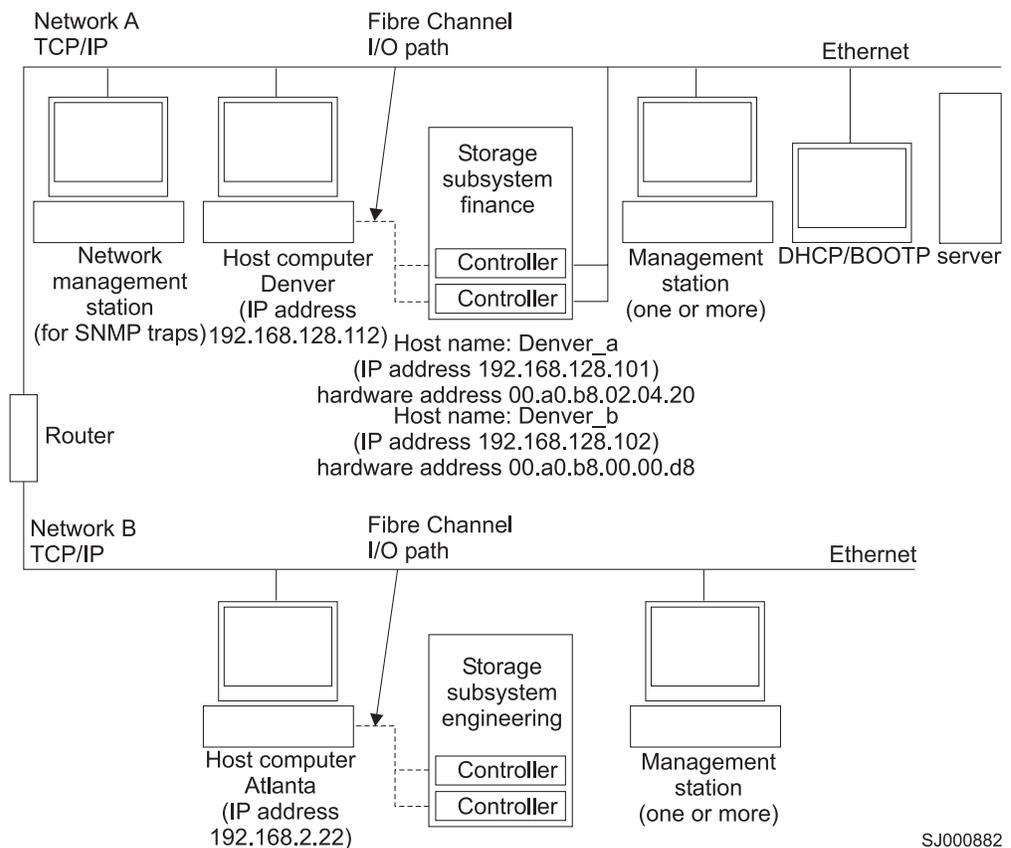
Figure 3. Sample network using directly-managed and host-agent managed storage subsystems

Where to install software components

How you manage the storage subsystems determines where you must install the various software components.

Management stations

You must install the following software components on each management station:
- SMclient
- SMruntime (for Linux only)

Host computers

Table 5 shows the software components that you are required to install on each host computer:

Table 5. Required host software components

	RDAC	SMutil	LSIMPE	Qlogic SANsurfer	QLRemote agent
Linux	✔ (see note 1)	✔		✔ (see note 2)	✔ (see note 2)
Windows 2000	✔	✔		✔ (see note 3)	✔ (see note 3)
Windows Server 2003	✔	✔		✔ (see note 3)	✔ (see note 3)
NetWare			✔		✔ (see note 4)
VMWare ESX Server	See note 5.				

Notes:

1. Linux RDAC is supported only when the DS4000 storage subsystems have controller firmware version 05.4x.xx.xx and later installed. See "Linux RDAC installation" on page 89 for detailed Linux RDAC installation instructions.

2. For Linux: Use Qlogic SANsurfer for IBM Fibre Channel HBA management and troubleshooting problems in the Fibre Channel path between host server HBA and the DS4000 storage subsystem, or for configuring LUN failover/failback when Linux RDAC is not used as the multipath driver.

3. Use Qlogic SANsurfer for IBM Fibre Channel HBA management and troubleshooting problems in the Fibre Channel path between host server HBA and the DS4000 storage subsystem only.

4. The QLRemote agent is used in conjunction with the Qlogic SANsurfer, and must be installed in a non-Netware server. It is used for IBM Fibre Channel HBA management and for troubleshooting problems in the Fibre Channel path between the Netware host server HBA and the DS4000 storage subsystem only.

5. DS4000 Storage Manager software is not currently available for VMware ESX Server operating systems. VMware has a built-in driver for multipath operation.

Depending on how you intend to manage the storage subsystems, you might also need to install the following additional host software components:

- SMruntime (for Linux only)
- SMclient (for Linux, Windows 2000, and Windows Server 2003)
- SMagent (for Linux (with Linux RDAC only), Windows 2000, and Windows Server 2003)

Notes:

1. Install the SMagent on a host computer if you intend to manage the storage subsystems using the host-agent management method.

2. You must install the SMclient on a host computer if you intend the host computer to act as a management station. If the host computer is not connected to a network, you must install TCP/IP software and assign an IP address.

Creating the SAN-attached configuration

This section contains the following topics:

- "Preparing for a SAN-attached configuration" on page 24
- "Steps for setting up a SAN-attached configuration" on page 24
- "Connecting HBAs in a FC switch environment" on page 24

Preparing for a SAN-attached configuration

To create a SAN-attached configuration, you must ensure that:

- Multiple Fibre Channel HBAs within the same server cannot "see" the same DS4000 controller port.
- The IBM Fibre Channel HBAs in a host system must be isolated from each other if they are connected to the same switch that is connected to the same DS4000 controller port.
- A multipath configuration requires two HBAs per host system, each in a separate switch zone that is connected to one of the two controllers.
- Each Fibre Channel HBA on each host, and controller port on each DS4000 subsystem, must be in its own fabric zone, if they are connecting through a single Fibre Channel switch.

    Note: Single HBA configurations are allowed. If you have a single HBA in a SAN-attached configuration, the controller must be Fibre Channel connected to the HBA through a switch, and both controllers must be within the same SAN zone as the HBA.

    Attention: Having a single HBA configuration can lead to loss of access data in the event of a path failure.

Steps for setting up a SAN-attached configuration

Complete the following steps to set up a SAN-attached configuration:

1. Connect the HBAs to the switch or switches.
2. Connect the DS4000 storage subsystem controllers to the switch or switches.
3. Set the required zones on the Fibre Channel switch or switches, if applicable.
4. Configure, then verify the configuration by logging into the switch to view the system.

Connecting HBAs in a FC switch environment

When connecting fibre channel host bus adapters in host servers to DS4000 Storage Server host ports in a fibre channel switch environment, IBM recommends that you establish one-to-one zones between the HBA and DS4000 host ports.

For instructions on how to set up a zone inside a fibre channel switch, see your fibre channel switch's installation and user's guide.

Note: You can find links to switch documentation at the following Web site:

www.ibm.com/servers/storage/support/san/index.html

Figure 4 on page 25 illustrates a sample configuration consisting of two host servers, each with two fibre channel host bus adapters, each of which are connected to a DS4000 Storage Server host port through a fibre channel switch.
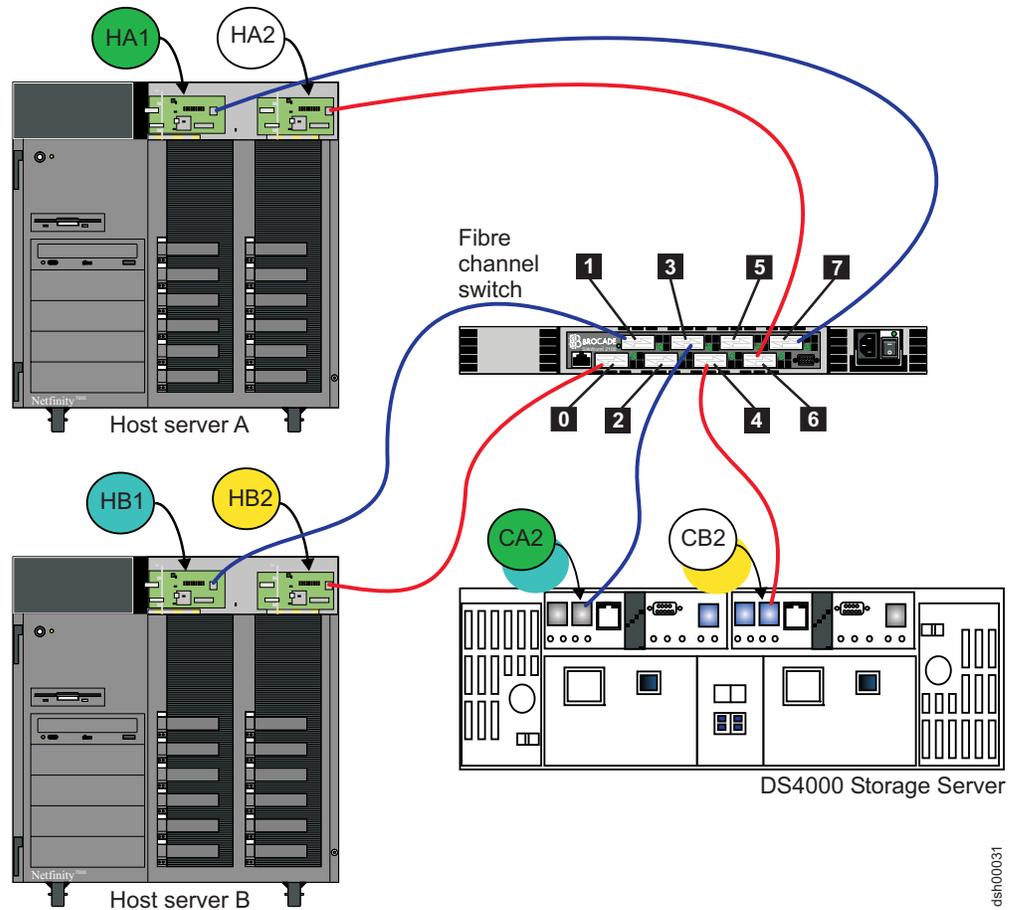
Figure 4. Fibre channel fabric switch environment connecting host servers to a DS4000 Storage Server

Controller	Zone	Port	Connection to and from	Description
A	1	7 3	HA1 CA2	This will zone the fibre channel HBA port HA1 in host server A to port 2 of the DS4000 Storage Server controller A.
	2	1 3	HB1 CA2	This will zone the fibre channel HBA port HB1 in host server B to port 2 of the DS4000 Storage Server controller A.
B	3	6 4	HA2 CB2	This will zone the fibre channel HBA port HA2 in host server A to port 2 of the DS4000 Storage Server controller B.
	4	0 4	HB2 CB2	This will zone the fibre channel HBA port HB2 in host server B to port 2 of the DS4000 Storage Server controller B.

Legend:

Configuration types

You can install Storage Manager 9.1x in either of the two following configurations:

- Standard (noncluster) configuration
- Cluster server configuration
  - Storage Manager 9.1x, with controller firmware versions 06.1x.xx.xx or later, supports SteelEye technology Linux cluster server configurations. You can contact your IBM resellers or representatives for updates regarding availability of support for other Linux cluster configurations in the future.
  - The following illustrations of the cluster server configurations do not pertain to NetWare or Linux.

Standard (non-cluster) configuration

Figure 5 shows a sample standard (non-cluster) configuration.
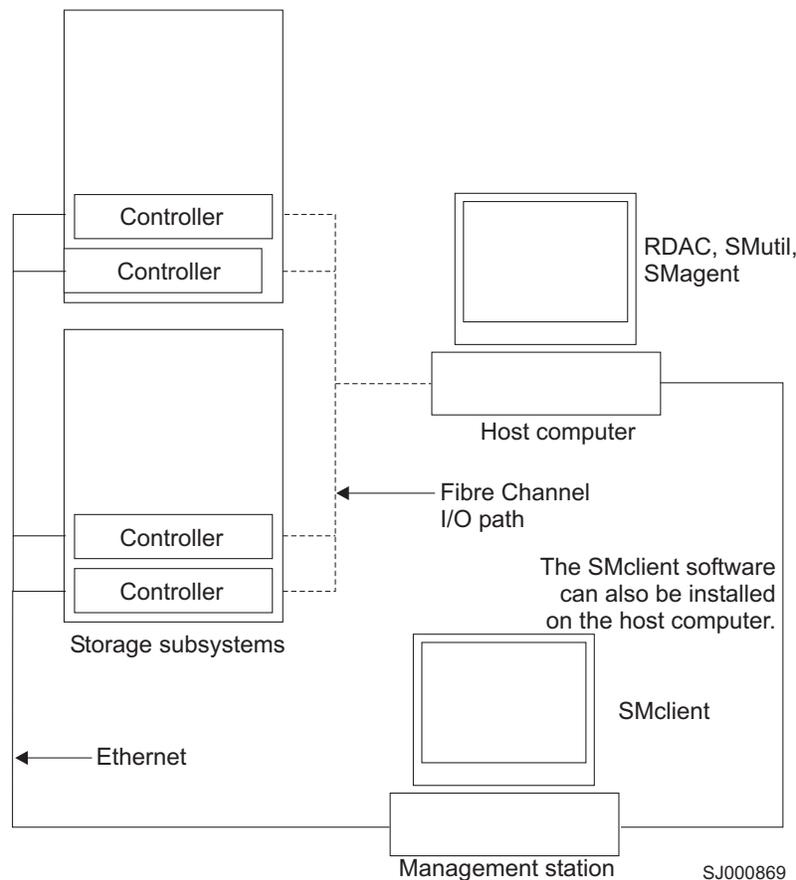
Figure 5. Sample standard (non-cluster) configuration

Cluster server configuration for Windows

Figure 6 shows a sample cluster server configuration.

RDAC, SMutil, SMagent

Ethernet →

SMclient

Cluster server node A

Cluster server node B

The SMclient software can also be installed on the cluster nodes.

Management station (one or more)

Managed hub or switch

Fibre Channel I/O path ←

Controller

Controller

Storage subsystem

SJ000870
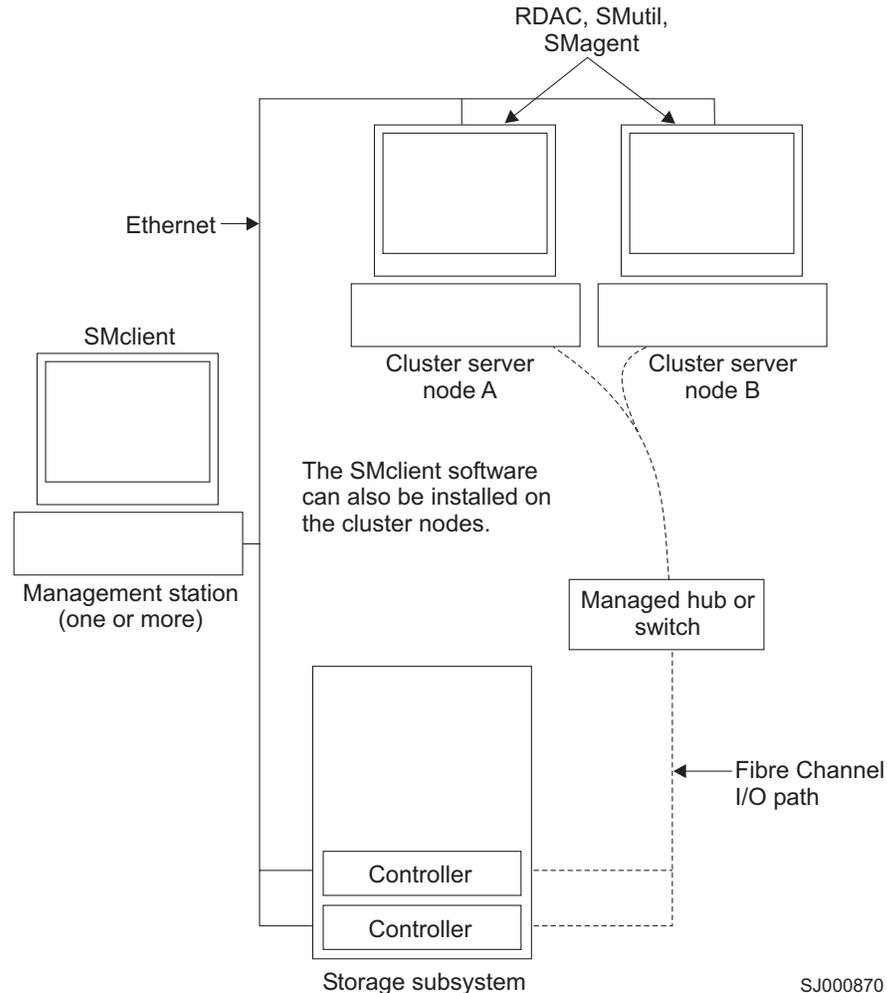
Figure 6. Sample cluster server configuration

Installation types

You can install Storage Manager 9.1x software in either of the following types of hardware environments:

- **New storage subsystem environment**. Use this hardware environment if you are installing the IBM TotalStorage DS4000 Disk Storage Subsystem using firmware 06.12.xx.xx (for DS4100, DS4300, DS4400 or DS4500) or 06.16.xx.xx (for DS4800) and you will manage storage subsystems using Storage Manager 9.16.

- **Existing storage subsystem environment**. If you are installing Storage Manager software in an environment with existing storage subsystems, see Table 6 on page 29 for your installation options.

Notes:

1. Where you are instructed in the following table to uninstall Storage Manager software, be sure to uninstall the management software on all management systems or hosts that have access to the storage subsystem that has firmware

06.12.xx.xx or later. The Storage Manager 9.16 RDAC (for Windows or Linux) has new functionality and features and it is compatible with older versions of firmware. To ensure the highest level of compatibility and error-free operation, install the Storage Manager 9.16 RDAC on all host computers that have disks defined on storage subsystems that have firmware level 06.12.xx.xx or later.

2. Because uninstallation and installation of RDAC in Windows operating systems requires system reboot, it is possible to install all other components of Storage Manager 9.16, except RDAC, so that you can download the new firmware version (06.12.xx.xx or later) to the storage subsystem and manage it. Schedule an RDAC installation as soon as possible to ensure error-free operation and the highest level of compatibility.

3. Controller firmware version 05.42.xx.xx is associated only with the IBM TotalStorage DS4100 single-controller (SCU) storage subsystem. Do not load this controller firmware version on any other DS4000 storage subsystem.

Table 6. Configurations for existing storage subsystems

Current environment	Planned environment	Action
Existing DS4400 and DS4500 (machine type 1742) storage subsystems with controllers that have firmware versions 05.00.xx.xx, 05.2x.xx.xx, 05.3x.xx.xx, 05.4x.xx.xx or 06.10.xx.xx Existing DS4300 storage subsystems (machine type 1722 — Turbo Option model) with controllers that have firmware version 05.4x.xx.xx Existing DS4300 storage subsystems (machine type 1722 - Standard/Base Option model) with controllers that have firmware version 05.34.xx.xx or 05.4x.xx.xx Existing DS4100 storage subsystems (machine type 1724 - Standard/Base Option model) with controllers that have firmware version 05.42.xx.xx Existing DS4800 storage subsystems (machine type 1815) with controllers that have firmware version 06.14.xx.xx or 06.15.xx.xx	Firmware version 06.16.xx.xx (for DS4800) or 06.12.xx.xx (for DS4100, DS4300, DS4400, or DS4500) Storage Manager 9.16. **Notes:** 1. For FC/SATA intermix support behind a DS4000 storage subsystem, the FC/SATA intermix premium feature option is purchased and the targeted DS4000 model is in the FC/SATA intermix premium feature support list. 2. Firmware version 06.16.xx.xx does not currently support FC/SATA intermix. 3. Firmware version level 06.16.xx.xx supports attachment of EXP710 and EXP810 expansion enclosures only. If you have an EXP700 or an EXP100 attached to your DS4800 subsystem, use firmware version 06.15.xx.xx. 4. Firmware version 06.10.11.xx and later supports the intermix of both fibre channel expansion enclosures (EXP700 and EXP710) and SATA expansion enclosures (EXP100) behind a DS4000 storage subsystem if the above requirements are met. 5. Firmware version 06.1x.06.xx and later supports both fibre channel expansion enclosures (EXP700 and EXP710) and SATA expansion enclosures (EXP100) without	1. Uninstall Storage Manager 8.4x or 9.1x. See "Uninstalling storage management software components" on page 138 for more information. 2. Install Storage Manager 9.16. See "New installation process" on page 59 for more information. 3. Discover the storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 113 for more information. 4. Download firmware and NVSRAM version 06.12.xx.xx or 06.16.xx.xx). See "Downloading controller firmware, NVSRAM, ESM firmware" on page 117 for more information. **Note:** To incorporate SATA hardware in an existing DS4300 Turbo, DS4400, or DS4500 storage subsystem with controller firmware 05.40.xx.xx or earlier installed, do not use the controller firmware version 05.41.xx.xx, just upgrade the storage subsystem with controller firmware 06.12.xx.xx, apply the FC/SATA intermix premium feature key and then connect the new EXP100 drive expansion enclosures. **Note:** Always add new hardware to an existing configuration while it is powered on and is in optimal condition.

Table 6. Configurations for existing storage subsystems (continued)

Current environment	Planned environment	Action
Existing FAStT500 (machine type 3552) storage subsystems with controllers that have firmware version levels 04.00.xx.xx through 05.3x.xx.xx	Firmware version level 05.3x.xx.xx Storage Manager 9.16. **Note:** Firmware version level 05.4x.xx.xx or higher does not support machine type 3552.	1. Uninstall the previous version of Storage Manager. See "Uninstalling storage management software components" on page 138 for more information. 2. Install Storage Manager 9.16. See "New installation process" on page 59 for more information. 3. Discover the storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 113 for more information. If the current controller firmware version number starts with "4.", go to the DS4000 technical support Web site listed on page xxi to download firmware level 04.01.02.30 or higher and its matching NVSRAM. **Important:** The storage subsystem controllers must be at firmware level 04.01.02.30 or higher before you download firmware level 05.3x.xx.xx and NVSRAM to the controllers. 4. If the current controller firmware version number starts with ″4.″, download firmware level 04.01.02.30 or higher and its associated NVSRAM. See "Downloading controller firmware, NVSRAM, ESM firmware" on page 117 for more information. 5. Download the latest firmware and NVSRAM version 5.3x.xx.xx from the IBM Web site. See "Downloading controller firmware, NVSRAM, ESM firmware" on page 117 for more information.

Table 6. Configurations for existing storage subsystems (continued)

Current environment	Planned environment	Action
Existing FAStT200 storage subsystems (machine type 3542) with controllers that have firmware versions 04.00.02.xx through 05.3x.xx.xx	Firmware version 5.3x.xx.xx Storage Manager 9.16. **Note:** Firmware version 05.4x.xx.xx or higher does not support machine type 3542.	1. Uninstall the previous version of Storage Manager software. See "Uninstalling storage management software components" on page 138 for more information. 2. Install Storage Manager 9.16. See "New installation process" on page 59. 3. Discover storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 113 for more information. If the current controller firmware version number starts with "4." , go to the DS4000 technical support Web site listed on page xxi to download the level 04.01.02.30 or higher firmware and matching NVSRAM. **Important:** The storage subsystem controllers must be at firmware level 04.01.02.30 or higher before you download firmware level 05.3x.xx.xx and NVSRAM to the controllers. 4. Download firmware level 04.01.02.30 or higher and its associated NVSRAM. See "Downloading controller firmware, NVSRAM, ESM firmware" on page 117 for more information. 5. Download firmware and NVSRAM version 5.3x.xx.xx. See "Downloading controller firmware, NVSRAM, ESM firmware" on page 117 for more information.
Existing DS4100 storage subsystems with single controller option (machine type 1724) with controllers that have firmware version 05.42.xx.xx Existing DS4300 storage subsystems with single controller option (machine type 1722) with controllers that have firmware version 05.34.xx.xx	Firmware version 5.42.xx.xx for DS4100 Single Controller model Firmware version 05.34.xx.xx for DS4300 single controller model Storage Manager 9.16. **Note:** Firmware version 06.1x.xx.xx does not support DS4300 or DS4100 Single controller models.	1. Uninstall Storage Manager 8.4x. See "Uninstalling storage management software components" on page 138 for more information. 2. Install Storage Manager 9.16. See "New installation process" on page 59 for more information. 3. Discover the storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 113 for more information.

Table 6. Configurations for existing storage subsystems (continued)

Current environment	Planned environment	Action
Existing DS4300, DS4400, DS4500, FAStT500, FAStT200 storage subsystems (machine types 1722, 1742, 3552, and 3542, respectively) and storage subsystems with controllers that have firmware versions 04.01.xx.xx through 06.1x.xx.xx	Remain at existing firmware version. Storage Manager 9.16 **Note:** Storage Manager 9.14 can only manage and send I/O operations to DS4000 storage subsystems with controller firmware versions 05.xx.xx.xx or higher.	1. Uninstall the previous version of Storage Manager. See "Uninstalling storage management software components" on page 138 for more information. 2. Install Storage Manager 9.16. See "New installation process" on page 59 for more information. 3. Discover the storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 113 for more information.
Existing IBM Netfinity RAID Controller Unit, FAStT200, and FAStT500 (machine types 3526, 3542, and 3552, respectively) storage subsystems with controllers that have firmware versions 04.00.02.xx up to 04.01.xx.xx	Existing firmware versions Storage Manager 8.4x	Set up a separate management station with Storage Manager 8.4x installed to manage the storage subsystems with controllers that have back-level firmware. **Note:** The minimum controller firmware level required for management by Storage Manager 9.1x is 05.xx.xx.xx or higher.
Existing IBM Netfinity RAID Controller Unit and FAStT500 (machine types 3526 and 3552, respectively) storage subsystems with controllers that have firmware versions 04.00.xx.xx through 4.00.01.xx	Existing firmware versions Storage Manager 7.10	This is not a supported environment with Storage Manager 9.1x, which can only manage and send I/O operations to DS4000 subsystems with controller firmware 05.xx.xx.xx and higher. You must set up a separate management station with Storage Manager 7.10 installed to manage the storage subsystems with controllers that have back-level firmware. You must also set up a different host server/computer with Storage Manager version 7.10 or 8.4x host software to perform I/O from the DS4000 subsystems with controller firmware 04.00.xx.xx through 4.00.01.xx.

Managing coexisting storage subsystems

Storage subsystems are *coexisting storage subsystems* when the following conditions are met:

- Multiple storage subsystems with controllers are running different versions of firmware.
- These storage subsystems are attached to the same host.

For example, a coexisting situation exists when you have a new storage subsystem with controllers running firmware version level 06.16.xx.xx, and it is attached to the same host as one or more of the following configurations:

- A storage subsystem with controllers running firmware version levels 06.10.xx.xx.
- A storage subsystem with controllers running firmware version levels 05.xx.xx.xx.

Important: The common host must have the latest level (9.16) of RDAC and SMagent installed. Upgrade all storage subsystems running firmware at or below level 05.2x.xx.xx to the current code level. The latest firmware versions for FAStT200, FAStT500, DS4300 Single Controller subsystems (05.3x.xx.xx); for DS4100 Single Controller subsystems (05.42.xx.xx); for DS4100 Base, DS4300 Base and Turbo, DS4400, and DS4500 subsystems (06.12.xx.xx); and for DS4800 subsystems (06.16.xx.xx) are available free of charge for download with all fixes and software patches from the following IBM support Web site:

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

System requirements

This section provides detailed information about the hardware, software, and operating system requirements for Storage Manager 9.1x.

Hardware requirements

Table 7 lists the hardware required for installing Storage Manager 9.1x.

Table 7. Hardware requirements for Storage Manager 9.1x software

Hardware component	Requirements
A DHCP/BOOTP server (only for directly managed storage subsystems) **Note:** If the controllers static IP addresses or default IP addresses are used, you do not need to set up the DHCP/BOOTP server.	One of the following BOOTP or BOOTP-compatible servers: • Microsoft® BOOTP-compatible DHCP server for Windows 2000 • Microsoft BOOTP-compatible DHCP server for Windows Server 2003 • UNIX BOOTP server • NetWare DHCP server
Storage subsystems (one or more)	Storage subsystems with controllers running controller firmware version levels 04.01.xx.xx through 06.xx.xx.xx
Supported Fibre Channel host adapters	• IBM DS4000 host adapter (part number: 00N6881) • An IBM DS4000 FC2 Host Bus Adapter (part number 19K1246) or IBM DS4000 single port FC2-133 Host Bus Adapter (part number 24P0960) For information about specific host adapter requirements: • Refer to the readme file in the `\Host_Adapter` directory on the installation CD. • Read the host adapter documentation. • Go to the Web site at: www.ibm.com/pc/support/

Table 7. Hardware requirements for Storage Manager 9.1x software (continued)

Hardware component	Requirements	

Management station requirements (for client software)	• Intel Pentium®® or Pentium-equivalent microprocessor (450 MHz or faster)
	• CD-ROM drive
	• Mouse or similar pointing device
	• System memory:
	  – For Windows 2000: A minimum of 128 MB (256 MB recommended)
	  – For Windows Server 2003, NetWare, and Linux: A minimum of 256 MB (512 MB recommended)
	• Ethernet network interface adapter
	• AGP or PCI video adapter (AGP preferred); ISA adapters are not supported
	• Monitor setting of 1024 x 768 pixels with 64,000 colors. The minimum display setting that is allowed is 800 x 600 pixels with 256 colors.
	• Hardware-based Windows acceleration. Desktop computers that use system memory for video memory are not preferred for use with the storage management software.
	
	Important: Many PC-based servers are not designed to run graphic-intensive software. If your server has difficulty displaying the Storage Manager user interface, you might need to upgrade the server video adapter.	

Supported Fibre Channel fabric switches (if needed for the desired configuration)	**Switch product name**	**Model number**
	IBM TotalStorage SAN Switch	2109 S08 2109 S16 2019 F16 2109 F32 3534 F08 2005-H08 2005-H16 2005-B32
	CNT switch	2042-01 2042-128
	McDATA 4500 switch	2031-216 2031-224 2032-232
	McDATA 6140 switch	2032-140
	CISCO MDS 9209 switch	2062-D07 2062-T07
	CISCO MDS 9216 switch	2062-D01

Notes:

1. For more information about host adapters, fabric switches, and managed hubs, see the following ServerProven®™ Web site:

   www.ibm.com/pc/us/compat/

   Also, see the DS4000 interoperability matrix at the following Web Site:

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

2. For specific fibre-channel switch setup requirements, read the documentation provided by the switch manufacturer. You can also find more information about switches at the following Web site:

www.ibm.com/servers/storage/san

Determining firmware levels

There are two different methods to determine DS4000 storage subsystem, expansion unit, drive, and ESM firmware versions. Each method uses the DS4000 Storage Manager client that manages the DS4000 storage subsystem with the attached expansion unit.

Method one:

Go to the Subsystem Management window and select **Storage Subsystem → View Profile** (if the DS4000 storage subsystem has controller firmware 06.xx.xx.xx or later) or **View → Storage Subsystem Profile** (if the DS4000 storage subsystem has controller firmware 05.4x.xx.xx or earlier). When the Storage Subsystem Profile window opens, select the **All** tab and scroll through the **Profile For Storage Subsystem** to locate the following information.

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

DS4000 storage subsystem

- NVSRAM version
- Appware version (Appware is a reference to controller firmware.)
- Bootware version (Bootware is a reference to controller firmware.)

See the following example of profile information.

```
Controller in Enclosure 0, Slot A
Status: Online
Current configuration
Firmware version: 06.12.xx.xx
Appware version: 06.12.xx.xx
Bootware version: 06.12.xx.xx
NVSRAM version: 1722F600R910V05
```

Drives

- Firmware version

ESM

- ESM card firmware version

Method two:

Select the appropriate procedure from the following options and complete it to obtain the specified firmware version.

To obtain the controller firmware version:

Right click the Controller icon in the Physical View pane of the Subsystem Management window and select **Properties**. The Controller Enclosure properties window opens and displays the properties for that controller.

You must perform this step for each individual controller.

To obtain the drive firmware version:

Right Click the Drive icon in the Physical View pane of the Subsystem

Management window and select **Properties**. The Drive Properties window opens and displays the properties for that drive.

You must perform this step for each individual drive.

To obtain the ESM firmware version:

1. In the Physical View pane of the Subsystem Management window, click the Drive Enclosure Component icon (which is the icon furthest to the right). The Drive Enclosure Component Information window opens.

2. Click the ESM icon in the left pane. The ESM information displays in the right pane of the Drive Enclosure Component Information window.

3. Locate the firmware version of each ESM in the drive enclosure.

Windows software requirements

Table 8 lists the disk space and administrator privileges that are required to install version 9.1x of the storage management software in a Windows environment.

Note: The disk space listed in Table 8 is for the packages after the installation. During the installation of each software package, you might need up to 150 MB of free disk space.

Table 8. Installation requirements for Windows by software package

Package	Disk space requirement (Windows 2000/Server 2003)	Administrator privilege (Windows 2000/Server 2003)
SMclient	120 MB (150 MB for host server based on the Intel Architecture 64 bit [Itanium 2] processor technology)	Not required
RDAC	2 MB	Required
SMagent	1 MB 45 MB (75 MB for host server based on the Intel Architecture 64 bit [Itanium 2] processor technology) if SMclient is not installed.	Required
SMutil	2 MB	Required

Windows operating system requirements

Each management station, host computer, or cluster node requires one of the following operating systems.

Important: Check the Storage Manager readme files for the latest supported operating system and host software versions.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Management stations
- Windows 2000 Server with Service Pack 4
- Windows 2000 Professional with Service Pack 4
- Windows 2000 Advanced Server with Service Pack 4

- Windows XP, Professional Edition
- Windows Server 2003, Web Edition with Service Pack 1 (SP1)
- Windows Server 2003, Standard Edition with SP1
- Windows Server 2003, Enterprise Edition with SP1

Host computers
- Windows 2000 Server with Service Pack 4
- Windows 2000 Professional with Service Pack 4
- Windows 2000 Advanced Server with Service Pack 4
- Windows Server 2003, Web Edition with SP1
- Windows Server 2003, Standard Edition with SP1
- Windows Server 2003, Enterprise Edition with SP1

Cluster nodes
- Windows 2000 Advanced Server with Service Pack 4
- Windows 2000 Datacenter
- Windows Server 2003, Enterprise Edition with SP1

Linux software requirements

Table 9 lists the disk space that is required for installing Storage Manager 9.1x in a Linux environment.

Table 9. Installation requirements for Linux by software package

Package	Disk space requirement
Storage Manager 9.1x Client (SMclient)	80 MB on /opt, 2 MB on /tmp
Qlogic SANsurfer	160 MB on /opt
Storage Manager 9.1x RDAC	2 MB
Storage Manager 9.1x Agent (SMagent)	2 MB on /opt
Storage Manager 9.1x Utility (SMutil)	7 MB on /opt
IBM Host Adapter device driver	1 MB
Storage Manager 9.1x run time (SMruntime)	70 MB on /opt, 1 MB on /var
Note: Qlogic SANsurfer replaces FAStT MSJ.	

Linux operating system requirements

Check the Storage Manager readme files for Linux for the latest supported Linux operating systems and kernel versions.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

NetWare software requirements

Storage Manager 9.16 software, which is required to manage DS4000 storage subsystem with controller firmware 6.16.xx.xx, is not available for the NetWare operating system environment.

To manage a DS4000 storage subsystem with controller firmware 6.16.xx.xx that is connected to a NetWare host server, you must install the Windows version of the Storage Manager 9.16 SMclient program in a Microsoft Windows management station, and make an out-of-band management connection to the DS4000 storage subsystem.

Table 10 lists the disk space that is required for the NetWare host environment. During the installation of each software package, you may need up to 130 MB of free disk space.

Table 10. Installation requirements for NetWare by software package

Package	Disk space requirement
LSIMPE.CDM driver	2 MB
Qlogic SANsurfer (see the Notes at the end of the table)	2 MB
IBM HBA device driver	2 MB

Notes:

1. Qlogic SANsurfer replaces FAStT MSJ.

2. Another 160 MB on a separate Microsoft Windows computer is required to install the actual Qlogic SANsurfer program. This program will work with the installed agent in the NetWare server to allow for the IBM DS4000 and FC2, FC2-133 Fibre Channel Host Bus Adapter maintenance and troubleshooting.

NetWare operating system requirements

Each host computer or cluster node requires one of the following operating systems.

Important: Check the Storage Manager readme files for the latest supported operating system and host software versions.

See "Readme files and concepts" on page 1 to find out how to access the most recent readme files on the Web.

Management stations
- Windows 2000 Server with Service Pack 4
- Windows 2000 Professional with Service Pack 4
- Windows 2000 Advanced Server with Service Pack 4
- Windows XP
- Windows Server 2003 with SP1

Host computers (for I/O attachment only)
- Novell NetWare 6.0 with Service Pack 4
- Novell NetWare 6.5 with Service Pack 2

Cluster nodes (for I/O attachment only)
- Novell NetWare 6.0 with Service Pack 4 and NCS 1.6
- Novell NetWare 6.5 with Service Pack 2 and NCS 1.7

LSIMPE driver
- LSIMPE.CDM

Versions of this component appear on the latest IBM fibre channel HBA device driver for NetWare, on Novell NetWare Support Packs and on the Novell web site. Always select the latest version of this component for use. Download this software component from the following Web site:

support.novell.com

Note: In a Novell NetWare environment, you need to manage the DS4000 storage subsystem using the direct (out-of-band) method from a Windows Management station.

Number of supported logical drives

With controller firmware versions 05.40.xx.xx and later, the supported logical drive limits for NetWare 6.0, Linux, Windows 2000, and Windows Server 2003 are as follows:

- NetWare 6.0 with SP3 or later and NetWare 6.5 with SP2 or later, support up to 256 logical drives per storage subsystem (LUNs 0-255) when you use IBM-approved DS4000 adapters and their supported device drivers.
- Linux supports up to 256 logical drives per storage subsystem (LUNs 0 through 255) when you use IBM-approved DS4000 adapters and their supported device drivers.

  Check your Linux kernel documentation for the maximum total number of logical drives supported in the host sever and the maximum number of logical drives that can be mapped from a storage subsystem.
- Windows 2000 supports up to 64 logical drives per storage subsystem (LUNs 0 through 63) when you use IBM-approved DS4000 adapters and their supported device drivers.
- Windows Server 2003 supports a maximum of 255 LUNs (LUNs 0 through 254) when you use IBM-approved DS4000 adapters and their supported device drivers.
- The maximum number of logical drives that a DS4000 storage subsystem supports with firmware version 05.4x.xx.xx depends on the model of the DS4000 storage subsystem. See Table 11.

Table 11. Maximum number of logical drives per storage subsystem

Product name	Model Type	Maximum logical drives	Maximum logical drives per storage unit partition	Maximum FlashCopy logical drives
DS4800	1815	2048 (See notes 3 on page 40 and 4 on page 40)	256 (See notes 5 on page 40 and 6 on page 40)	1024 (See note 2 on page 40)
DS4400	1742	2048 (See notes 3 on page 40 and 4 on page 40)	256 (See notes 5 on page 40 and 6 on page 40)	1024 (See note 2 on page 40)
DS4500				
DS4300	1722	1024 (See notes 1 on page 40 and 4 on page 40)	256 (See notes 5 on page 40 and 6 on page 40)	512 (See note 2 on page 40)
DS4100	1724	1024 (See notes 1 on page 40 and 4 on page 40)	256 (See notes 5 on page 40 and 6 on page 40)	512 (See note 2 on page 40)

The access logical drive is also referred to as the *Universal Xport Device*.

Notes:

1. When you use firmware version 5.xx.xx.xx or later, the firmware reserves one logical drive for use by the system.

2. Each standard logical drive supports a maximum of four FlashCopy logical drives.

3. Using the Enhanced Remote Mirroring premium feature, maximum of 64 Remote Mirror pairs with controller firmware version 06.1x.xx.xx or later, for DS4400, DS4500, and DS4800 ; for DS4300 Turbo and DS4100, a maximum of 32 Remote Mirror pairs is supported.

4. For firmware versions 05.2x.xx.xx and later, the maximum number of logical drives includes the FlashCopy repository logical drives, the VolumeCopy target logical drive and the Remote Mirror logical drives, in addition to the standard data logical drives. If the Remote Mirror Option is enabled, two logical drives are reserved for use by the system.

5. For firmware version level 05.4x.xx.xx and later, the default host type limit is the maximum LUN value allowed in the default partition. If the default host type has the restriction option enabled, the default partition allows only 32 LUNs; otherwise, it allows 256 LUNs.

6. The host-agent management method uses a special logical drive, called an *access logical drive*, to communicate with the controllers on the storage subsystem. The access logical drive uses one of the available LUNs. Therefore, managing storage subsystems with the host-agent software limits you to one fewer LUN than the maximum number supported by the operating system and the host adapter.

Important:

- The FlashCopy drive can not be added or mapped to the same server that has the base logical drive of the FlashCopy logical drive in a Windows 2000, Windows Server 2003, or NetWare environment. You must map the FlashCopy logical drive to another server.

- For firmware version 05.3x.xx.xx and earlier, the maximum number of logical drives that can be mapped to a host server from each storage subsystem is 32.

Chapter 2. Preparing for installation

This chapter provides information to help you plan the installation of the storage management software.

See the appropriate sections of this document to install Storage Manager client and host software for a particular operating system. When you have completed Storage Manager software component installation procedures, perform the procedures in Chapter 8, "Completing storage management installation and configuration," on page 109 and Chapter 9, "Completing storage management tasks for Windows hosts," on page 133.

Planning and preparing for Windows installation

Note: Servers with AMD, AMD64 or Intel EM64T processor architecture do not have Storage Manager 9.1x host software support when their operating systems are written in AMD64 or EM64T native code. If the IA-32 version of the operating system is installed and is running in compatibility mode on the AMD64 or EM64T servers, then you can use the appropriate IA-32 software package. Contact your IBM resellers or representatives for the latest information about Storage Manager 9.1x host software support for AMD64 or EM64T.

Table 12 contains information about where you need to install the Storage Manager software components.

Table 12. Software component installation in a Windows environment

System type	Software installation sequence
Management station	SMclient

Host computer and cluster node	1. IBM FC Host bus adapter driver
	2. Storage Manager 9.16 host software package, which installs the following components:
	  a. SMclient (optional)
	    SMclient is necessary if you intend to manage the storage subsystem from the host computer.
	  b. RDAC (required)
	  c. SMagent (optional)
	    SMagent is installed when you select the Typical Installation option in the Storage Manager installation wizard. It is necessary if you intend to use the host-agent management method.
	  d. SMutil (required)
	    SMutil contains the hot_add, SMdevices, and SMrepassist utilities.
	3. Qlogic SANsurfer

Planning and preparing for Linux installation

Note: Storage Manager 9.16 now supports AMD64 and EM64T Linux RHEL 4 and SLES 9 servers running x86_64 Linux kernels (AMD64 or EM64T native code), in addition to the previously-supported Intel Itanium 64 bit processor architecture (IA64) Linux operating systems. See "IBM DS4000 Storage Manager Version 9.1x software for Linux" on page 14 for details.

Table 13 shows the installation sequence for Storage Manager software components and provides information to help you plan for the installation of the storage management software for Linux.

Table 13. Software component installation sequence in a Linux environment

System type	Software installation sequence
Management station (and any host server in use as a management station)	1. Storage Manager 9.1x runtime (SMruntime) 2. Storage Manager 9.1x Client (SMclient) See "Installing the Storage Manager 9.1x Client (SMclient)" on page 86.

Table 13. Software component installation sequence in a Linux environment (continued)

System type	Software installation sequence
Host computer and cluster node	If you chose the Linux RDAC as the failover multipath, install the following components:
	1. IBM Linux fibre channel host bus adapter ***non-failover*** device driver version of the fibre channel HBA (`QLA2200.o` and `QLA2300.o`).
	2. Storage Manager 9.1x RDAC (required)
	This component provides failover/failback capability. See "RDAC" on page 163.
	3. Storage Manager 9.1x Agent (optional)
	This component is necessary if you intend to use the host-agent (in band) management method. It requires that you first install RDAC (see step 2). IBM recommends direct (out-of-band) management method only in a Linux environment.
	See "Installing Storage Manager 9.1x Agent (SMagent)" on page 88.
	4. Storage Manager 09.1x Utility
	This required component packaged with the SMclient package contains the hot_add, SMdevices, and SMrepassist utilities.
	5. IBM DS4000 MSG (QLogic SANsurfer) and QLRemote Agent (optional, for diagnostics only)
	These components are optional. Completed this step to provide fibre channel host bus adapter diagnostic functions.
	See "Installing Qlogic SANsurfer" on page 96.
	Install the following packages if you chose the IBM Linux Host Bus Adapter failover driver as the multipath (non-RDAC) failover driver:
	1. IBM Linux Host Adapter ***failover*** device driver version of the FC HBA (`QLA2200.o` and `QLA2300.o`).
	These required components enable your computer to communicate with the host adapter and to provide logical drive failover/failback support.
	See "Installing the IBM fibre-channel host bus adapter device driver" on page 96.
	2. Qlogic SANsurfer and QLRemote (required)
	This package is required if you did not install RDAC (step 5). It will configure the LUN failover/failback path information for the Linux FC Host Bus Adapter failover device drivers and also provide diagnostic function. See the readme file that ships with the Qlogic SANsurfer package and the Linux FC HBA failover device driver for information needed to set up the failover/failback path.
	See "Installing Qlogic SANsurfer" on page 96.

Table 13. Software component installation sequence in a Linux environment (continued)

System type	Software installation sequence

Notes:

1. There are three different packages for IBM FAStT MSJ (QLogic SANsurfer); one for each of the following systems:

   - 32 bit (IA32) Linux
   - Intel Itanium 64-bit
   - AMD64 and EM64T

   Be sure to install the correct package for your system.

2. Linux RDAC is provided separately from the Storage Manager 9.1x host software package. There are two Linux RDAC packages, one for each type of kernel:

   - 2.4 kernel (RHEL 3 and SLES 8)
   - 2.6 kernel (RHEL 4 and SLES 9)

   Be sure to install the correct Linux RDAC for your system. Note that neither of these packages can be used for Linux on POWER-based servers. For information about installing RDAC for Linux on POWER systems, see *IBM TotalStorage DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX , Solaris, and Linux on POWER*.

Planning and preparing for NetWare installation

Storage Manager 9.16 software, which is required to manage DS4000 storage subsystem with controller firmware 6.16.xx.xx, is not available for the NetWare operating system environment.

To manage a DS4000 storage subsystem with controller firmware 6.16.xx.xx that is connected to a NetWare host server, you must install the Windows version of the Storage Manager 9.16 SMclient program in a Microsoft Windows management station, and make an out-of-band management connection to the DS4000 storage subsystem.

Table 14 shows the installation sequence for host software components.

Table 14. Software component installation sequence in a Novell NetWare 6.0 environment

System type	Software installation sequence
Management station (Windows management station only)	Storage Manager 9.1x Client (SMclient)
NetWare host computer and cluster node	1. Fibre Channel Host Bus Adapter device driver 2. `LSIMPE.cdm` driver and NetWare native failover device driver

To prepare the NetWare 6.0 or 6.5 operating system environments for host I/O attachment to the DS4000 storage subsystem, you *must* install the software on each host computer in the following order:

1. Fibre Channel Host Bus Adapter device driver
2. LSIMPE.cdm driver and NetWare native failover device driver
3. NetWare Agent component of Qlogic SANsurfer

Preparing a network installation

To begin installing the storage management software, ensure that the network components are set up and operating properly, and that you have all the host and controller information needed for the software to operate correctly.

Overview of network installation tasks

The following procedures provide an overview of the tasks involved in setting up a network installation:

- "Direct-managed systems: Network installation overview"
- "Host-managed systems: Network installation overview"

Direct-managed systems: Network installation overview

The following steps provide an overview of the tasks involved in setting up a network installation of a direct-managed system:

1. Install all hardware components (host computers, storage subsystems, and cables) that you want to connect to the network. You might need to refer to the installation guides for the specific hardware components.

2. Establish a naming convention for the storage subsystems that will be connected to the network. See "Step 1: Naming the storage subsystems" on page 46 for more information.

3. Record the storage subsystem names and management types in Appendix D, "Storage subsystem and controller information record," on page 183. An example of a completed information record is shown in Table 15 on page 47.

   Note: Throughout the remaining steps, you will need to return to Appendix D, "Storage subsystem and controller information record," on page 183 to record information such as hardware Ethernet addresses and IP addresses.

4. Determine the hardware Ethernet address for each controller in storage subsystems connected to the network. See "Step 3: Identifying the hardware Ethernet MAC address for each controller" on page 47 for more information.

5. For a directly-managed system only) If you are using a default controller IP address, go to step 7. Otherwise, obtain the TCP/IP address and host name for each of the controllers in the storage subsystems on the network from the network administrator. See "Step 4: Assigning IP addresses to hosts and controllers" on page 50.

6. Set up the DHCP/BOOTP server to provide network configuration information for a specific controller. If you are using a controller static IP addresses, skip this step.

7. Verify that the TCP/IP software is installed. For more information, see "Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table" on page 55.

8. Set up the host or domain name server (DNS) table. For more information, see "Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table" on page 55.

9. Power on the devices that are connected to the network.

Host-managed systems: Network installation overview

The following steps provide an overview of the tasks involved in setting up a network installation of a host-managed system:

1. Install all hardware components (host computers, storage subsystems, and cables) that you want to connect to the network. You might need to refer to the installation guides for the specific hardware components.

2. Establish a naming convention for the storage subsystems that will be connected to the network. See "Step 1: Naming the storage subsystems" for more information.

3. Record the storage subsystem names and management types in Appendix D, "Storage subsystem and controller information record," on page 183. An example of a completed information record is shown in Table 15 on page 47.

   Note: Throughout the remaining steps, you will need to return to Appendix D, "Storage subsystem and controller information record," on page 183 to record information such as hardware Ethernet addresses and IP addresses.

4. Obtain the IP address and host name of the host computer on which the host-agent software will run from the network administrator. See "Step 4: Assigning IP addresses to hosts and controllers" on page 50.

5. Verify that the TCP/IP software is installed. For more information, see "Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table" on page 55.

6. Power on the devices that are connected to the network.

Step 1: Naming the storage subsystems

As you set up your network, decide on a naming convention for the storage subsystems. When you install the storage management software and start it for the first time, all storage subsystems in the management domain display as `<unnamed>`. Use the Subsystem Management window to rename the individual storage subsystems.

Consider the following factors when you name storage subsystems:

- There is a 30-character limit. All leading and trailing spaces are deleted from the name.
- Use a unique, meaningful naming scheme that is easy to understand and remember.
- Avoid arbitrary names or names that might quickly lose their meaning.
- The software adds the prefix `Storage Subsystem` when displaying storage subsystem names. For example, if you name a storage subsystem *Engineering*, it is displayed as:

  `Storage Subsystem Engineering`

Step 2: Recording the subsystem names

After you decide on a naming scheme, record the storage subsystem names in the blank information record form provided in Appendix D, "Storage subsystem and controller information record," on page 183).

Table 15 on page 47 shows a sample information record for the network shown in Figure 3 on page 22. This network contains storage subsystems that are managed by using both the direct-management and host-agent-management method.

Table 15. Sample information record

Storage subsystem name	Management method	Controllers-Ethernet and IP addresses, and host name		Host-IP address and host name
		Controller A	**Controller B**	
Finance	Direct	Hardware Ethernet address = 00a0b8020420	Hardware Ethernet address = 00a0b80000d8	
		IP address = 192.168.128.101	IP address = 192.168.128.102	
		Host = Denver_a	Host = Denver_b	
Engineering	Host-agent			IP address = 192.168.2.22
				Host = Atlanta

Direct-management method: If you plan to manage your storage subsystem using the direct-management method, go to "Step 3: Identifying the hardware Ethernet MAC address for each controller."

Host-Management method: If you plan to manage your storage subsystem using the host-agent management method, go to "Step 4: Assigning IP addresses to hosts and controllers" on page 50.

Step 3: Identifying the hardware Ethernet MAC address for each controller

To manage your storage subsystem using the direct-management method, you need to identify the hardware Ethernet medium access control (MAC) address for each controller.

Identifying the Ethernet MAC addresses on a DS4800 Storage Subsystem

The machine type, model number, and serial number are located on top of each RAID controller unit. The MAC addresses are located near the Ethernet ports on each RAID controller, as shown in Figure 7 on page 48.

Note: You can access the controllers from the back of the DS4800 chassis.

MAC address label (Controller A)
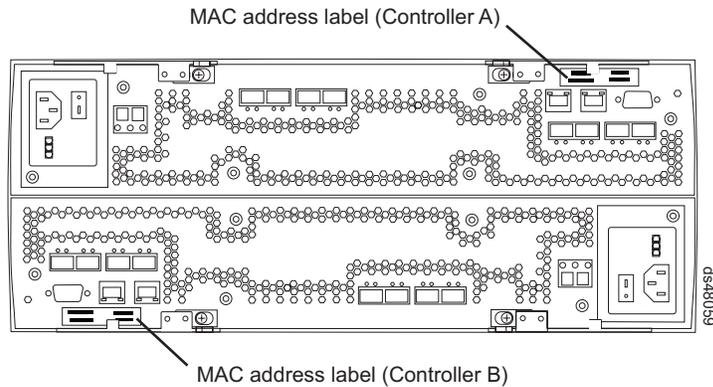
Figure 7. Location of MAC address on DS4800 RAID controllers

Identifying the Ethernet MAC addresses on FAStT500, DS4100, DS4400, and DS4500 Storage Subsystems

To identify the hardware Ethernet MAC address for FAStT500, DS4100, DS4400 and DS4500 storage subsystems, perform the following steps:

1. Remove the front bezel from the storage subsystem, as shown in Figure 8. Carefully pull the bottom of the bezel out **1** to release the pins. Then slide the bezel down **2** .
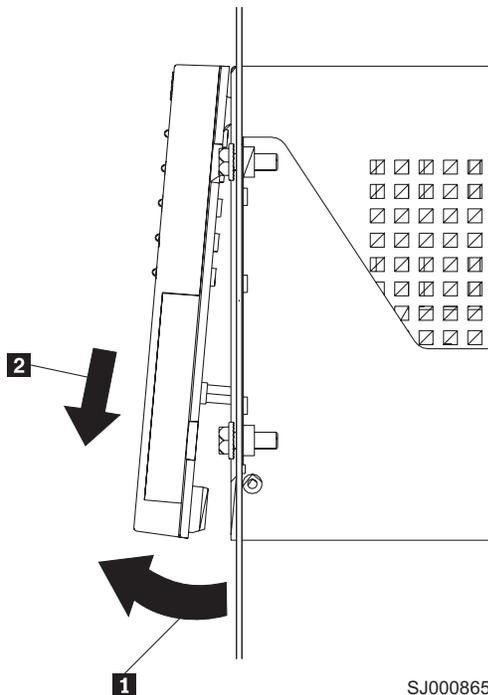
Figure 8. Removing the controller-unit bezel (machine types 3552 [FAStT500] and 1742 [DS4400 and DS4500])

2. On the front of each controller, look for a label with the hardware Ethernet MAC address. The number will be in the form xx.xx.xx.xx.xx.xx (for example, 00.a0.b8.20.00.d8).

3. Record each Ethernet address in the information record (Appendix D, "Storage subsystem and controller information record," on page 183).

4. To replace the bezel, slide the top edge under the lip on the chassis **1** . Then push the bezel bottom until the pins snap into the mounting holes **2** , as shown in Figure 9.

SJ000867
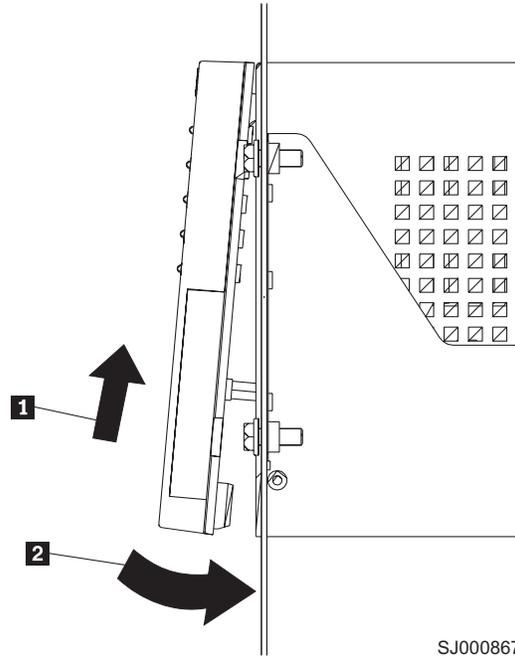
Figure 9. Replacing the controller-unit bezel (machine types 3552 [FAStT500] and 1742 [DS4400 and DS4500])

5. Continue with "Step 4: Assigning IP addresses to hosts and controllers" on page 50.

Identifying the Ethernet MAC addresses on FAStT200 and DS4300

To identify the hardware Ethernet MAC address for machine types 3542 (FAStT200) and 1722 (DS4300), perform the following steps:

1. Locate the Ethernet MAC address at the back of the unit, under the controller fibre-channel host ports, as shown in Figure 10 on page 50. The number will be in the form xx.xx.xx.xx.xx.xx (for example, 00.a0.b8.20.00.d8).

2. Record each Ethernet address in the information record (Appendix D, "Storage subsystem and controller information record," on page 183).

Hardware Ethernet
address label

SJ000866
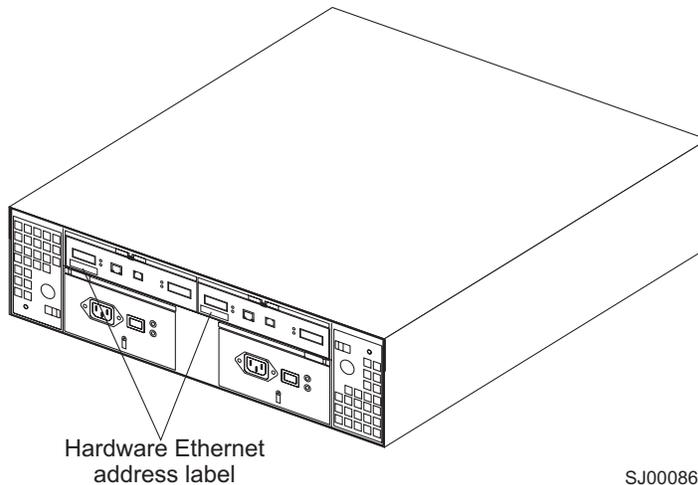
Figure 10. Locating the Ethernet MAC address (machine types 3542 [FAStT200], 1724 [DS4100], and 1722 [DS4300])

Step 4: Assigning IP addresses to hosts and controllers

If you plan to manage your storage subsystem using the out-of-band management (direct-management) method, assign a unique IP address for every controller in all storage subsystems on the network. Record the IP address for each controller in the information record (Appendix D, "Storage subsystem and controller information record," on page 183). Then, go to "Step 5: Setting up the DHCP or BOOTP-compatible server" on page 51.

Note: If you are not able to use the controller default TCP/IP address to assign the static TCP/IP address, refer to the information in "Direct-management (out-of-band) method" on page 19 and Retain Tip #H171389 *Unable to setup networking without DHCP/BOOTP*, which is located at the following IBM support Web site:

www.ibm.com/support

Then go to "Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table" on page 55.

For DS4000 storage controllers with firmware versions 05.4x.xx.xx or later, you can establish the out-of-band management connection to the DS4000 storage subsystem by using the default IP addresses of 192.168.128.101 and 192.168.128.102 for controllers A and B, respectively. You can change the IP addresses by using the **Controller → Change → Network Configuration** menu option in the Storage Manager Client Subsystem Management window.

If you plan to manage your storage subsystem using the host-agent management method, assign an IP address for each host on which you will install the host-agent software. Record the IP address for each host in the information record (Appendix D, "Storage subsystem and controller information record," on page 183). Then, go to "Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table" on page 55.

Step 5: Setting up the DHCP or BOOTP-compatible server

To directly manage storage subsystems through the Ethernet connection to each controller, you will need to set up a DHCP or BOOTP-compatible server and configure the following options:

- Router/Gateway
- DNS Server
- Hostname
- DNS

This section provides instructions to set up a DHCP server on Windows 2000 or Windows Server 2003, as well as instructions to set up a UNIX BOOT server.

Note: The remote management station (RMS) and network management station (NMS) entries used in previous versions of the storage management software are not required for Storage Manager 9.1x

Setting up a Windows 2000 DHCP server

You must use a version of DHCP that supports BOOTP static addressing. To use a DHCP server, you must have a DHCP Manager installed. If a DHCP Manager is installed on the system, go to "Creating a scope and setting up a DHCP server" on page 52.

Installing the DHCP Manager

To install the DHCP Manager, perform the following steps:

1. Click **Start → Administrative Tools → Configure Your Server**. The Configure Your Server window opens.
2. In the left pane, double-click **Networking**. Click **DHCP**.
3. In the right pane, click **Start**. The Windows Components Wizard starts.
4. In the **Components** field, select **Networking Services**. Then click **Details**. The Networking Services window opens.

   Note: Do not select the check box; you do not want to install all of the Networking Services subcomponents.
5. In the **Subcomponents of Networking Services** field, select **Dynamic Host Configuration Protocol (DHCP)**.
6. Click **OK**. The Windows Components Wizard window opens.
7. Click **Next** to start the installation process.
8. If prompted, type the full path to the Windows 2000 distribution files and click **Continue**.
9. When the installation has successfully completed, the Windows Components Wizard window closes and the Configure Your Server Window opens.
10. Click **Next**.
11. Click **Open the DHCP Manager**. The DHCP window opens.
12. Continue with step 2 on page 52 of "Creating a scope and setting up a DHCP server" on page 52.

Note: After you install the DHCP Manager, you can refer to the DHCP Manager online help for additional information.

Creating a scope and setting up a DHCP server

Use the following procedure to create a scope and to set up a DHCP server. A scope defines a group of controllers by their IP addresses. You must create and configure a scope so that dynamic IP addresses can be assigned to controllers on your network. Refer to the information record (Appendix D, "Storage subsystem and controller information record," on page 183). Before you begin, read through the instructions to determine what information is required. Then request the information from your network administrator.

1. Click **Start → Programs → Administrative Tools → DHCP**. The DHCP window opens.

2. In the Console tree, right-click the server you want to configure; click **New Scope**. The New Scope Wizard starts, as shown in Figure 11.

SJ000868

Figure 11. New Scope Wizard: IP Address Range window

3. Follow the on-screen instructions to define the scope of IP addresses for TCP/IP clients. You will define the following fields:
   a. Scope name and description
   b. IP address range for the subnet mask, and the controllers you are configuring
   c. IP addresses that you want to exclude from the IP address range
   d. IP address lease duration
   e. Common DHCP options:
      - IP address for a router
      - Domain name and DNS servers

4. When you have defined the scope, click **Yes, I want to activate this scope now**. The wizard ends, and the DHCP window opens.

5. In the Console tree, open the scope folder.

6. Right-click **Reservations**. Then select **New Reservations**. The New Reservations window opens.

7. To define the IP address reservation, type the following information:
   a. Reservation name
   b. IP address
   c. Ethernet hardware MAC address
   d. Description

8. In the **Supported Type** field, select **Both (DHCP and BOOTP)**.

9. Click **Add**.

10. Repeat steps 5 on page 52 through 9 for each controller in the network.

11. Restart the DHCP server and then restart the storage subsystem so that all modifications are applied.

12. Proceed to "Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table" on page 55.

Setting up a Windows Server 2003 DHCP server

You must use a version of DHCP that supports BOOTP static addressing. To use a DHCP server, you must have a DHCP Manager installed. If a DHCP Manager is already installed on the system, see "Creating a scope and setting up a DHCP server."

Installing the DHCP Manager

To install the DHCP Manager, perform the following steps:

1. Click **Start → Control Panel → Add or Remove Programs**. The Add or Remove Programs window opens.

2. In the left pane, click **Add/Remove Windows Components**. The Windows Components Wizard window opens.

3. In the **Components** field, select **Networking Services**. Then click **Details**. The Networking Services window opens.

   Note: Do not select the check box; you do not want to install all of the Networking Services subcomponents.

4. In the **Subcomponents of Networking Services** field, select **Dynamic Host Configuration Protocol (DHCP)**. Click **OK**. The Networking Services window closes.

5. In the Windows Components Wizard window, click **Next** to start the installation process.

6. If prompted, type the full path to the Windows Server 2003 distribution files and click **Continue**.

7. When the installation has successfully completed, the Windows Components Wizard window opens. Click **Finish** to close the Windows Components Wizard window.

8. Close the Add or Remove Programs window. You are now ready to perform the tasks in "Creating a scope and setting up a DHCP server."

After you install the DHCP Manager, you can refer to the DHCP Manager online help for additional information.

Creating a scope and setting up a DHCP server

Perform the following steps to create a scope and to set up a DHCP server. A scope defines a group of controllers by their IP addresses. You must create and configure a scope so that dynamic IP addresses can be assigned to controllers on

your network. See Appendix D, "Storage subsystem and controller information record," on page 183. Before you begin, read through the instructions to determine what information is required. Then request the information from your network administrator.

1. Click **Start → Administrative Tools → DHCP**. The DHCP window opens.
2. In the Console tree, right-click the server you want to configure, then click **New Scope**. The New Scope Wizard starts.
3. Follow the on-screen instructions to define the scope of IP addresses for TCP/IP clients. You will define the following fields:
   - Scope name and description
   - IP address range for the subnet mask, and the controllers that you are configuring
   - IP addresses that you want to exclude from the IP address range
   - IP address lease duration
   - Common DHCP options:
     – IP address for a router
     – Domain name and DNS servers or Windows Internet Naming Service (WINS) servers
4. When you have defined the scope, click **Yes, I want to activate this scope now**. The New Scope Wizard window opens.
5. Click **Finish**. The New Scope Wizard window closes and the DHCP window opens.
6. In the Console tree, expand the Scope folder.
7. Right-click **Reservations**. Then select **New Reservations**. The New Reservations window opens.
8. To define the IP address reservation, type the following information:
   - Reservation name
   - IP address
   - Ethernet hardware MAC address
   - Description
9. In the **Supported Type** field, select **Both (DHCP and BOOTP)**.
10. Click **Add**.
11. Repeat steps 7 through 10 for each controller in the network.
12. Restart the DHCP server and then restart the storage subsystem so that all the modifications are applied.
13. Proceed to "Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table" on page 55.

Setting up a UNIX BOOTP server

To use a UNIX BOOTP server, you must set up a BOOTP table. Table 16 and the information record (Appendix D, "Storage subsystem and controller information record," on page 183) provide the necessary information.

Table 16. Required entries for setting up the UNIX BOOTP server

Entry	Description	Sample format in BOOTP server
Subnet mask	Mask that is used to route packets to defined subnets	dot notation (sm=255.255.0.0)

Table 16. Required entries for setting up the UNIX BOOTP server (continued)

Entry	Description	Sample format in BOOTP server
Router	IP address of the host computer that routes packets to networks	dot notation (`gw=192.168.128.1`)
Host name for the controller	Host name that is associated with the controller (see Table 27 on page 183)	host name (`Denver_a`)
IP address	IP address of the controller (see Table 27 on page 183)	dot notation (`ip=192.168.128.101`)
Ethernet address	The Ethernet address of the controller hardware (see Table 27 on page 183)	hexadecimal notation (`ha=00a0b8020420`)

Perform the following steps to set up a UNIX BOOTP server:

1. Use a text editor to edit the bootptab file in the `/etc` directory.

   Use the following example of the BOOTP table to configure the Network A server shown in Figure 3 on page 22 where the `s4.default:\` entry denotes settings that are common to all controllers, and the `tc=s4.default:\` entry associates this common setting group to a specific controller.

```
s4.default:\ (common settings)
ht=ether:\
sm=255.255.255.0:\
gw=192.168.128.1:\
hn:
denver_a:\
tc=s4.default:\ (common settings)
ip=192.168.128.101:\
ha=00a0b8020420:
denver_b:\
tc=s4.default:\
ip=192.168.128.102:\
ha=00a0b80000d8:
```

2. If the storage subsystem is running, shut down and then restart the subsystem. This ensures that the parameters in the BOOTP table take effect.

3. Continue with "Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table."

Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table

Install the TCP/IP networking stack to enable SMclient functions. Perform the following two tasks by using the procedure that follows them:

- Verify that the TCP/IP protocol software is installed on the management station or the host server on which you will install and from which will run SMclient.
- Set up the host or DNS table.

Note: Make sure that the host names for the controllers match the IP addresses for the controllers.

Windows 2000

Perform the following steps for Windows 2000:

Important: To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data after you complete these steps.

1. Right-click **My Network Places**.
2. Select **Properties**. The Network and Dial-up Connections window opens.
3. Right-click a defined network connection.
4. Select **Properties**. Make sure that the Internet Protocol TCP/IP box under the Components checked that are used by this connection is marked. If not, mark it, click **Install**, and follow the instructions that display.
5. Update the DNS table to specify a host name to associate with an IP address.

   If you do not have a DNS server, use a text editor to update the hosts file to link the IP address and controller name entries. The following example shows the host tables for the controllers that are connected to Network A as shown in Figure 3 on page 22:

```
# Copyright (c) 1993-1999 Microsoft Corp.

# This is a sample HOSTS file used by Microsoft TCP/IP for Windows.

# This file contains the mappings of IP addresses to host names. Each
# entry should be kept on an individual line. The IP address should be placed
# in the first column followed by the corresponding host name. The IP address
# and the host name should be separated by at least one space.

# Additionally, comments (such as these) might be inserted on individual

# lines or following the machine name denoted by a'#' symbol.

# For example:

# 102.54.94.97    rhino.acme.com    # source server

# 38.25.63.10    x.acme.com       # x client host

127.0.0.1      local host

192.168.128.101    denver_a

192.168.128.102    denver_b
```

Windows Server 2003

Perform the following steps for Windows Server 2003:

Important: To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data after you complete these steps.

1. Open the Windows Explorer window.
2. Right-click the My Network Places folder and select **Properties** from the pull-down menu. The Network Connections window opens.
3. Right-click a defined network connection and select **Properties** from the pull-down menu.
4. A network_name Properties window opens. Make sure that the Internet Protocol TCP/IP box under "The Connection Uses The Following Items" window pane is selected. If not, select it and click **OK** to close the network_name Properties window.
5. Update the DNS table to specify a host name to associate with an IP address. If you do not have a DNS server, use a text editor to update the hosts file to link the IP address and controller name entries. The following example shows the host tables for the controllers that are connected to Network A, as shown in Figure 3 on page 22.

```
# Copyright (c) 1993-1999 Microsoft Corp.

# This is a sample HOSTS file used by Microsoft TCP/IP for Windows.

# This file contains the mappings of IP addresses to host names. Each
# entry should be kept on an individual line. The IP address should
# be placed in the first column followed by the corresponding host name.
# The IP address and the host name should be separated by at least one
# space.

# Additionally, comments (such as these) may be inserted on individual

# lines or following the machine name denoted by a '#' symbol.

# For example:

#      102.54.94.97      rhino.acme.com          # source server

#       38.25.63.10      x.acme.com              # x client host

127.0.0.1       localhost

192.168.128.101 denver_a

192.168.128.102 denver_b
```

Step 6 (Linux): Verifying the TCP/IP protocol and setting up the host or DNS table

The normal default installation process will install the TCP/IP software package.

Perform the following step to set up the host or DNS table. Make sure that the host names for the controller match the IP addresses for the controllers.

Important: To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data after you complete this step.

1. Update either the host table or the DNS table to specify a host name to associate with an IP address. If you do not have a DNS table, edit the host table that is found in the /etc/hosts directory. Your directory might be different if the operating system is not installed on the root.

The following sample shows a Linux host file. Do not remove the following line, or various programs that require network functionality will fail.

```
127.0.0.1 rh71_8500 localhost.localdomain
localhost 102.54.94.97 rhino.acme.com x.acme.com
```

Chapter 3. Installing Storage Manager software in a standard Windows configuration

This chapter describes how to install the storage management software for Windows 2000, and Windows Server 2003 in a standard (noncluster) configuration. Before you install the software, make sure that you have read the following information:

- If you intend to configure your system for clustering, see Chapter 4, "Installing Storage Manager software in a Windows cluster server environment," on page 67.
- If you have existing storage systems, see "Installation types" on page 27 and "Managing coexisting storage subsystems" on page 32.
- To ensure proper installation, make sure that you have completed all preparation tasks described in Chapter 2, "Preparing for installation," on page 41.

Important:

1. Always check for a readme file on any installation media. The readme file contains important information that was not available when the guide was prepared.

   See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

2. This version of the storage management software does not support 64-bit versions of Windows XP. All administrator functions using the storage management software must be performed from a 32-bit storage management station.

3. Configure the Event Monitor on only one storage management station to prevent receipt of duplicate event messages. Note that duplicate alerts are also sent if the Enterprise Management Window and the SMmonitor are running simultaneously.

4. Do not reboot during the installation process. You will reboot after installing all storage management software components.

New installation process

You can install the Storage Manager 9.16 software components on host computers (only) or on both host computers and management stations.

Important:

1. If you are upgrading from version 9.10 or earlier of DS4000 Storage Manager software, you must remove the current software before installing the DS4000 Storage Manager Version 9.16 software.

2. Windows servers with AMD AMD64 or Intel EM64T processor architecture have no Storage Manager 9.1x host software support when their operating system are written in AMD64 or EM64T native code. If the IA-32 version of the operating system is installed and is running in compatibility mode on the AMD64 or EM64T servers, then you can use the appropriate IA-32 software package. Contact your IBM resellers or representatives for the latest information about Storage Manager 9.1x host software support for AMD64 or EM64T.

Management station: A management station is a system that you use to manage the storage subsystem. You can attach it to the storage subsystem in the following ways:

- Through a TCP/IP Ethernet connection to the controllers in the storage subsystem
- Through a TCP/IP network connection to a host computer with host-agent software installed on it, which in turn is directly attached to the storage subsystem through the fibre-channel input/output (I/O) path

You **must** install the Storage Manager 9.1x SMclient software on a management station.

Host computer: A host computer (or host) is a system that is directly attached to the storage subsystem through a fibre-channel I/O path.

Important: Be sure you install the host-bus adapter and driver before you install the storage management software.

You **must** install storage management software on each host computer in the following order:

1. SMclient (SMclient is needed only if you want to manage the DS4000 storage subsystem through this host server.)
2. RDAC
3. SMagent
4. SMutil

To begin the installation on your management station, see "Installing Storage Manager 9.15 Client" on page 61.

To begin installation on a host, see "Installing the IBM fibre-channel host bus adapter device driver."

Installing the IBM fibre-channel host bus adapter device driver

An IBM fibre-channel host bus adapter (HBA) provides the interface between a host server and an DS4000 storage subsystem. IBM DS4000 fibre-channel HBAs are high-performance, direct memory access, bus-master, host adapters that are designed for high-end systems. These HBAs support all fibre-channel peripheral devices that support private-loop direct-attach and fabric-loop attachment. The IBM Host Adapter device driver enables your operating system to communicate with the fibre-channel HBA.

See the readme file included in the driver package for installation instructions associated with your operating system. See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web. Additional information is also available in Appendix E, "Host bus adapter settings," on page 185.

Note: Read the device driver readme for any required modifications to the default HBA BIOS and host operating system registry settings to ensure optimal performance. If you make any changes to the HBA BIOS settings, the machine will reboot automatically.

For more information, see the Installation and User's Guide for your particular fibre-channel HBA model.

Installing Storage Manager 9.15 Client

This section describes how to install different components of Storage Manager 9.15 host software on management stations and host computers that run Windows operating systems. The installation is applicable for Storage Manager 9.15 (or 9.12) host software only. If you are installing Storage Manager 9.10, refer to Appendix B, "Installing Storage Manager 9.10 Client," on page 161.

Before you install the software, make sure that the management station or host computer has at least 260 MB (320 MB for Windows Server 2003 IA-64 [Itanium 2] environment) of available disk space for the installation software package, the temporary files during installation, and the final files after the installation. The final installation directory size will be 100 MB, if you install all software packages in Windows 2000 or Windows Server 2003 32 bit environment. In Windows Server 2003 IA-64 (Itanium 2) environment, the final installation directory size will be 130 MB.

Important: When you install SMclient on a stand-alone host and manage storage subsystems through the fibre-channel I/O path rather than through the network, you must install the TCP/IP software on the host and assign an IP address to the host.

Starting with the DS4000 Storage Manager host software version 9.12, all four components - SMclient, RDAC, SMagent and SMutil - of the host software are packaged in a single host software package installer. Depending on the user's needs, up to four packages can be installed using this host software package installation program.

Notes:

1. If the operating system of the computer that you want to install this software is of management support list only (like Windows XP and Windows 2000 Professional), the only host software component that is available for installation is the SMclient program.
2. Windows 2000 Professional and Windows XP support the DS4000 Storage Manager Client package *only*. Do not install any other storage management software packages on Windows 2000 Professional or XP. RDAC is *not* supported on these Windows operating systems.

Perform the following steps to install the DS4000 Storage Manager host software packages in either a server or management station.

Important: These installation instructions are not for servers with SAN-boot or Remote-boot disk.

1. Before installing this software, close all other programs.
2. Insert the IBM DS4000 Storage Manager Version 9.15 support for Microsoft Windows OS's CD into the CD-ROM drive.

    Note: If you downloaded the Storage Manager version 9.15 host software package for Windows from the DS4000 support web site, you must unzip the downloaded `.zip` file to unpack the content of the Storage Manager 9.15 host software web package for Windows into your specified directory. Go to this directory and select the `Windows` directory to get access to the Windows host software package install program. Go to step 6 on page 62.

3. From the Windows desktop, double-click the **My Computer** icon. The **My Computer** window is displayed.
4. Double-click the CD-ROM drive that has your DS4000 Storage Manager Version 9.15 CD. The CD window is displayed.
5. Select the appropriate directory in the CD for your operating system architecture (IA-32-bit or IA-64-bit).

Directory	Operating System
Win32	Windows 2000 Server, Advanced Server and DataCenter
WS03_32bit	Windows Server 2003 32bit Server, Enterprise Edition and DataCenter
WS03_64bit	Windows Server 2003 IA-64 (Itanium Architecture only) Server, Enterprise Edition and DataCenter

6. To launch the host software package installer, double-click the `.exe` file, such as `SMIA-WS....exe`.

   The DS4000 Storage Manager Installation wizard dialog is displayed while the software is loading. When the software is loaded, the **Introduction** window is displayed.
7. Click **Next**.

   The **Copyright Statement** window is displayed.
8. Click **Next**.

   The **License Agreement** window is displayed.
9. Select the option that accepts the terms of the License Agreement.
10. Click **Next**.

    The **Choose Install Folder** window is displayed, identifying the default install directory. The default directory is `Windows_boot_drive_letter:\Program Files\IBM_DS4000`. You could change this value to another directory; but it is recommended to keep the specified default installation directory.
11. Click **Next**.

    The **Select Installation Type** window is displayed.
12. Based on the type of installation you are performing, select one of the following actions. Note that the following steps are written for a typical (full installation).

    - **Typical (Full Installation)** - This selection, which is the default, installs all of the packages on the system. This is a safe choice if you do not know which installation type to select. This option will install all four host software components - SMClient, RDAC, SMAgent and SMUtil.
    - **Management Station** - This selection installs the software needed to configure, manage, and monitor a storage array. This option is for your workstation or management PC. This option will install SMClient program only.
    - **Host** - This selection installs the storage array server software. Use this type of installation for the host (server) connected to the storage array (Windows 2000 and Windows Server 2003 only). This option will install all host software components with the exception of SMClient program.
    - **Custom** - This selection enables you to customize the features to be installed. The SMAgent package can not be selected without the selecting RDAC package.

The selected installation type is highlighted in blue text.

13. Click **Next**.

    If there are previously installed Storage Manager software packages, the **Overwrite Warning** dialog is displayed.

14. If the **Overwrite Warning** dialog is displayed, click **OK**.

    The **Automatically Start Monitor?** window is displayed. This refers to the Event Monitor service, which monitors the specified DS4000 storage subsystems and forward any critical alerts from those subsystems when the SMclient program is not running.

15. In the **Automatically Start Monitor?** window, select the appropriate option for your system.

    Notes:

    a. To enable automatic ESM firmware synchronization, you must enable the Event Monitor. Select **Automatically Start Monitor**. (See "Automatic ESM firmware synchronization" on page 120 for more information.)

    b. If you start the Event Monitor service on multiple machines, you might receive duplicate error messages from the same storage array. To avoid receiving duplicate error messages, start the monitor on only one machine. It is recommended that you run the monitor on one machine that will run continually.

16. Click **Next**.

    The **Pre-Installation Summary** window is displayed.

17. Click **Install**.

    The **Installing** window is displayed while the software is loading. The **Installation/Remove** status window is also displayed throughout the installation process.

    The **Security Alert** dialog might be displayed multiple times.

18. Did the **Security Alert** dialog display?

    • **Yes** - Click **Yes**.

    • **No** - Go to step 19 on page 64. When the software is loaded, the **Install Complete** window is displayed.

    Important:

    a. If RDAC is not installed in the computer, the **Install Complete** window displays an error message stating that the installation is finished and that there are some warnings. The message suggests looking at the installation log for details. The installation log contains a warning that a Win32 exception can be found. This is normal and expected behavior. The installation was successful

    b. If you cancel an installation before the installation completes its run (while the progress bar is still visible), the installation might not clean up the aborted installation properly, and the host-software installation wizard creates an install log. In addition, the **Add/Remove Program** window might show that the program is already installed. However, when you try to un-install it, you will get an un-installation error and whether you want to remove the entry from the **Add/Remove** program list. Click **Yes** to remove the entry. Then, you must delete the `.xml` file in the `Windows_boot_drive_letter:\Program Files\Zero G Registry` directory. If you did not delete the `.xml` file, when you try to run the DS4000 Storage Manager Installation wizard again, it will state that an existing version of the program is already installed and whether you want to updated it.

However, when you click **OK** and proceed through the installation process, the files will be installed in this directory

```
Documents and Settings\user_login_ID\LocalSettings\
Temp\UniqueDirectoryName\Windows\NULL
```

which does not exist. In the above directory name, the **user_login_ID** and **UniqueDirectoryName** fields will be different for different installations. The `Windows_boot_drive_letter:\Program Files\Zero G Registry` directory might be hidden from the normal Windows Explorer view. If this is the case, change the settings of the Windows Explorer to **Show hidden files and folders**.

If you cancel the installation *before* the progress bar is visible, the installation wizard will clean up the abort process properly. You do not need to do anything before starting the wizard again.

19. Verify that the **Yes, restart my system** option is selected.

20. Click **Done**.

    Several files and program packages are installed to the directory that you specified in step 10 on page 62. The default directory is `Windows_boot_drive_letter:\Program Files\IBM_DS4000`.

    The installation is completed, and Windows is restarted.

    Important: If you repeatedly cancel an installation or uninstallation before the process completes its run and try to install again, the installation process might not work, and the software might not be installed after the installation process is completed. The installation complete panel tells you where the software is installed, but it is not there. If this problem occurs, delete the `.xml` file from the `Windows_boot_drive_letter:\Program Files\Zero G` directory.

21. To verify that the software packages were installed, go to "Verifying the Installation" on page 65.

Verifying the Installation

Use this procedure to verify that the host-software package installer ran successfully.

1. Select **Start** → **Settings** → **Control Panel**.

   The Control Panel window opens. Select **Add/Remove programs**. The Add/Remove Programs Properties window opens.

2. Look for the IBM DS4000/FAStT Storage Manager Host Software entry.

3. Was the installation successful (no failure reported)?

   - **Yes** - Go to Chapter 8, "Completing storage management installation and configuration," on page 109.

   - **No** - Repeat the steps in "Installing Storage Manager 9.15 Client" on page 61. If the failure persists, contact IBM Technical Support.

If you installed other host-software packages besides the SMclient software package, you may use this procedure to verify that the packages were installed successfully:

WARNING: If you use Registry Editor incorrectly, you may cause serious problems that may require you to reinstall your operating system. IBM cannot guarantee that you can solve problems that result from using Registry Editor incorrectly. **Use Registry Editor at your own risk.**

1. Open the **Command Prompt** window and type in `regedt32`.

2. Go to the registry key `\HKEY_LOCAL_MACHINE\SOFTWARE\Storage`.

3. For each package that you installed, there would be a folder under the `\HKEY_LOCAL_MACHINE\SOFTWARE\Storage` key. Click on that folder name and look for the Version data field in the right window pane. The Version data field will have the correct version of the host software package that you installed. Record these versions for future reference. For example, Figure 12 on page 66 shows that all four host-software packages were installed in this server and the version of the SMUtil package is 09.12.35.00.
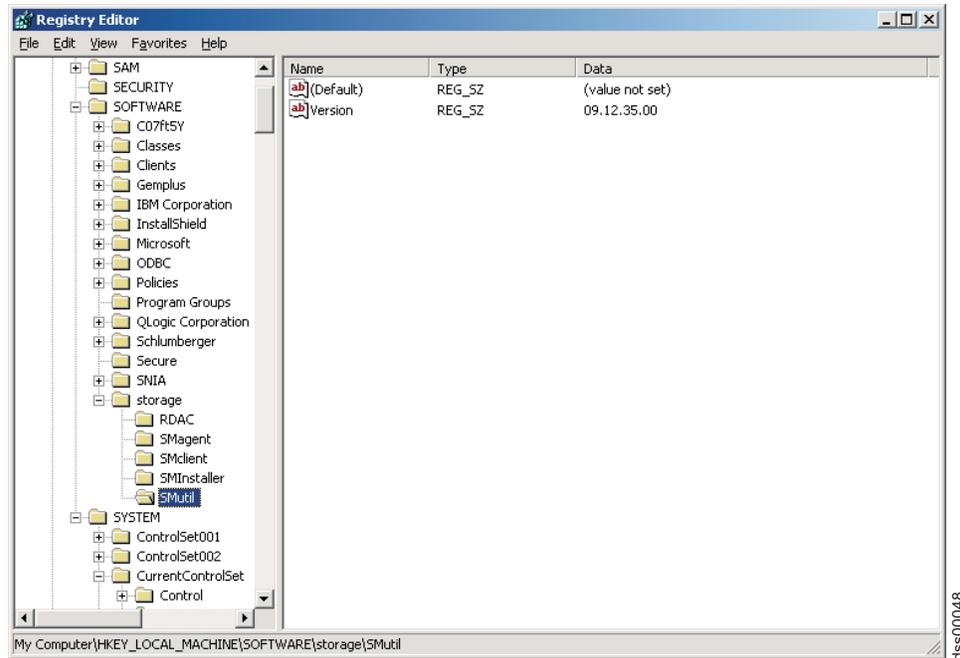
Figure 12. Registry Editor window

Configuring storage management

After you install Storage Manager, complete the tasks that are described in Chapter 8, "Completing storage management installation and configuration," on page 109. These tasks include the following:

- Performing an initial automatic discovery of storage subsystems
- Adding devices
- Naming storage subsystems
- Creating arrays and logical drives
- Downloading controller firmware and NVSRAM
- Verifying and defining the default host type
- Setting up alert notifications

Additional information

For additional information about installing and using Storage Manager 9.1x for Windows 2000 and Windows Server 2003 in a standard (noncluster) configuration, see "Windows operating system limitations" on page 169.

For additional information about uninstalling Storage Manager components in Windows, see "Uninstalling storage management software components" on page 138.

Chapter 4. Installing Storage Manager software in a Windows cluster server environment

This chapter describes how to install the storage management software in a Windows cluster server environment. Before you install the software, make sure that you have read the following information:

- If you have existing storage systems, read "Installation types" on page 27 and "Managing coexisting storage subsystems" on page 32.
- If you are upgrading from a previous version of Storage Manager on an existing cluster, go to "Upgrading from a previous version of the storage management software" on page 73.
- To ensure proper installation, complete all preparation tasks described in Chapter 2, "Preparing for installation," on page 41.
- Review Table 24 on page 170 for related information.

Important: Always check the Storage Manager readme file for your operating system before installing the software. A readme file contains important information that was not available when this guide was prepared. See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Preinstallation considerations

The hardware installation involves installing host adapters and storage subsystems. Before you begin the installation of the DS4000 Storage Manager software, make sure that all hardware components are installed correctly for the cluster server configuration.

Configuration options

You can connect the storage subsystem to the cluster nodes either directly or through fibre-channel switches. Figure 13 on page 68 shows typical direct-attached or fibre-channel switch connection configurations. Both configurations offer full redundancy.

Interlink

Node A

Host adapters

Node B

Host adapters

**Fibre Channel
connection
(direct)**

Mini hub
1

Mini hub
2

Storage subsystem

Storage
subsystem
controllers

Interlink

Node A

Host adapters

Node B

Host adapters

**Fibre Channel
connection
(Fibre Channel switch)**

Switch

Switch

Mini hub
1

Mini hub
2

Storage subsystem

Storage
subsystem
controllers

SJ000871
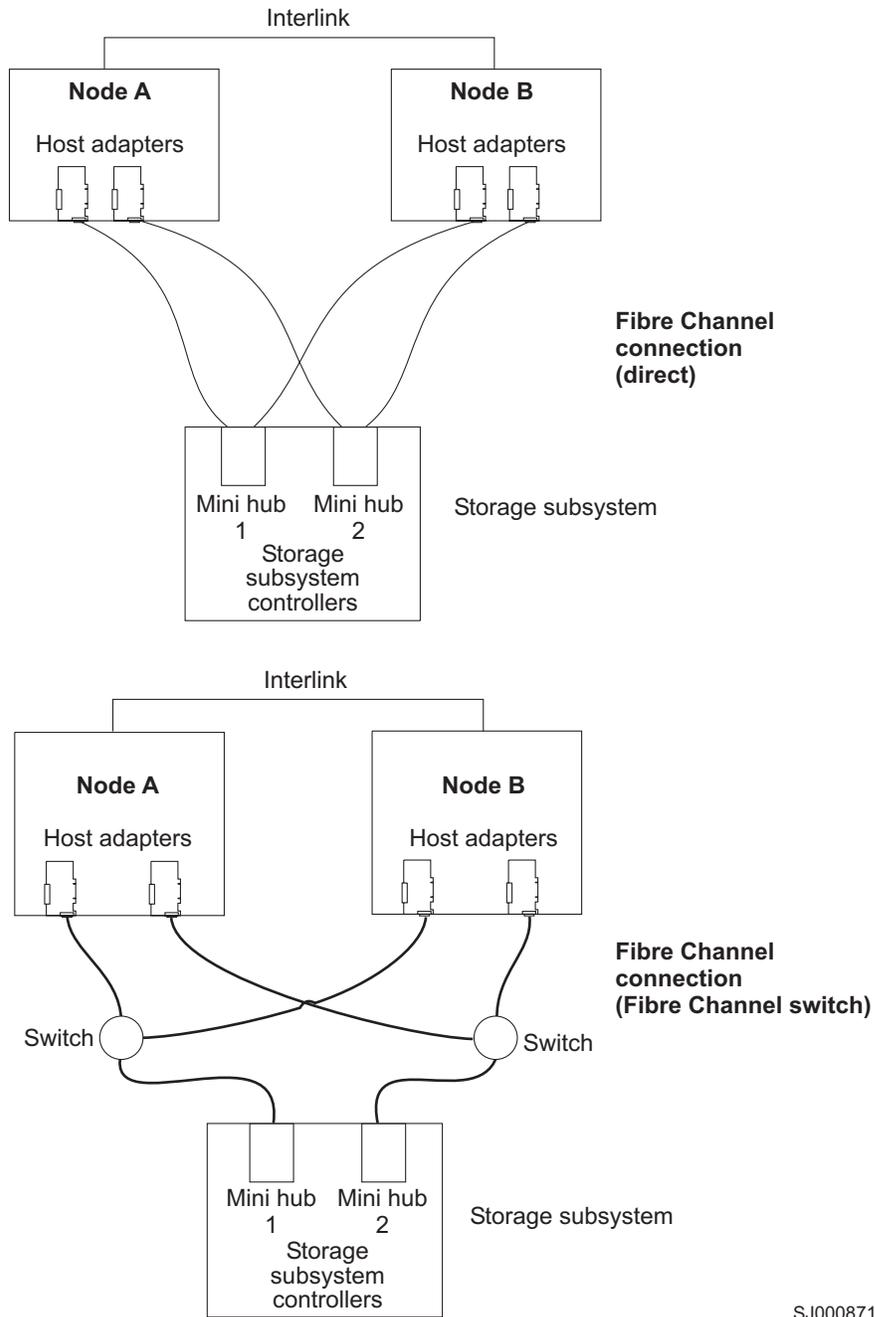
Figure 13. Installing the storage subsystem on a fibre-channel network

Host adapters

Refer to the appropriate host-adapter documentation for specific installation
requirements and procedures. The following considerations apply:

- To use the dual-path configuration, perform the following tasks:
    – Install two host adapters in each node.
    – Run two fibre-channel cables from each node to the storage subsystem.

- If you connect the storage subsystem through a Fibre Channel-Arbitrated Loop (FC-AL), ensure that every adapter on the loop is assigned a unique hard ID. For instructions about changing hard IDs, see the documentation provided with your host adapters.
- The correct device driver is installed for the host adapter. See the readme file in the \Host_Adapter directory on the IBM DS4000 Storage Manager CD for information about supported host adapters and device drivers.

Storage subsystems

Refer to the appropriate hardware documentation for specific installation requirements and procedures. If you are managing storage subsystems directly, you must connect Ethernet cables to both controllers in each storage subsystem.

Installing the storage management software in a cluster environment

The following procedures describe how to install the storage management software in a cluster environment.

Windows 2000

Perform the following steps to install the storage management and cluster service software on Windows 2000:

1. Be sure that the HBA and device driver are installed in each cluster node. For information about HBA and device driver installation, see "Installing the IBM fibre-channel host bus adapter device driver" on page 71.
2. Power down node B. Start node A.
3. Install the storage management software on node A. See "Installing the storage management software" on page 71 for instructions.
4. Complete the procedures in Chapter 8, "Completing storage management installation and configuration," on page 109.
5. Run the hot_add utility on node A. See "Using the hot_add utility" on page 136 for instructions.

   Note: You might have to restart node A in order to see the newly-added logical drives.
6. Format all shared logical drives as NT File System (NTFS), assign volume labels, and specify a drive letter for each.
   Important: You must assign a permanent (sticky) drive letter to the shared logical drive on both cluster nodes. The two nodes must have the same drive letters on each shared drive. If you do not assign permanent drive letters, Windows might assign different drive letters on each node. Assigning a permanent drive letter ensures that Windows assigns the same drive letter to the partition on both cluster nodes.
7. Shut down node A. Start node B.
8. Install the storage management software on node B. See "Installing the storage management software" on page 71 for instructions.
9. To verify the drive letters for the cluster configuration, perform one of the following procedures:
   - For Windows 2000, perform the following steps:
     a. Click **Start → Programs → Administrative Tools → Computer Management**. The Computer Management window opens.
     b. Click **Storage → Disk Management**.

10. Verify that the following conditions are met:

    - The same logical drives display on each cluster node.
    - Each cluster node has the same number of partitions defined on the logical drives.
    - Drive letters are assigned to the configured logical drives.
    - The drive letters on the partitions are the same on both cluster nodes.

11. Shut down node B.

12. Install the cluster server software. See "Installing the cluster server software" on page 71 for instructions.

13. Go to Chapter 8, "Completing storage management installation and configuration," on page 109.

Windows Server 2003

Perform the following steps to install the storage management and cluster service software on Windows Server 2003:

1. Make sure that the HBA and device driver are installed in each cluster node. For information about HBA and device driver installation, see "Installing the IBM fibre-channel host bus adapter device driver" on page 71.

2. Install the storage management software on the host server that will be the first node of the cluster. See "Installing the storage management software" on page 71 for instructions.

3. Complete the procedures in Chapter 8, "Completing storage management installation and configuration," on page 109, specifically to create LUNs that will be used as cluster disks and to make sure that the host type of the host group or host ports that these LUNs are mapped to were set to "Windows 2000/Server 2003..clustered" or "Windows 2000 clustered".

4. Run the hot_add utility on the first node of the cluster. See "Using the hot_add utility" on page 136 for instructions.

   Note: You might have to restart the first node of the cluster in order to see the newly-added logical drives (LUNs).

5. Format all shared logical drives as NT File System (NTFS), assign volume labels, and specify a drive letter for each.

   Important: You must make sure that the permanent (sticky) drive letters that are assigned to LUNs in the first cluster node are available (not used) in the rest of the cluster nodes. In another words, all of the nodes in the cluster must have the same drive letters on each shared drive. If you do not assign permanent drive letters, Windows might assign different drive letters on each node, which will prevent the cluster disks from operating correctly. Assigning a permanent drive letter ensures that Windows assigns the same drive letter to the partition on all cluster nodes.

6. Install the storage management software on the second node of the cluster.

   Note: You must install the RDAC and SMutil software packages. You do not have to install all of the storage management software packages unless you want to manage the storage subsystem from this cluster node.

7. Run the hot_add utility on the second node of the cluster.

8. Repeat step 6 and step 7 for each additional node of the cluster.

9. Install the cluster server software. See "Installing the cluster server software" on page 71 for instructions.

10. Manually move the cluster disk groups from the first cluster node to each of the nodes in the cluster, making sure that they can be brought online. If they can be brought online with no problems, you are ready to continue with your application software installation. If you experience any problems, call IBM support for assistance.

Installing the IBM fibre-channel host bus adapter device driver

An IBM fibre-channel host bus adapter (HBA) provides the interface between a host server and a DS4000 storage subsystem. IBM DS4000 fibre-channel HBAs are high-performance, direct memory access, bus-master, host adapters that are designed for high-end systems. These HBAs support all fibre-channel peripheral devices that support private-loop direct-attach and fabric-loop attachment. The IBM Host Adapter device driver enables your operating system to communicate with the fibre-channel HBA.

See the readme file included in the driver package for installation instructions associated with your operating system. Additional information can also be found in Appendix E, "Host bus adapter settings," on page 185.

Note: Read the device driver readme for any required modifications to the default HBA BIOS and host operating system registry settings to ensure optimal performance. If you make any changes to the HBA BIOS settings, the machine will reboot automatically.

For more information, see the Installation and User's Guide for your particular fibre-channel HBA model. The current readme file and latest multipath I/O device driver are available at the following Web site:

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

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Installing the storage management software

This section describes how to install the storage management software on Windows operating systems. Before you install Storage Manager on an existing storage subsystem, see your hardware's documentation for any specific configuration instructions. A specific configuration might be required for your hardware to support the storage management software in a cluster configuration. If you are installing Storage Manager 9.16, refer to "Installing Storage Manager 9.15 Client" on page 61, then go to "Installing the storage management software in a cluster environment" on page 69.

If you are installing Storage Manager 9.10, refer to Appendix B, "Installing Storage Manager 9.10 Client," on page 161.

Installing the cluster server software

The following sections describe how to install the cluster server software on Windows operating systems.

Windows 2000

Important: Do not perform this procedure unless you installed the necessary storage management software components on both cluster nodes.

To install the cluster server software on node A and node B, perform the following steps:

1. Install the cluster server software on node A, as follows:

   a. Refer to the appropriate Microsoft Cluster Server (MSCS) documentation for the correct procedure to install the cluster server software.

      Note: During installation, specify that you want to form a new cluster.

   b. After the system restarts, leave node A running.

2. Install the cluster server software on node B, as follows:

   a. Refer to the appropriate MSCS documentation for the correct procedure to install the Cluster Server software.

      Note: During installation, specify that you want to join the existing cluster.

   b. After the system restarts, leave node B running.

3. After you install MSCS, perform one of the following tasks:

   • For systems running Windows 2000, reinstall Service Pack 4.

   Note: Refer to Microsoft Knowledge Base article Q174799 for more information regarding service pack installation in a cluster environment.

4. Verify the software installation as follows:

   a. On either node A or node B, click **Start → Programs → Administrative Tools → Cluster Administration**.

   b. In the **Cluster** or **Server Name** field, type either the name of the cluster or the name or IP address of one of the nodes.

      If the installation is successful, the computer names of both nodes appear on the left side of the Cluster Administrator window.

   c. Make sure that the cluster disk groups can be moved between cluster nodes.

5. If both node names do not display on the left side of the Cluster Administrator window, reinstall the cluster server software. If the problem persists, contact your IBM technical support representative.

Windows Server 2003

Important: Do not perform this procedure unless the necessary storage management software components are installed on all cluster nodes.

Perform the following steps to install the cluster server software on cluster nodes:

1. Install the cluster server software on the first node of the cluster. Refer to the appropriate Microsoft Cluster Server (MSCS) documentation for the correct procedure to install the cluster server software.

   Note: During installation, specify that you want to form a new cluster.

2. In the Cluster Administrator window, make sure that all of the cluster disk groups can be varied online and offline with no problems.

3. Install the cluster server software on the second node of the cluster. Refer to the appropriate MSCS documentation for the correct procedure to install additional nodes in the cluster server. (For systems running Windows Server 2003, reinstall Service Pack 1.)

    Note: During installation, specify that you want to join the existing cluster. You can add one cluster node at a time or all of the remaining cluster nodes at the same time. You should add cluster nodes one at a time.

4. If all node names do not display on the left side of the Cluster Administrator window, reinstall the cluster server software. If the problem persists, contact your IBM technical support representative.

Upgrading from a previous version of the storage management software

Be sure that you are familiar with the steps required in a new installation before you continue with the following upgrade procedure.

Choose one of the following two procedures:

- **Performing a scheduled upgrade:** A scheduled upgrade requires scheduling downtime on your cluster server to upgrade the controller firmware and storage management software. The services and resources offered by the cluster are not available during the upgrade. If you choose this upgrade method, it is important that you perform the upgrade during off-peak workload time.

  Note: The scheduled upgrade is the preferred procedure for upgrading a cluster server configuration.

- **Performing a rolling upgrade:** A rolling upgrade requires upgrading the storage management software first in one of the cluster nodes and then in each of the remaining cluster nodes, one cluster node a time, so that the services and resources offered by the cluster are always available.

Important: Do not upgrade your storage subsystem firmware until you have upgraded the storage management software on all cluster nodes and management stations. If you upgrade your storage subsystem controller firmware level to version 06.1x.xx.xx, you will not be able to communicate with the controller until you have upgraded to Storage Manager 9.1x software on your management station and cluster nodes. Previously installed versions of Storage Manager will not recognize controllers running version 06.1x.xx.xx firmware.

Performing a scheduled upgrade

The following sections describe how to perform a scheduled upgrade on Windows operating systems.

Windows 2000

To perform a scheduled upgrade from Storage Manager version 7.xx, through version 9.12 to Storage Manager 9.16 on machines that are running Windows 2000, perform the following procedure:

1. Click **Start → Programs → Administrative Tools → Services**. The Services window opens.
2. Shut down node B.

3. From node A, uninstall the components from the previous version of the storage management software. To uninstall the previous version of Storage Manager, see "Uninstalling storage management software components" on page 138.

   Note: Uninstall the storage management components in the following order:
   a. SMagent
   b. SMutil
   c. RDAC
   d. SMclient

4. Verify that the IBM host adapter device driver versions are current. If they are not current, refer to the readme file located in the \Host_Adapter directory on the installation CD and upgrade the device drivers.

5. Perform a full install of the storage management software on node A. See "Installing Storage Manager 9.15 Client" on page 61 for instructions.

6. Shut down node A.

7. Restart node B.

8. From node B, uninstall the components from the previous version of the storage management software. To uninstall the previous version of Storage Manager, see "Uninstalling storage management software components" on page 138.

9. Verify that the IBM host adapter device driver versions are current. If they are not current, refer to the readme file located in the `\Host_Adapter` directory on the installation CD and upgrade the device driver versions before you continue.

10. Perform a full install of the storage management software on node B. See "Installing Storage Manager 9.15 Client" on page 61 for instructions.

11. Shut down node B.

12. Start up one node at a time and complete the following procedure:
    a. Click **Start → Programs → Administrative Tools → Services**. The Services window opens.
    b. From the list of displayed services, right-click the cluster server. Click **Automatic** to change the cluster server startup option.
    c. Start the cluster server service on node B.

13. Go to Chapter 8, "Completing storage management installation and configuration," on page 109.

Windows Server 2003

To perform a scheduled upgrade from Storage Manager version 7.xx through version 9.12 to Storage Manager 9.16 on machines that are running Windows Server 2003, perform the following procedure:

1. Before you install the storage management software, perform the following steps in each of the cluster nodes in the cluster:
   a. Click **Start → Administrative Tools → Services**. The Services window opens.
   b. From the list of displayed services, right-click the cluster server. Then click **Manual**.
   c. Stop the cluster server on all nodes in the cluster configuration.

2. From each cluster node, uninstall the components from the previous version of the storage management software. See "Uninstalling storage management software components" on page 138 for instructions.

> **Note:** Uninstall the storage management components in the following order:
>   a. SMagent
>   b. SMutil
>   c. RDAC
>   d. SMclient

3. Verify that the IBM host adapter device driver version in each cluster node is current. If they are not current, refer to the readme file located in the \Host_Adapter directory on the installation CD and upgrade the device drivers.

4. Install the new version of the Storage Manager software in each cluster node. See "Installing the storage management software" on page 71 for instructions.

5. Start up one node at a time and complete the following steps for each node:

   a. Click **Start → Administrative Tools → Services**. The Services window opens.

   b. From the list of displayed services, right-click the cluster server. Click **Automatic** to change the cluster server startup option.

   c. Manually start the cluster server service.

6. Open Cluster Administrator windows and verify that the cluster groups can be brought online. If not, contact your IBM service representative for support.

Performing a rolling upgrade

This section describes how to perform a rolling upgrade on Windows operating systems.

Important: If you have applications installed in the cluster server environment that do not support a rolling upgrade, perform one of the following tasks:

- Put those resources offline before the upgrade; then, put them back online after the upgrade.
- Perform a scheduled upgrade. A scheduled upgrade requires scheduling downtime on your cluster server to upgrade the controller firmware and storage management software.

Windows 2000

To perform a rolling upgrade from Storage Manager version 7.xx through version 9.12 to Storage Manager 9.16 on machines that are running Windows 2000, perform the following steps:

1. From node A, open Cluster Administrator.

2. Double-click the Active Groups folder in the right pane of the Cluster Administrator window.

3. Select each group listed and move them to node B.

4. Select node A. Then click **File → Pause Node** to pause cluster service in node A.

5. From node A, uninstall the components from the previous version of the software. To uninstall previous versions of Storage Manager, see "Uninstalling storage management software components" on page 138.

   > **Note:** Uninstall the components in the following order:
   >   a. SMagent
   >   b. SMutil
   >   c. RDAC
   >   d. SMclient

6. Verify that the IBM host adapter device driver versions are current. If they are not current, refer to the readme file located in the \Host_Adapter directory on the installation CD and upgrade the device drivers.

7. Perform a full install of the storage management software on node A. See "Installing Storage Manager 9.15 Client" on page 61 for instructions.

8. Run Cluster Administrator. Then click **File → Resume Node** to resume cluster service in node A.

9. From node B, open Cluster Administrator.

10. Double-click the Active Groups folder in the right pane of the Cluster Administrator window.

11. Select each group listed and move them to node A.

12. Select node B. Then click **File → Pause Node** to pause cluster service in node B.

13. From node B, uninstall the components from the previous version of the software. To uninstall previous versions of Storage Manager, see "Uninstalling storage management software components" on page 138.

14. Verify that the IBM HBA device driver versions are current. If they are not current, see the readme file located in the \Host_Adapter directory on the installation CD and upgrade the device drivers.

15. Perform a full install of the storage management software on node B. See "Installing Storage Manager 9.15 Client" on page 61 for instructions.

16. Run Cluster Administrator. Then click **File → Resume Node** to resume cluster service in node B.

17. Go to Chapter 8, "Completing storage management installation and configuration," on page 109.

Windows Server 2003

To perform a rolling upgrade from Storage Manager version 7.xx through 9.12 to Storage Manager 9.16 on machines that are running Windows Server 2003, perform the following steps:

1. In the first node of the cluster, open the Cluster Administrator window.

2. Double-click the Active Groups folder in the right pane of the Cluster Administrator window.

3. Select each of the active groups listed in the first cluster node and move them to other nodes in the cluster configuration. Make sure that the cluster groups come online successfully.

4. Select the first node of the cluster in the Cluster Node Tree view and click **File → Pause Node** to pause cluster service in that node.

5. From node A, uninstall the components from the previous version of the software. To uninstall the previous version of Storage Manager software, see "Uninstalling storage management software components" on page 138.

   Note: Uninstall the components in the following order:
   a. SMagent
   b. SMutil
   c. RDAC
   d. SMclient

6. Verify that the IBM HBA device driver versions in the cluster node are current. If they are not current, refer to the readme file located in the \Host_Adapter directory on the installation CD and upgrade the device drivers.

7. Install the new version of the Storage Manager software in the first cluster node. See "Installing the storage management software" on page 71 for instructions.

8. In the Cluster Administrator window, select the first node of the cluster and click **File → Resume Node** to resume cluster service in first cluster node.

9. Move all cluster groups that were active in the first cluster node back to it. Make sure that the cluster groups can be brought online in the first cluster node with no problems.

10. Repeat steps 1 on page 76 through 9 for each of the other nodes in the cluster configuration. Perform all steps for each cluster node, one cluster node at a time.

Upgrading Windows operating systems

The following sections describe how to upgrade from one supported Windows operating system to another.

Upgrading from Windows 2000 to Windows Server 2003 in a cluster configuration

Note: Always perform a full system backup before you perform any upgrade procedure.

Important: If you have applications that are installed in the cluster server environment that do not support a rolling upgrade, perform one of the following tasks:

- Put those applications offline before the upgrade. Then put them back online after the upgrade.
- Perform a scheduled upgrade. A scheduled upgrade requires scheduling downtime on your cluster server to upgrade the controller firmware and storage management software.

To upgrade from Windows 2000 Advanced Server to Windows Server 2003 Enterprise Edition, perform the following steps:

1. On node A, open the Cluster Administrator window.

2. Double-click the Active Groups folder in the right pane of Cluster Administrator.

3. Move all active cluster groups in node A to node B. Make sure that the cluster groups come online successfully in node B.

4. Select node A. Click **File → Pause Node** to pause cluster service in node A.

5. From node A, uninstall all software components. To uninstall the software, see "Uninstalling storage management software components" on page 138. Uninstall the components in the following order:

   a. SMagent
   b. SMutil
   c. RDAC
   d. SMclient

6. Follow the instructions from Microsoft to upgrade node A from Windows 2000 Advanced Server to Windows Server 2003 Enterprise Edition.

> **Note:** During the upgrade, the existing cluster server installation is detected and clustering for Windows 2000 Advanced Server is installed. When the upgrade is complete, node A rejoins the cluster and remain paused.

7. Verify that the HBA device driver versions are correct. If they are not the certified versions, refer to the readme file in the `\Host_Adapter` directory on the installation CD and upgrade the device driver versions before you continue.

8. Verify that node A was successfully upgraded to Windows Server 2003 Enterprise Edition.

9. Install the Storage Management software in node A. See "Installing the storage management software" on page 71.

10. In the Cluster Administrator window, select node A and click **File → Resume Node** to resume cluster service in node A.

11. Move the cluster groups that were active in node A back to node A.

12. On node B, open the Cluster Administrator window.

13. Double-click the Active Groups folder in the right pane of Cluster Administrator.

14. Make sure that all cluster groups failover to node A successfully.

15. Select node B. Click **File → Pause Node** to pause cluster service in node B.

16. From node B, uninstall all software components. To uninstall the software, see "Uninstalling storage management software components" on page 138. Uninstall the components in the following order:

    a. SMagent
    b. SMutil
    c. RDAC
    d. SMclient

17. Follow the instructions from Microsoft to upgrade node B from Windows 2000 Advanced Server to Windows Server 2003 Enterprise Edition.

    > **Note:** During the upgrade, the existing cluster server installation is detected and clustering for Windows 2000 Advanced Server is installed. When the upgrade is complete, node B rejoins the cluster and remain paused.

18. Verify that the HBA device driver versions are correct. If they are not the certified versions, refer to the readme file in the `\Host_Adapter` directory on the installation CD and upgrade the device driver versions before you continue.

19. Verify that node B was successfully upgraded to Windows Server 2003 Enterprise Edition.

20. Install the Storage Management software in node B. See "Installing the storage management software" on page 71 for instructions.

21. In the Cluster Administrator window, select node B and click **File → Resume Node** to resume cluster service in node B.

22. In the Cluster Administrator window, move the cluster groups that were active in node B back to node B. Make sure that they come online with no problems.

23. If there are more than two nodes in a cluster, repeat steps 12 through 22 for each of the remaining nodes in a cluster, one cluster node at a time.

Configuring storage management

After you install Storage Manager, complete the tasks that are described in Chapter 8, "Completing storage management installation and configuration," on page 109. These tasks include the following:

- Performing an initial automatic discovery of storage subsystems

- Adding devices
- Naming storage subsystems
- Creating arrays and logical drives
- Downloading controller firmware and NVSRAM
- Verifying and defining the default host type
- Setting up alert notifications

Additional information

For additional information about installing and using Storage Manager in a Windows cluster server configuration, see "Windows operating system limitations" on page 169.

Chapter 5. Installing Storage Manager software in a Linux configuration

This chapter describes how to install the storage management software in a Linux operating system environment.

Note: This document does not provide any information about using Linux on POWER-based hosts. For information about using Linux on POWER-based hosts in a DS4000 subsystem, see *IBM TotalStorage DS4000 Storage Manager 9 Installation and Support Guide for AIX, HP-UX, Solaris, and Linux on POWER.*

If you have existing storage systems, make sure that you have read "Installation types" on page 27 and "Managing coexisting storage subsystems" on page 32.

To ensure proper installation, make sure you have completed all preparation tasks described in Chapter 2, "Preparing for installation," on page 41.

Important: Always check the Storage Manager readme file for your operating system before installing the software. A readme file contains important information that was not available when this guide was prepared.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Installation overview

Important: Be sure that you install the HBA and device driver before you install the storage management software.

Linux software requirements

Table 17 lists the disk space that is required for installing Storage Manager 9.1x in a Linux environment.

Table 17. Installation requirements for Linux by software package

Package	Disk space requirement
Storage Manager 9.1x Client (SMclient)	60 MB on /opt, 2 MB on /tmp
Qlogic SANsurfer	160 MB on /opt
Storage Manager 9.1x RDAC	2 MB
Storage Manager 9.1x Agent (SMagent)	2 MB on /opt
Storage Manager 9.1x Utility (SMutil)	7 MB on /opt
IBM Host Adapter device driver	1 MB
Storage Manager 9.1x runtime (SMruntime)	70 MB on /opt, 1 MB on /var

Linux operating system requirements

Table 18 on page 82 describes the minimum operating system and kernel level requirements for each management station or host computer. Check the Storage Manager readme file for the latest information regarding supported kernel versions. See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Table 18. Management station or host computer by minimum operating system and kernel levels

Operating system	Kernel
Red Hat Enterprise Linux Advanced Server 3.0	2.4.21-27.0.2.el or later
Red Hat Enterprise Linux Advanced Server 4.0	2.6.9-11 EL
SuSE Linux Enterprise Server Version 8 (SLES 8)	2.4.21-273 or later
SuSE Linux Enterprise Server Version 9 (SLES 9)	2.6.5-7.151

To begin installing the storage management software, ensure that the network components are set up and operating properly, and that you have all the host and controller information that you need for the software to operate.

Attention: Linux RDAC is supported only when the DS4000 storage subsystems have controller firmware version 05.4x.xx.xx and later installed.

When using Linux RDAC as the multipath failover/failback device driver, it is recommended that you install the software on each host computer in the following order:

1. Uninstall the earlier version Storage Manager.
2. Install Storage Manager 9.1x Runtime.
3. Install Storage Manager 9.1x Client.
4. Disable and enable the Event Monitor.
5. Install the IBM fibre channel HBA **non-failover** version device driver (for Linux operating systems).
6. Install Linux RDAC.
7. Install Storage Manager 9.1x Agent (SMagent, optional)
8. Install Storage Manager 9.1x Utility.
9. Specify the correct host type. See "Verifying and defining the default host type" on page 126.

When not using RDAC as the multipath failover/failback device driver, and using the IBM DS4000 fibre channel HBA failover version of the device driver as the multipath driver, you *must* install the software on each host computer in the following order:

1. Uninstall the earlier version Storage Manager.
2. Install Storage Manager 9.1x Runtime.
3. Install Storage Manager 9.1x Client.
4. Disable and enable the Event Monitor.
5. Install Storage Manager 9.1x Utility.
6. Uninstall existing IBM DS4000 Management Suite Java (use this procedure when installing Storage Manager 9.1x on an existing storage subsystem).
7. Install the IBM fibre channel Host Adapter (HA) **failover** version device driver for Linux operating systems.
8. Install IBM DS4000 Management Suite Java and QLRemote Agent.
9. Configure path failover/failback. See the device driver readme file for information.

Install the storage management software on a management station in the following order:

1. Uninstall the earlier version Storage Manager.

2. Install Storage Manager 9.1x Runtime.

3. Install Storage Manager 9.1x Client.

In "Uninstalling Storage Manager," the package names SMutil, SMclient, SMagent and SMruntime are the prefixes of the actual package names that are either installed or to be installed. To determine the full names of the installed Storage Manager software packages, at the command prompt, type `rpm –qa | grep SM`. The system will display the installed package file names.

Note: For Storage Manager version 9.14 and later, the default installed directory for the host software packages is `/opt/IBM_DS4000`. (In previous Storage Manager versions, the directory was `/opt/IBM_FAStT`.)

Uninstalling Storage Manager

This section contains procedures for uninstalling an earlier version of Storage Manager software from one or more Linux management stations or hosts. Use the following procedure to remove previous versions of the software before installing Storage Manager version 9.1x. The software removal procedures can also be performed using an rpm-compatible, GUI-based package manager.

If you installed the host software components individually, use the procedure in "Uninstalling manually-installed Storage Manager packages" to uninstall an earlier version of Storage Manager. If you installed the host software using the DS4000 Storage Manager installation wizard, use the procedure in "Uninstalling wizard-installed Storage Manager packages" on page 84.

Note: You do not need to restart your host computer after removing a software component. During the software removal process, the host keeps existing storage subsystem mappings and storage partition configurations, which the new client software will recognize.

Uninstalling manually-installed Storage Manager packages

Complete the following steps to uninstall an earlier version of Storage Manager if you installed the host software components individually.

1. Be sure that you have root privileges, which are required to uninstall Storage Manager.

2. To remove previously installed software packages:

   a. Type the appropriate uninstallation command at the command prompt in the order listed in Table 19 and press **Enter**.

Table 19. Software removal commands

Package	Removal command
SMutil	`rpm -e SMutil`
SMclient	`rpm -e SMclient`
SMagent	`rpm -e SMagent`
SMruntime	`rpm -e SMruntime`

   When the software has been removed, the system will return to the command prompt.

   b. At the command prompt, type the verification command for the selected software package, and press **Enter**. See Table 20 on page 84.

Table 20. Software removal verification commands

Package	Removal command
SMutil	`rpm -qi SMutil`
SMclient	`rpm -qi SMclient`
SMagent	`rpm -qi SMagent`
SMruntime	`rpm -qi SMruntime`

> The following message displays.
>
> `Package <packagename> is not installed.`

c. The Linux RDAC driver is not packaged as RPM package. See "Installation and setup instructions" on page 91 for that information. However, always check with the Linux RDAC readme file for the latest changes to the installation and uninstallation instructions.

> See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

3. If you are installing a new version of the software, proceed to "Installing the Storage Manager 9.1x software." If you are not installing a new version of the software, you have successfully completed this procedure.

Uninstalling wizard-installed Storage Manager packages

The DS4000 Storage Manager installation wizard will create an `Uninstall` directory in the directory that you specified to install the Storage Manager host software. The default name for this directory is `/opt/IBM_DS4000`. Inside, there is a file named `Uninstall_IBM_DS4000`. To uninstall the host software, change to this directory and type the following command:

```
# sh ./Uninstall_IBM_DS4000
```

When the wizard opens, follow the instructions.

Installing the Storage Manager 9.1x software

The DS4000 Storage Manager 9.16 software for Linux operating systems is available as a single package that you can install using the installation wizard, or as individual packages that you can install manually.

Notes:

1. This document does not provide information about using Storage Manager 9.16 with Linux on POWER host servers. For information about using Storage Manager 9.16 with Linux on POWER servers, see *IBM TotalStorage DS4000 Storage Manager 9 Installation and Support Guide for AIX, HP-UX, Solaris, and Linux on POWER*.

2. Storage Manager 9.16 supports AMD64 and EM64T Linux RHEL 4 and SLES 9 servers running x86_64 Linux kernels (AMD64 or EM64T native code), in addition to the previously-supported Intel Itanium 64 bit processor architecture (IA64) Linux operating systems. IBM supplies two different Storage Manager 9.16 host software packages for Linux:

   - Storage Manager 9.16 host software package for the 32 bit x86 (32 bit) *and* x86_64 (AMD64 and EM64T) processor architecture Linux operating systems

   - Storage Manager 9.16 host software package for Intel Itanium 64 bit processor architecture (IA64) Linux operating systems only

Check the Storage Manager readme file for Linux operating systems to ensure that you have the correct software to use in your Linux operating system environment. See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

The installation wizard package file names have the `SMIA` prefix. Each individual package file name have one of the following prefixes: `SMruntime`, `SMclient`, `SMutil` or `SMagent`.

This section contains the following procedures:
- "Installing the Storage Manager 9.1x software using the installation wizard"
- "Installing the Storage Manager 9.1x software manually" on page 86

Installing the Storage Manager 9.1x software using the installation wizard

The DS4000 Storage Manager installation wizard is a Java-based interactive method of choosing which packages to automatically install on your host system. The installation wizard installs the following software packages on the Linux host:
- SMruntime
- SMclient
- SMagent
- SMutil

Requirements
- DS4000 Storage Manager 9.16
- Graphics adapter card installed on the Linux host

Steps for installing DS4000 Storage Manager software using the installation wizard

Complete the following steps to install the DS4000 Storage Manager software using the installation wizard. Adjust the steps as necessary for your specific installation.

1. Download the Storage Manager 9.16 SMIA package file from the DS4000 Storage Manager CD, or from the DS4000 support Web site, to a directory on your system.

2. Change into this directory and type the following command to start the Storage Manager installation wizard:

```
./SMIA-LINUXxxx-09.16.A5.xx.bin
```

   Note: Use the exact file name of the SMIA file. The name shown in the example is for illustrative purposes only.
   The Storage Manager Installation wizard's Introduction window opens.

3. Follow the instructions in each window of the wizard. When you select the installation type, you can choose one of the following options:
   - Typical (Full) Installation — Installs all Storage Manager software packages
   - Management Station — Installs SMruntime and SMclient
   - Host — Installs SMruntime, SMagent and SMutil
   - Custom — Allows you to select which packages you want to install

Result: The DS4000 Storage Manager software packages are installed in the `/opt/IBM_DS4000` directory.

Installing the Storage Manager 9.1x software manually

Use the procedures in this section to install the applicable Storage Manager 9.1x software packages on a management station or host computer. These software installation procedures can also be performed using an rpm-compatible, GUI-based package manager.

Important: Before installing the client software, install the runtime software. A system reboot is only required when installing the RDAC driver package. The Event Monitor software is installed automatically during the client software installation.

1. Ensure that you have root privileges, which are required to install the software.
2. Insert the installation CD and, if necessary, mount the CD-ROM drive.

   Note: In the following procedure, the CD-ROM drive is mounted at:
   - */mnt/cdrom* for Red Hat or
   - */media/cdrom* for SuSE

   You must uncompress the installation packages from the CD-ROM to an existing folder on your hard drive. In the following procedure, this temporary directory is designated as */tmp*. You may choose to create a different destination directory name.

   Modify these instructions as required to meet your particular installation requirements.

Installing Storage Manager 9.1x Runtime (SMruntime)

Installation of the SMruntime package is necessary for both hosts and storage management stations.

Note: The following steps direct you to enter commands necessary to install the appropriate software packages. After you invoke each command, the software installation begins. When the installation completes, a message displays indicating that the installation was successful and returning the system command prompt.

Perform the following steps to install SMruntime:

1. Type the following command at the command prompt and press **Enter**.

   ```
   rpm -ivh SMruntime-LINUX<version number>.rpm
   ```
2. To verify the installation of the SMruntime package, type the following command at the command prompt and press **Enter**.

   ```
   rpm -qa SMruntime
   ```
3. If the installation was successful, and no failure was reported, continue with "Installing the Storage Manager 9.1x Client (SMclient)." If the installation was unsuccessful, repeat steps 1 and 2. If the failure persists, see the Storage Manager 9.1x Release Notes or contact your IBM technical support representative.

Installing the Storage Manager 9.1x Client (SMclient)

Installation of the SMclient package is necessary only if the system is a storage management station or if the system is a host acting as a storage management station. If you are not installing SMclient, proceed to "Installing the RDAC package" on page 88.

Perform the following steps to install the SMclient:

1. Type the following command at the command prompt and press **Enter**.

```
rpm -ivh SMclient-LINUX<version number>.rpm
```

2. To verify the installation of the SMclient package, type the following command at the command prompt and press **Enter**.

```
rpm -qa SMclient
```

3. If the installation was successful, and no failure was reported, continue with "Installing the RDAC package" on page 88. If the installation was unsuccessful, repeat steps 1 on page 86 and 2. If the failure persists, see the Storage Manager 9.1x Release Notes or contact your IBM technical support representative.

Disabling and enabling the Event Monitor

The Event Monitor, which comes with the client software, installs automatically during the client software installation. The Event Monitor handles storage subsystem error notification through e-mail or SNMP traps when the storage management software is not actively running on the management station or host computer.

You can disable and enable the Event Monitor while the Event Monitor is running, or you can disable and enable the boot-time reloading of the Event Monitor. If you disable the Event Monitor while it is running, it will start automatically at the next reboot.

Important:

1. The Event Monitor must remain enabled if you intend to use automatic ESM firmware synchronization. (See "Automatic ESM firmware synchronization" on page 120 for more information.)

2. If you installed the client software and configured alert notifications on multiple hosts, you might receive duplicate error messages from the same storage subsystem. To avoid receiving duplicate error messages, disable the Event Monitor on all but one system. You must run the Event Monitor on one host that will run continually.

Disabling the Event Monitor while the software is running: **Important:** If you disable the Event Monitor while it is running, it will start automatically at the next reboot.

At the command prompt, type the following command and press **Enter**:

```
SMmonitor stop
```

When the program shutdown is complete, the system displays the following message.

`Stopping SMmonitor process <xxxx>.` where xxxx represents the process ID number.

Enabling the Event Monitor while the software is running: At the command prompt, type the following command and press **Enter**:

```
SMmonitor start
```

When the program startup begins, the system displays the following message.

`SMmonitor started.`

Disabling boot-time loading of the Event Monitor: At the command prompt, type the following command and press **Enter**:

```
mv /etc/rc2.d/S99SMmonitor /etc/rc2.d/disabledS99SMmonitor
```

You are returned to the command prompt.

Enabling boot-time loading of the Event Monitor: At the command prompt, type the following command and press **Enter**:

```
mv /etc/rc2.d/S99SMmonitor /etc/rc2.d/S99SMmonitor
```

You are returned to the command prompt.

Installing the Storage Manager 9.1x Utility (SMutil)

Installing the SMutil package is necessary only if the system is a host. If you are not installing SMutil, proceed to "Installing Storage Manager 9.1x Agent (SMagent)."

Perform the following steps to install the SMutil:

1. Type the following command at the system prompt and press **Enter**.

   ```
   rpm -ivh SMutil-LINUX.rpm
   ```

2. To verify installation of the SMutil package, type the following command at the system prompt and press **Enter**.

   ```
   rpm -qa SMutil
   ```

3. If the installation was successful, and no failure was reported, continue with "Installing Storage Manager 9.1x Agent (SMagent)." If the installation was unsuccessful, repeat steps 1 and 2. If the failure persists, see the Storage Manager 9.16 Release Notes or contact your IBM technical support representative.

Installing Storage Manager 9.1x Agent (SMagent)

Installation of the Storage Manager 9.1x Agent software is necessary only if the system is a host and the storage array is to be managed using the in-band storage array management method. In addition, RDAC must be installed. If you are not installing SMagent, proceed to "Removing the temporary Installation files" on page 95. To install the SMagent package

1. Type the following command at the system prompt and press **Enter**.

   ```
   rpm -ivh SMagent-LINUX.rpm
   ```

2. To verify installation of the SMagent package, type the following command at the system prompt and press **Enter**.

   ```
   rpm -qa SMagent
   ```

3. If the installation was successful, and no failure was reported, continue with "Removing the temporary Installation files" on page 95. If the installation was unsuccessful, repeat steps 1 and 2. If the failure persists, see the Storage Manager 9.1x Release Notes or contact your IBM technical support representative.

Installing the RDAC package

This section describes how to install RDAC on the Linux operating system.

Notes:

1. Linux RDAC is provided separately from the Storage Manager 9.1x host software package. There are two Linux RDAC packages, one for each type of kernel:

   - 2.4 kernel (RHEL 3 and SLES 8)
   - 2.6 kernel (RHEL 4 and SLES 9)

   Be sure to install the correct Linux RDAC for your system. (Note that neither of these packages can be used for Linux on POWER-based servers. For information about installing RDAC for Linux on POWER systems, see *IBM TotalStorage DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX , Solaris, and Linux on POWER*.)

2. Always see the readme file that is included with the Linux RDAC package for the latest instructions for installing Linux RDAC, including any dependencies or limitations.

Installation of the RDAC package is necessary only if the system is a host. You must install RDAC on each host computer. The RDAC package installs the multipath device driver that is necessary for controller failover support. A system reboot is required when installing the RDAC driver package. You must also need to install the non-failover version of the fibre channel HBA device driver before installing RDAC.

Note: See the Storage Manager 9.1x Release Notes for information on supported levels of HBA drivers.

1. To unpack the Linux RDAC source files from the directory in which you placed the RDAC source .tgz file, type the following command at the command prompt, where *<filename>* is the name of the Linux RDAC source file, and press **Enter**.

    `tar -zxvf <filename>.tar.gz`

    The source files will uncompress into the *<yourdirectory>*/linuxrdac directory, or into *<yourdirectory>*/linuxrdac-*<version>* (where *<version>* is the RDAC number; for example, linuxrdac-09.01.B5.02).

2. For detailed procedures on compiling and installing the driver modules, see "Linux RDAC installation."

3. If the installation was successful, and no failure was reported, continue with "Installing the Storage Manager 9.1x Utility (SMutil)" on page 88. If the installation was unsuccessful, repeat steps 1 and 2. If the failure persists, see the Storage Manager 9.1x Release Notes or contact your IBM technical support representative.

Linux RDAC installation

The Linux RDAC provides multipath failover/failback support for the logical drives in the DS4000 storage server that are mapped to the Linux host server. The Linux host server must have fibre channel connections to the host ports of both controllers A and B of the DS4000 Storage Server. It is provided as a multipath driver alternative to the Linux fibre channel host bus adapter failover device driver.

See "Dependencies" on page 91 for the required code levels and Linux kernel versions. In addition, see the IBM TotalStorage Disk Storage Systems Technical Support Web site for the latest supported DS4000 Storage Server models, host adapters, device drivers, Linux kernel versions and updated readme.

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

Note: Deviations from the listed code levels are not supported. Contact IBM Support for assistance if required.

Limitations

1. The Linux RDAC driver cannot coexist with HBA-level multipath failover/failback drivers such as the `6.06.63-fo` driver. You may have to modify the driver make file to enable it to be compiled in the non-failover mode. In addition, see the Linux RDAC readme file for the minimum Fibre Channel HBA device driver version that is required for a particular version of Linux RDAC.

2. SteelEye LifeKeeper Clustering is currently supported with only 8 LUNs. Use the following instructions to set up the LifeKeeper cluster.

   a. Recompile the fibre channel Host Bus Adapter driver using the following setting.

      - Change the `QLA2X_PERFORMANCE` setting to 0 in the `qla_settings.h` file.

   b. Change the following settings in the `/etc/default/LifeKeeper` file.

      - LCMHBEATTIME=5
      - LCMNUMHBEATS=16

   c. Reboot the Linux host after completing step 2a and 2b.

3. All limitations which apply to the current DS4000 Storage Server when configured with Linux servers also apply to this Linux RDAC release.

4. This Linux RDAC release does not support auto-volume transfer/auto-disk transfer (AVT/ADT) mode. AVT/ADT is automatically enabled in the Linux storage partitioning host type. Disable it by using the script that is bundled in the IBM Linux RDAC Web package or in the `\Scripts` directory of the DS4000 Storage Manager Version 9 Linux CD. The name of the script file is `DisableAVT_Linux.scr`. Use the following steps to disable the AVT/ADT mode in your Linux host type partition.

   - Open the DS4000 Storage Manager Enterprise Management window
   - Highlight the subsystem
   - Select **Tools**.
   - Select **Execute Script**. A script editing window opens.
   - In this window, select **File**.
   - Select **Load Script**
   - Give the full path name for the script file (for example, `<CDROM>/scripts/DisableAVT_Linux.scr`) and click **OK**.
   - Select **Tools**.
   - Select **Verify and Execute**.

   Note: It is assumed that the `Linux` host type is selected for the Storage Partition in which the Linux host server HBA port is defined. This `Linux` host type has AVT/ADT enabled as the default. See online Help for the script editor in the Enterprise Management window for information on how to execute a script.

5. The Linux SCSI layer does not support skipped (sparse) LUNs. If the mapped LUNs are not contiguous, the Linux kernel will not scan the remaining LUNs. Therefore, LUNs following the skipped LUN will not be available to the host server. Always map LUNs using consecutive LUN numbers., and use the Storage Manager **hot_add** utiliy program.

6. If a host server has multiple HBA ports and each HBA port sees both controllers (over an un-zoned switch), the Linux RDAC driver may return I/O errors during controller failover. In this case, use multiple unconnected fibre

channel switches to zone the fibre channel switch into multiple zones so that each HBA port sees only one controller in a DS4000 Storage Server.

7. When the RDAC driver detects that all paths to a DS4000 Storage Server are failed, it will immediately report I/O failure. This behavior differs from that of the IBM fibre channel HBA failover driver, which will wait for a certain time period before reporting an I/O failure to the host application. There is no work-around for this behavioral difference.

8. It is not possible to load the virtual HBA driver if there no storage array attached. The work-around for this inability is to connect the host server to the DS4000 storage server and run the `hot_add` utility.

    Note: If no LUN is mapped to the host server partition on the DS4000 Storage Server, the hot_add utility will not bring up the `mpp_Vhba` module.

9. The cluster support feature in the Linux RDAC driver is only available for 5.4x.xx.xx or later firmware. If a SCSI-2 reserve/release command is addressed to a LUN on an array running a firmware version lower than 05.40, a check-condition 05-02-00 (`key-asc-ascq`) (illegal request, invalid command operation code) will be returned.

10. The Linux RDAC driver does not support LUN deletion. It is necessary to reboot the server after deleting mapped logical drives.

11. The RDAC driver stack, which includes the **mpp_Upper** and **mpp_Vhba** tools, and the low level HBA driver, should not be loaded or unloaded using the **modprobe** kernel module utility. Any use of **modprobe** on the RDAC driver stack is entirely the responsibility of the user. IBM does not support the use of **modprobe** with the RDAC driver stack. Use of **rmmod** to remove all the drivers in the RDAC driver stack, in order, is also not supported.

    Recommendation: Reboot the system whenever you need to unload the driver stack.

Dependencies

See the Linux RDAC readme file for the latest related dependencies. See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Installation and setup instructions

Prerequisites:

1. The Linux RDAC driver is released as a source-code package in the format of a gunzip compressed tar file. To unpack the driver source package, type the following command in the Linux console window: tar -zxvf `rdac-LINUX-xx.xx.xx.xx-source.tar.gz` where `xx.xx.xx.xx` is the release version of the RDAC driver. The source files will uncompress to the `linuxrdac` or `linuxrdac-<version>` directory (wheren `<version>` is the RDAC version; for example, `linuxrdac-09.01.B5.01`.

2. Properly build and install the non-failover fibre channel HBA device driver on the Host server prior to Linux RDAC driver installation. See the fibre channel HBA device driver readme file or the fibre channel HBA User Guide for instructions on installing the non-failover version of the device driver. If you need to build the non-failover fibre channel HBA device driver from the source tree, the driver source tree is included in the source-code package. This driver must be loaded before the RDAC installation.

3. Although the Host server can have different fibre channel HBAs from multiple vendors or different fibre channel HBA models from the same vendors, only one model of fibre channel HBAs can be connected to the IBM DS4000 Storage Servers.

4. Check for the following entries in the appropriate file for a given Linux OS distribution.

   a. On RedHat RHEL 3.0 servers, it is assumed that there is a scsi_hostadapter entry for the physical HBA drivers in the `/etc/modules.conf` file. For example, if the system has the IBM FC2-133 FC HBA, there should be a scsi_hostadapter entry such as alias `scsi_hostadapterx qla2300`.

   b. On SuSE SLES 8 servers, it is assumed that the low-level HBA driver names are included in the INITRD_MODULES string in the `/etc/sysconfig/kernel` file. For example, if the system has the IBM FC2-133 FC HBA, INITRD_MODULES string should include the word `qla2300`.

5. Assure that the kernel source tree against which to build the Linux kernel version is installed prior to RDAC driver package installation.

Build and installation: Complete the procedures in this section.

For SuSE distribution only: This first procedure is for the SuSE distribution only. For the Red Hat distribution, proceed to "RDAC driver building for SuSE and RedHat."

1. Install the kernel-source from the SuSE distribution.

2. Create a soft link to the kernel source. `ln -sf /usr/src/<linux-version> /usr/src/linux`.

3. To ensure kernel version synchronization between the driver and running kernel, type the following commands in the Linux console window. Press **Enter** after typing each command.

   - `cd /usr/src/linux`
   - `make mrproper` (completely clean the kernel tree)
   - `- cp /boot/config-`uname -r` .config` (copy the new config)
   - `make oldconfig` (update configuration using .config)
   - `make dep` (rebuild the dependencies)
   - `make modules` (build the modules-not require on newer kernel version)

RDAC driver building for SuSE and RedHat:

1. Change to the `linuxrdac` directory.

2. To remove the old driver modules in that directory, type the following command:
   `make clean`

3. Press **Enter**.

4. To compile all driver modules and utilities in a server with multiple CPUs (SMP kernel), type the following command:
   `make`

5. Press **Enter**.

RDAC driver installation:

1. To copy driver modules to the kernel module tree and build the new RAMdisk image (`mpp.img`) which includes RDAC driver modules and all driver modules that are needed during boot time, type `make install` and press **Enter**.

2. Follow the instructions that display at the end of the build process to add a new boot menu option which uses `/boot/mpp-<kernel version>.img` as the initial RAMdisk image.

3. Near the end of the Linux RDAC installation, if you see the error message `All of your loopback devices are in use`; and the RDAC RAMDISK does not get created; and the installation fails, type the following commands in the Linux console window:

```
insmod loop      <--this loads the loopback device driver onto the kernel-->
make uninstall  <--this uninstalls the previous, unsuccessful RDAC driver-->
make install     <--this installs the RDAC driver again-->
```

IMPORTANT: If your system is a RedHat RHEL 3.0, note edit the `/sbin/mkinitrd` script in the following area to change `3000` to `15000`:

```
if['uname -m' = "ia64"];
      then IMAGESIZE=400
      else IMAGESIZE=15000
fi
```

The following instructions may work in certain RedHat kernel versions. Add `ramdisk_size=15000` as a kernel boot parameter in the new boot option, similar to the following `grub.conf` example.

Note: The actual sample may vary in different system setup configurations.

```
title Red Hat Linux Advanced Server-up (2.4.9-e.27smp)
root (hd0,6)
kernel /vmlinuz-2.4.9-e.27smp ro root=/dev/hda7 ramdisk_size=15000
initrd /mpp-<kernel version>.img
```

RDAC driver post-installation:

1. Reboot the system using the new boot menu option.

2. Type `lsmod` to verify that the driver stack is properly loaded.

   Note: On Red Hat distributions, the following modules should be loaded: `scsi_mod`, `sd_mod`, `sg`, `mpp_Upper`, `mpp_Vhba(*)`, and Fibre Channel HBA drivers (for example, qla2300).

   On SuSE distributions, the following modules should be loaded: `sg`, `mpp_Upper`, `mpp_Vhba(*)` Fibre Channel HBA drivers.

3. To verify that the RDAC driver discovered the available physical LUNs and created virtual LUNs for them, type `ls -lR /proc/mpp` and press **Enter**.

4. You can now issue I/Os to the LUNs.

5. If you make any changes to the MPP configuration file (`/etc/mpp.conf`) or the persistent binding file (`/var/mpp/devicemapping`), run `mppUpdate` to rebuild the RAMdisk image and to include the new file so that the new configuration file (or persistent binding file) can be used on any subsequent system reboot.

6. The file `/etc/syslog.conf` should have entries for `kern.debug`, `kern.notice`, `kern.info` and `kern.warning` in order to capture all debug and error messages for MPP driver.

If you use the Linux host type as the host type for your Linux host partition, you must disable AVT/ADT as indicated in "Limitations" on page 90. You do not need to

do this if you choose `LNXCL` as the host type. This host type will set AVT/ADT to disable and enable propagated reservation.

PROC entries: To verify that the RDAC driver discovered the available physical LUNs and created virtual LUNs for them, type `ls -lR /proc/mpp` and press Enter.

The linux system provides a `/proc` file system that is a special memory-only, software-created file system that is used by the kernel to export driver information to the user space.

The **proc** pseudo-filesystem is mounted to `/proc`. The Linux SCSI subsystem's **proc** file system directory is `/proc/scsi`. By convention, each HBA driver creates a subdirectory under `/proc/scsi`.

The Linux RDAC (MPP) driver **proc** entries are as follows:
- **/proc/mpp**

  Entry for the MPP driver.
- **/proc/scsi/mpp/*<adapter_number>***

  Entry for the MPP virtual host adapter. This can differ from system to system, and is assigned by the scsi middle-layer.
- **/proc/mpp/*<storage_sys_name>***

  Entry for each subsystem that is visible to the host.
- **/proc/mpp/*<storage_sys_name>*/controller*<A/B>***

  Entries for the two targets on each subsystem as seen by the host. Each storage subsystem has two controllers.
- **/proc/mpp/*<storage_sys_name>*/controller*<A/B>*/*<low_level_driver/HCT#>***

  Here, the *<low_level_driver>* can be any one of QLogic, or Emulex HBAs. *<HCT#>* can be the *<Host#>* (host number of the low-level driver that is assigned by the scsi mid-layer), *<Channel#>* (depends on whether the HBA card is single- or dual-channeled), or *<Target#>* (target number that is assigned to that controller on that subsystem by the low-level HBA driver).
- **/proc/mpp/*<storage_sys_name>*/controller*<A/B>*/*<low_level_driver/HCT#/LUN#>***

  These are the logical drives or LUN numbers of logical drives, as mapped on host partition on the storage subsystem and seen through that path, or initiator(host)-target combination.

Persistent naming: Linux SCSI device names have the possibility of changing when the host system reboots. IBM recommends using a utility such as `devlabel` to create user-defined device names that will map devices based on a unique identifier, called a UUID.

As of this writing, `devlabel` is available as part of the Red Hat Enterprise Linux 3 distribution, or online at:

linux.dell.com/devlabel/devlabel.html

RDAC driver package uninstall and reinstall/update: To un-install the RDAC driver package, type `make uninstall` and press **Enter**.

Note: To Reinstall/Update the RDAC driver package, issue the command "make uninstall" followed by the "make install" command under the `/linuxrdac` directory in the new RDAC driver source code bundle.

Kernel update: After applying the kernel update and booting into the new kernel, perform the following steps to build MPP `Initrd` image for the new kernel:

1. Change the directory to the `Linuxrdac` source code directory.

2. Issue the ″make uninstall″ command.

3. Follow the driver building and installation procedure described in "RDAC driver building for SuSE and RedHat" on page 92 and "RDAC driver installation" on page 92.

Initial Ramdisk image (initrd): The Initial RamDisk Image (`initrd` image) is automatically created when the driver is installed by issing the ″make install″ command. The boot loader Configuration file needs to have an entry for this newly created image.

The `initrd` image is located in the boot partition with file name, `mpp-'uname -r'.img` (for example, `mpp-2.4.21-9.ELsmp.img`).

For a driver update, if the system already has old entry for MPP, the system administrator need only modify the existing MPP entry accordingly in the boot loader configuration file. In most cases, no change is required if the kernel version is same.

To create a new `initrd` image, run `mppUpdate`, which will overwrite the old image file with the new image file.

If you need to add third-party drivers to the `initrd` image, edit the `/etc/sysconfig/kernel` (SuSE) or `/etc/modules.conf` (RedHat) with the third-party driver entries. Run `mppUpdate` to create a new ramdisk image.

Adding and deleting mapped logical drives (LUNs): Linux RDAC supports re-scan of newly mapped LUN without rebooting the server. The utility program is packaged with the Linux RDAC driver. It can be invoked by issuing either the ″hot_add″ or ″mppBusRescan″ command. ″hot_add″ is a symbolic link to `mppBusRescan`. There are man pages for both commands.

The Linux RDAC driver does not, however, support LUN deletion. It is necessary to reboot the server after deleting mapped logical drives.

Removing the temporary Installation files

This section describes how to remove the temporary Installation files from the temporary directory.

1. At the prompt, type the following command, and press **Enter**.

    `rm /install_dir/SM*-LINUX.rpm`

    ...where `/install_dir/` is the directory from which you will extract the installation files.

2. To confirm, type *y* and press **Enter**.

Uninstalling Qlogic SANsurfer

If you are installing Storage Manager 9.1x in an environment with existing storage subsystems, you need to uninstall older versions of Qlogic SANsurfer and then install the version of Qlogic SANsurfer that came on the IBM DS4000 Storage Manager Version 9.1x CD.

Perform the following steps to uninstall Qlogic SANsurfer from a Red Hat or SuSE Linux system:

1. Open a command shell.
2. Change to the directory where SANblade Manager is installed. For example, type the following and then press **Enter**:

   `cd /opt/QLogic_Corporation/SANsurfer`
3. Change to the UninstallData directory:

   `cd /UninstallData`
4. Type the following and then press **Enter** to run the InstallAnywhere un-installation program:

   `./SANsurferUninstaller`

Installing Qlogic SANsurfer

The IBM Qlogic SANsurfer software includes the DS4000 GUI device driver that is required for failover and diagnostic support. You can use the GUI to configure logical drives, storage, and failover.

Perform the following steps to install IBM Qlogic SANsurfer onto a Red Hat or SuSE Linux system:

1. Open a command shell.
2. Change to the directory into which you downloaded the SANsurfer installer.
3. Type the following command and then press **Enter**:

   `sh ./`*`installer_file`*`.bin`where *installer_file* is the name of the SANsurfer installer file.
4. Restart your Linux server.
5. Continue with "Installing the IBM fibre-channel host bus adapter device driver."

For additional configuration information, see the Qlogic SANsurfer online help.

Installing the IBM fibre-channel host bus adapter device driver

An IBM fibre-channel host bus adapter (HBA) provides the interface between a host server and a DS4000 storage subsystem. IBM DS4000 fibre-channel HBAs are high-performance, direct memory access, bus-master, host adapters designed for high-end systems. These HBAs support all fibre-channel peripheral devices that support private-loop direct-attach and fabric-loop attachment. The IBM Host Adapter device driver enables your operating system to communicate with the fibre-channel HBA.

See the readme file included in the driver package for installation instructions associated with your operating system. For more information, see the Installation and User's Guide for your particular fibre-channel HBA model. Additional information can also be found in Appendix E, "Host bus adapter settings," on page 185.

Note: Depending on your controller's firmware version, change the LUNs per target BIOS setting from the default value of `0` to `31` or `255` for IBM DS4000 fibre channel HBA.

The current readme file and latest multipath I/O device driver are available for download at the following Web site:

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

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Configuring storage management

After you install Storage Manager, complete the tasks that are described in Chapter 8, "Completing storage management installation and configuration," on page 109. These tasks include the following:

- Performing an initial automatic discovery of storage subsystems
- Adding devices
- Naming storage subsystems
- Creating arrays and logical drives
- Downloading controller firmware and NVSRAM
- Verifying and defining the default host type
- Setting up alert notifications

Additional information

For additional information about installing and using Storage Manager 9.1x in a Linux configuration, see "Linux operating system limitations" on page 178.

Chapter 6. Using DS4000 storage subsystems with NetWare hosts

Storage Manager 9.16 software, which is required to manage DS4000 storage subsystem with controller firmware 6.16.xx.xx, is not available for the NetWare operating system environment.

To manage a DS4000 storage subsystem with controller firmware 6.16.xx.xx that is connected to a NetWare host server, you must install the Windows version of the Storage Manager 9.16 SMclient program in a Microsoft Windows management station, and make an out-of-band management connection to the DS4000 storage subsystem.

This section describes how to install the Fibre Channel HBA device driver, the LSIMPE.cdm driver, and the NetWare native failover device driver. To ensure proper installation, complete all preparation tasks described in this section.

If you have existing storage systems, read "Installation types" on page 27 and "Storage subsystem management methods" on page 16.

Important: Always check the latest Storage Manager readme file for NetWare, which might contain important information that was not available when this guide was prepared.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Installing the NetWare fibre channel HBA device driver

An IBM fibre-channel host bus adapter (HBA) provides the interface between a host server and a DS4000 storage subsystem. IBM DS4000 fibre-channel HBAs are high-performance, direct memory access, bus-master, host adapters that are designed for high-end systems. These HBAs support all fibre-channel peripheral devices that support private-loop direct-attach and fabric-loop attachment. The Novell NetWare native failover device driver enables your operating system to communicate with the fibre-channel HBA.

See the readme file included in the driver package for installation instructions associated with your operating system. For more information, see the Installation and User's Guide for your particular fibre-channel HBA model. Additional information can also be found in Appendix E, "Host bus adapter settings," on page 185.

Note: Depending on your controller's firmware version, change the LUNs per target BIOS setting from the default value of 0 to 31 or 255 for IBM DS4000 fibre channel HBA. In addition, review the device driver readme for any other required modifications to the default HBA BIOS and host operating system registry settings to ensure optimal performance. If you make any changes to the HBA BIOS settings, the machine will reboot automatically.

The latest multipath I/O device driver is available at the following Web site:

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

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Installing the LSIMPE driver and NetWare native failover device driver

The NetWare native failover device driver is the only recommended failover device driver for the NetWare operating system environment. The device driver is available in NW5.1 SP7 or later, NW6.0 SP3 or later, and in NW6.5 SP1a or later.

Note: Always use the Novell NetWare native failover device in the latest SP™ for a particular NetWare operating system version. In addition, use the later version of the LSIMPE.CDM file from either the latest Novell Support Pack or the version that is included with the IBM Fibre Channel HBA device driver for NetWare which is available at the IBM DS4000 support web site.

The LSIMPE.CDM driver is used in a Novell NetWare environment to enable the Novell native multipath device driver to recognize the NetWare host-mapped logical drives that were created on DS4000 storage subsystems. The LSIMPE.CDM driver is a custom driver module that is packaged with the IBM DS4000 Host Adapter driver and the Novell operating system distribution CD. In case of a failure along the I/O path, the Novell native multipath device driver sends the I/O requests through the alternate path and Auto-Volume Transfer (AVT) moves the logical drive within the DS4000 storage subsystem.

See the current IBM Fibre Channel HBA device driver readme file for the current LSIMPE.CDM driver, and the pointer to the Novell native multipath device driver installation instructions. You can find the readme at the following Web site:

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

Installing Qlogic SANsurfer

The Qlogic SANsurfer Storage Management Suite is a diagnostic application that you can use to verify the status of the fibre channel connections before you use the storage subsystem.

For information about installing and using this software, see the *IBM TotalStorage DS4000 Problem Determination Guide* or see the Storage Manager online help.

Note: Qlogic SANsurfer replaces FAStT MSJ, and serves the same function as FAStT MSJ.

Additional information

You cannot use a NetWare host operating system as a management station with Storage Manager 9.16. For information that describes how to use a NetWare host operating system as a management station with *previous* versions of Storage Manager, see Appendix A, "Installing previous Storage Manager versions in a NetWare configuration," on page 141.

For additional information about NetWare configurations, see "NetWare operating system limitations" on page 155.

Chapter 7. Using DS4000 with a VMware ESX Server configuration

DS4000 Storage Manager software is not currently available for VMware ESX Server operating systems. Therefore, to manage DS4000 storage subsystems with your VMware ESX Server host, you must install the Storage Manager client software (SMclient) on a Windows or Linux management workstation. (This can be the same workstation that you use for the browser-based VMware Management Interface.)

See Chapter 3, "Installing Storage Manager software in a standard Windows configuration," on page 59 or Chapter 5, "Installing Storage Manager software in a Linux configuration," on page 81 for instructions on how to install DS4000 Storage Manager 9.1x client software (SMclient) on a Windows or Linux management station.

This chapter contains the following topics:
- "Finding DS4000 readme files online"
- "Sample configuration" on page 102
- "Software requirements" on page 102
- "Hardware requirements" on page 103
- "VMware ESX Server restrictions" on page 103
- "Other VMware ESX Server host information" on page 105
- "Configuring storage subsystems" on page 105

For additional information about using a DS4000 storage subsystem with a VMware ESX Server host, see "VMware ESX Server operating system limitations" on page 181.

Finding DS4000 readme files online

Updated readme files contain important configuration information that supersedes the information in this document. To access the most recent DS4000 readme file for VMware ESX Server, complete the following steps.

1. Go to the following Web site:

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

2. Click the link for your storage subsystem (for example, **DS4800**).

3. When the subsystem support page opens, click the **Download** tab, then click the **Storage Manager, firmware, HBA and tools (including readmes)** link.

4. When the download page opens, click the **Storage Mgr** tab. A table displays.

5. In the table, find the row that contains **IBM DS4000 Storage Manager for VMware ESX Server 2.5**, then click on the corresponding **v9.1x** link under the **Current Versions and Readmes** column.

For additional information, you can view the DS4000 interoperability matrix at the following Web site:

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

Sample configuration

Figure 14 shows a sample VMware ESX Server configuration.
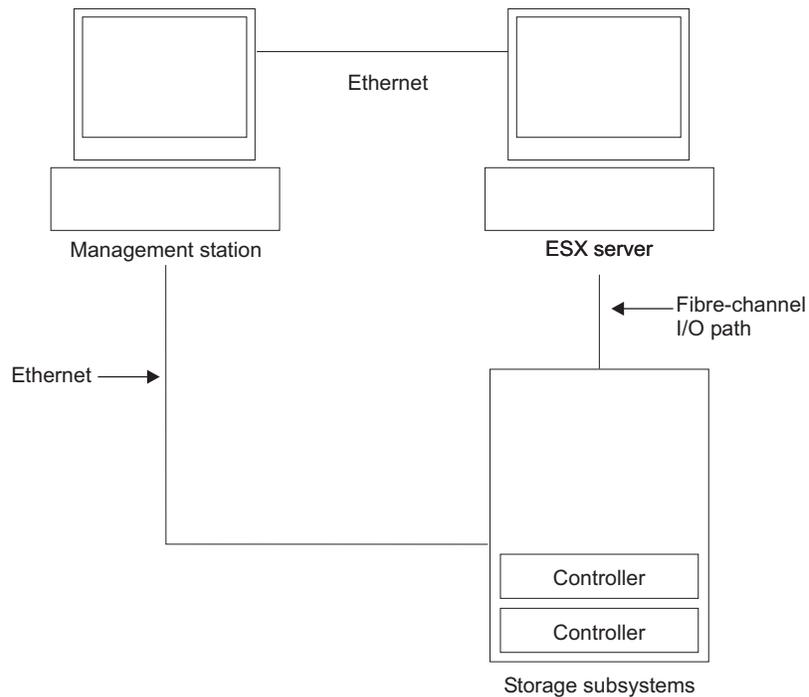
Figure 14. Sample VMware ESX Server configuration

Software requirements

This section describes the software that is required to use a VMware ESX Server host operating system with a DS4000 storage subsystem.

Note: See also "System requirements" on page 33 for general DS4000 requirements.

Management station

The following software is required for the Windows or Linux management station:
1. SM Runtime (Linux only)
2. SMclient (Linux and Windows)

Host (VMware ESX Server)

The following software is required for the ESX Server:
- VMware ESX Server 2.5.2 (with DS4000 controller firmware versions 06.12xx.xx and later)
- VMware-supplied driver for the fibre-channel HBAs
- VMware-supplied QLogic driver failover setup
- VMware Tools (installed on all virtual machines using DS4000 logical drives)

Earlier versions of VMware ESX Server:

1. VMware ESX Server 2.1 was supported with DS4000 controller firmware version 06.12.xx.xx only.

2. VMware ESX Server 2.0 was supported with DS4000 controller firmware version 05.xx.xx.xx only.

Clustering: If you intend to create a cluster configuration, you must use Microsoft Cluster Services software in addition to the host software requirements listed in this section.

For information about Windows clustering with VMware ESX Server, see the ESX 2.5 Installation Guide at the following Web site:

www.vmware.com/support/pubs/

Hardware requirements

You can use VMware ESX Server host servers with the following types of DS4000 storage subsystems and expansion units.

Note: See also "System requirements" on page 33 for general DS4000 requirements.

DS4000 storage subsystems

- DS4800
- DS4500
- DS4400
- DS4300 (Dual-controller and Turbo units only)
- DS4100 (Dual-controller units only)

DS4000 storage expansion units

- EXP100
- EXP710
- EXP700
- EXP500
- EXP810

VMware ESX Server restrictions

SAN and connectivity restrictions

- VMware ESX Server hosts support host-agent (out-of-band) managed DS4000 configurations only. Direct-attach (in-band) managed configurations are not supported.
- VMware ESX Server hosts can support multiple host bus adapters (HBAs) and DS4000 devices. However, there is a restriction on the number of HBAs that can be connected to a single DS4000 storage subsystem. You can configure up to two HBAs per partition and up to two partitions per DS4000 storage subsystem. Additional HBAs can be added for additional DS4000 storage subsystems and other SAN devices, up to the limits of your specific subsystem platform.
- When you are using two HBAs in one VMware server, LUN numbers must be the same for each HBA attached to DS4000 storage subsystem.

- Single HBA configurations are allowed, but each single HBA configuration requires that both controllers in the DS4000 be connected to the HBA through a switch. If they are connected through a switch, both controllers must be within the same SAN zone as the HBA.

  Attention: Having a single HBA configuration can lead to loss of access data in the event of a path failure.
- Single-switch configurations are allowed, but each HBA and DS4000 controller combination must be in a separate SAN zone.
- Other storage devices, such as tape devices or other disk storage, must be connected through separate HBAs and SAN zones.

Partitioning restrictions

- The maximum number of partitions per VMware ESX Server host, per DS4000 storage subsystem, is two.
- All logical drives that are configured for VMware ESX Server must be mapped to an VMware ESX Server host group.

  Note: Currently, a VMware-specific host type is not available for DS4000 storage subsystems. If you are using the default host group, ensure that the default host type is LNXCL.
- In DS4100 and DS4800 storage subsystem configurations, you must initially assign the LUNs to Controller A, on the lowest-numbered HBA. After the LUNs are formatted, you can change the path to Controller B. (This restriction will be corrected in a future release of ESX Server.)
- Assign LUNs to the ESX Server starting with LUN number 0.
- Do not map an access (UTM) LUN to any of the ESX Server hosts or host groups. Access (UTM) LUNs are used only with in-band managed DS4000 configurations, which VMware ESX Server does not support at this time.

Failover restrictions

- You must use the VMware ESX Server failover driver for multipath configurations. Other failover drivers (such as RDAC) are not supported in VMware ESX Server configurations.
- In DS4100 and DS4800 storage subsystem configurations, you must manually change the failover policy from Fixed to MRU. (This restriction will be corrected in a future release of ESX Server.)
- Use the LNXCL host type in VMware ESX Server configurations (2.0 and higher). The LNXCL host type automatically disables AVT/ADT.

Interoperability restrictions

- DS4100 and DS4300 *single-controller* storage subsystems are not supported with VMware ESX Server hosts. (DS4100 and DS4300 *dual-controller* storage subsystems are supported.)
- EXP700 storage expansion units are not supported with DS4800 storage subsystems. You must upgrade to EXP710 storage expansion units.

Other restrictions

- Dynamic Volume Expansion is not supported for VMFS-formatted LUNS.
- For information about availability of DS4000 Copy Service features that are supported VMware ESX 2.5 or 3.0 Server configurations, contact your IBM support representative.

- **Recommendation:** It is recommended that you do not boot your system from a SATA device.

Other VMware ESX Server host information

For more information about setting up your VMware ESX Server host, see the documentation and readme files that are maintained at the VMware support Web site:

www.vmware.com/support/pubs/

For information about installing a VMware ESX Server operating system on an IBM server, see the IBM support Web site at:

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

For information about configuring HBAs, see Appendix E, "Host bus adapter settings," on page 185.

Configuring storage subsystems

Before you can configure storage subsystems, you must physically configure the host server, SAN fabric, and DS4000 controllers; assign initial IP addresses to the controllers; and install SMclient on the Windows or Linux management station. These procedures are described elsewhere in this document, as follows:

Setting up your VMware ESX Server host
For information about setting up your VMware ESX Server host, see "Other VMware ESX Server host information."

Setting up the SAN fabric
For information about setting up the SAN fabric, including information about zoning, see "Creating the SAN-attached configuration" on page 23.

Assigning initial IP addresses
For information about assigning initial IP addresses to the DS4000 controllers, see "Step 4: Assigning IP addresses to hosts and controllers" on page 50.

Installing SMclient on a Windows or Linux management station
For information about installing SMclient on a Windows management station, see Chapter 3, "Installing Storage Manager software in a standard Windows configuration," on page 59.

For information about installing SMclient on a Linux management station, see Chapter 5, "Installing Storage Manager software in a Linux configuration," on page 81.

Completing storage management installation and configuration
For information about completing storage management installation and configuration tasks, see.Chapter 8, "Completing storage management installation and configuration," on page 109

These tasks include:
- Performing an initial automatic discovery of storage subsystems
- Adding devices, if necessary
- Setting up alert notifications, if you want
- Naming the storage subsystems

- Downloading controller firmware and NVSRAM
- Creating arrays and logical drives
- Verifying and define the default host type
- Configuring the heterogeneous hosts, including storage partitioning and defining host groups

Notes on mapping LUNS to a storage partition

See "Mapping LUNs to a partition" on page 129 for procedures that describe how to map the LUNs to a partition. This section contains notes about LUN mapping that are specific to VMware ESX servers.

When you map you LUNs on VMware, note the following:

- It is recommended that you always map the LUNs using consecutive numbers, starting with LUN 0. For example, map LUNs to numbers 0; 1; 2; 3; 4; 5; and so on, without skipping any numbers.
- On each partition, you must map a LUN 0.
- If your configuration does not require LUN sharing (single or multiple independent ESX servers, local virtual cluster), each logical drive must be mapped either directly to a host, or to a host group with a single host as a member.
- LUN sharing across multiple ESX servers is only supported when you are configuring VMotion enabled hosts or Microsoft Cluster nodes. On LUNs that are mapped to multiple ESX Servers, you must change the access mode to Shared.

  You can map the LUNS to a host group for the ESX servers, so they will be available to all members of the host group. For additional information on Windows Clustering with ESX Server, please see the ESX 2.5 or 3.0 Installation Guide at the following Web site:

  www.vmware.com/support/pubs/

Steps for verifying the storage configuration

Complete the following steps to help you verify that your storage setup is fundamentally correct and that you can see the DS4000 storage.

1. Boot the server.
2. On initialization of the Qlogic BIOS, press Cntrl+Q to enter the Fast!UTIL setup program.
3. Select the first host bus adapter that is displayed in the Fast!UTIL screen.
4. Select Host Adapter Settings and press Enter.
5. Select Scan Fibre Devices and press Enter. The resulting output is similar to the following:

```
                Scan Fibre Channel Loop
ID      Vendor         Product      Rev      Port Name          Port ID
128     No device present      0520
129     IBM     1742    0520  200400A0b00F0A16   610C00
130  No device present
131  No device present
132  No device present
133  No device present
134  No device present
135  No device present
```

Note: Depending on how the configuration is cabled, you might see multiple instances.

If you do not see a DS4000 controller, verify the cabling, switch zoning, and LUN mapping.

Chapter 8. Completing storage management installation and configuration

This chapter contains procedures on how to use the Enterprise Management and Subsystem Management features of DS4000 Storage Manager 9.1x to complete storage management installation tasks for Windows, NetWare, Linux, and VMware host operating system environments.

Notes:

1. DS4000 Storage Manager 9.16 software is not currently available for NetWare operating systems. To configure Storage Manager 9.16 storage management with your NetWare host, complete the tasks in this section using SMclient on a Windows or Linux management workstation or using Storage Manager 9.15. See Appendix A, "Installing previous Storage Manager versions in a NetWare configuration," on page 141 for more information about using NetWare with Storage Manager 9.15.

2. DS4000 Storage Manager software is not currently available for VMware operating systems. To configure DS4000 storage management with your VMware host, complete the tasks in this section using SMclient on a Windows or Linux management workstation (this can be the same workstation that you use for the browser-based VMware Management Interface). See Chapter 7, "Using DS4000 with a VMware ESX Server configuration," on page 101 for more information.

Completing the installation

To complete a Storage Manager 9.1x installation, perform the following tasks:

1. Perform an initial automatic discovery of storage subsystems.
2. Add devices, if necessary.
3. Set up alert notifications, if you want.
4. Name the storage subsystems.
5. Download controller firmware and NVSRAM.
6. Create arrays and logical drives.
7. Verify and define the default host type.
8. Configure the heterogeneous hosts.
9. Perform other storage subsystem tasks.

Each of these steps is discussed in detail in the sections that follow.

The Enterprise Management window opens when you start the DS4000 Storage Manager. Use the Enterprise Management window to:

- Add and discover the storage subsystems.
- View all storage subsystems in your management domain.
- Perform batch storage subsystem management tasks using the Script Editor.

Using the Task Assistant

The Task Assistant provides a convenient, central location from which you can choose to perform the most common tasks in the Enterprise Management window and in the Subsystem Management window.

In the Enterprise Management window, the Task Assistant provides shortcuts to these tasks:

- Adding storage subsystems
- Naming or renaming storage subsystems
- Setting up alert destinations
- Managing storage subsystems

In the Subsystem Management window, the Task Assistant provides shortcuts to these tasks:

- Configuring storage subsystems
- Saving configurations
- Defining hosts
- Creating a new storage partition
- Mapping additional logical drives

If there is a problem with the storage subsystem, a shortcut to the Recovery Guru appears, where you can learn more about the problem and find solutions to correct the problem.

To open the Task Assistant, choose **View >> Task Assistant** from either the Enterprise Management window or the Subsystem Management window, or click the Task Assistant button in the toolbar:

The Task Assistant window opens. See Figure 15 on page 111 for the Enterprise Management window Task Assistant or Figure 16 on page 112 for the Subsystem Management window Task Assistant.
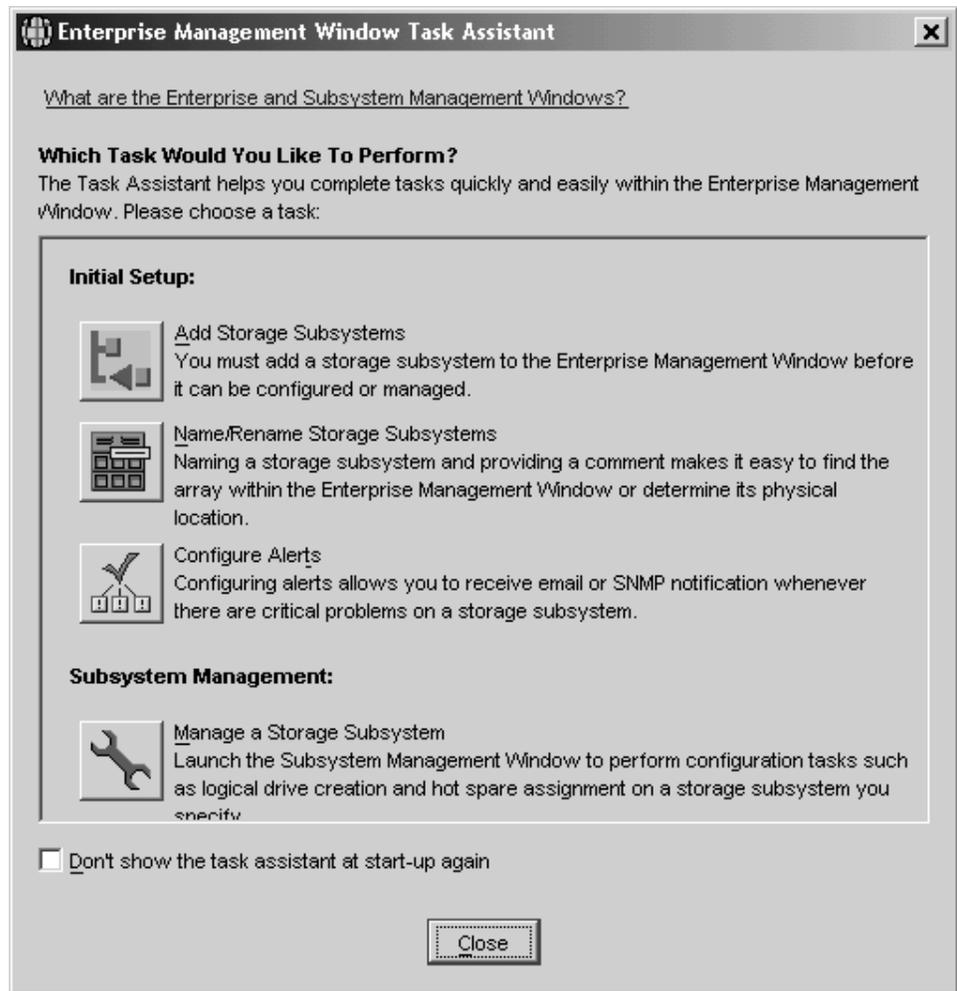
Figure 15. The task assistant in the Enterprise Management window
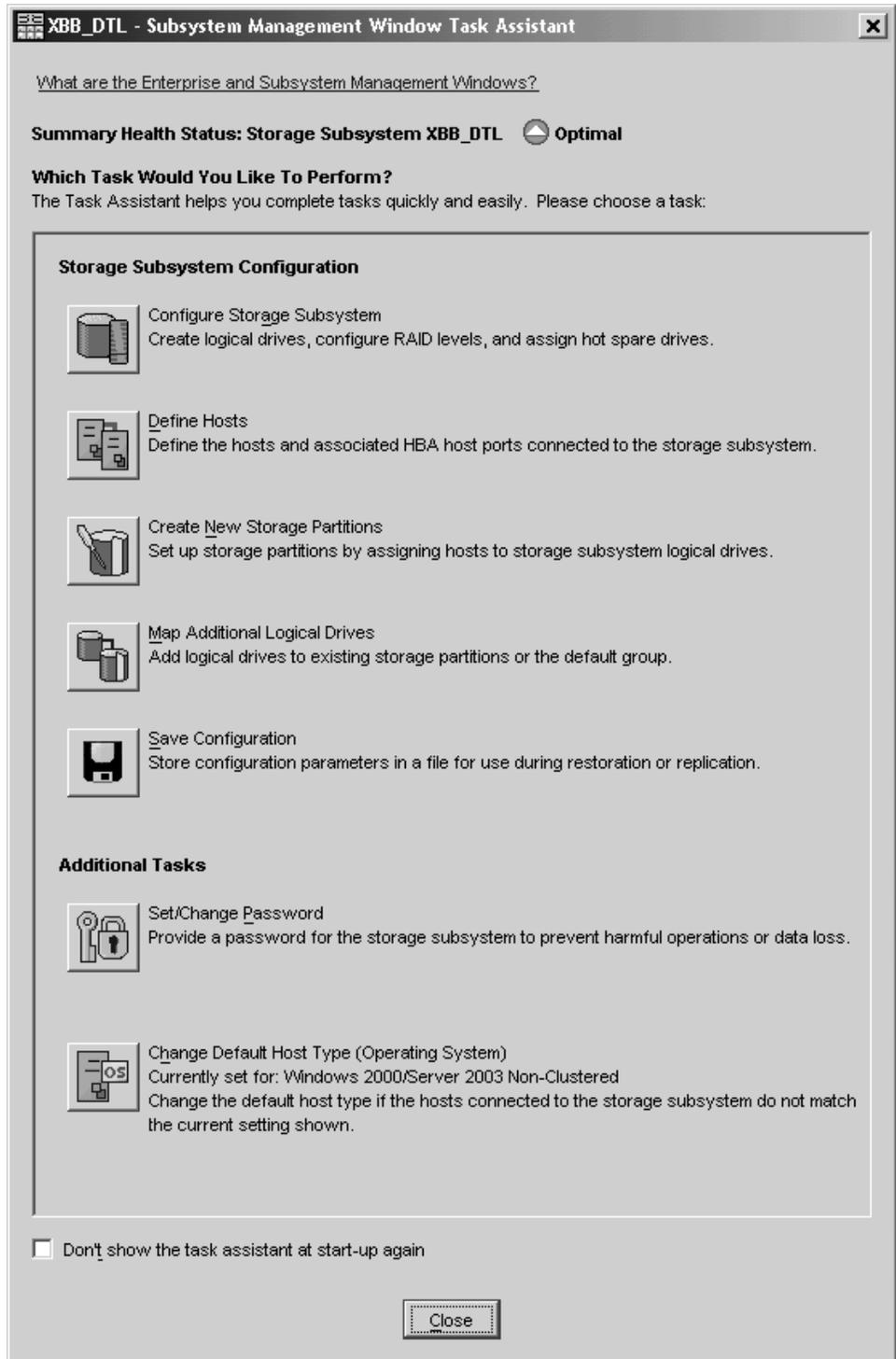
Figure 16. The task assistant in the Subsystem Management window

Note: The Task Assistant is automatically invoked every time you open the
Subsystem Management window unless you check the **Don't show the task
assistant at start-up again** check box at the bottom of the window.

Performing an initial automatic discovery of storage subsystems

To perform an initial automatic discovery of storage subsystems, perform the following steps:

1. Click **Start → Programs**.
2. Click **IBM DS4000 Storage Manager 9 Client**. The client software starts and displays the Enterprise Management window and the Confirm Initial Automatic Discovery window as illustrated in Figure 17.
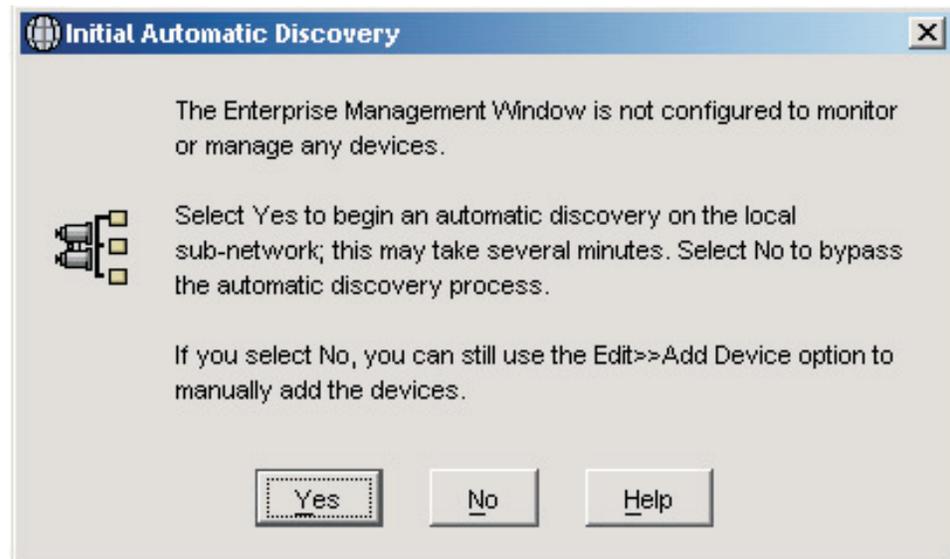
Figure 17. Confirm Initial Automatic Discovery window

> **Note:** The Enterprise Management window can take several minutes to open. No wait cursor (such as an hourglass) displays. Also, the Confirm Initial Automatic Discovery window might not be visible until you close the Enterprise Management window.

3. Click **Yes** to begin an initial automatic discovery of hosts and storage subsystems attached to the local subnetwork.

   After the initial automatic discovery is complete, the Enterprise Management window displays all hosts and storage subsystems attached to the local subnetwork.

   > **Note:** The Enterprise Management window can take up to a minute to refresh after an initial automatic discovery.
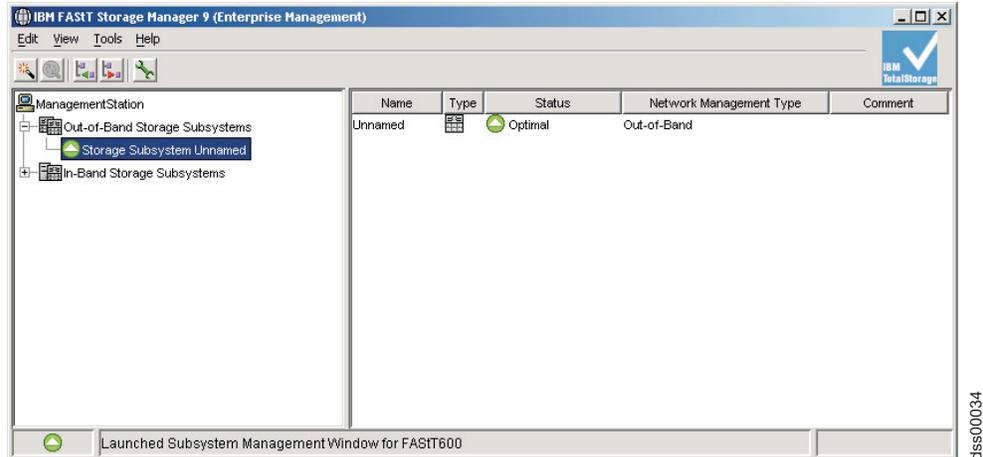
Figure 18. Enterprise Management window

4. Verify that each host and storage subsystem displays in the Enterprise Manager window.

   If a host or storage subsystem is not displayed, perform the following tasks:

   • Check the hardware and hardware connections for possible problems (refer to the hardware documentation for specific procedures).

   • Refer to the Enterprise Management online help for additional information about discovering storage subsystems.

   • If you are using the direct-management method, verify that all hosts and storage subsystems are connected to the same subnet network. If you are using the host-agent method, ensure that the fibre-channel connection between the host and storage subsystems is made.

   • Make sure that all of the preparation steps for setting up the storage subsystem for a directly-managed system in Chapter 2, "Preparing for installation," on page 41 are completed. If they are, use the Add Device option to add the IP addresses of the Storage subsystem. Add both IP addresses of the controller. Otherwise, you will get a ″partially-managed device″ error message when you try to manage the storage subsystem.

   • If you are using the host-agent management method, perform the following steps:

     a. Make sure that the SMagent is installed in the host.

     b. Verify that you have a fibre-channel connection from the storage subsystems to the host that has the SMagent installed.

     c. Verify that all of the preparation steps outlined in Chapter 2, "Preparing for installation," on page 41 are complete. If they are, perform the following steps:

        1) Run the `hot_add` utility.

        2) Restart the SMagent using the information in "Stopping and restarting the host-agent software" on page 137.

        3) Right click on the host and click **Tools → Rescan** in the Enterprise management window.

   Note: In certain situations, a storage subsystem might be duplicated in the device tree after an automatic discovery. You can remove a duplicate storage management icon from the device tree by using the Remove Device option in the Enterprise Management window.

5. Verify that the status of each storage subsystem is `Optimal`. If a device shows a status of `Unresponsive`, right-click the device and select **Remove Device** to delete it from the management domain. Then use the Add Device option to add it to the management domain again. Refer to the Enterprise Management window online help for instructions on removing and adding devices.

6. Continue with "Adding devices."

Adding devices

You can manually add more hosts or storage subsystems. You can use this option to selectively manage a group of storage subsystems from an SMclient. You can also use this option to add additional devices to be managed that were not discovered during the SMclient initial discovery. For more information about this option, see the Enterprise Management window online help.

Important:

- When you add new storage subsystems to the existing storage subsystems in a SAN that are managed through the host-agent software, you must stop and restart the host-agent service. When the host-agent service restarts, the new storage subsystem is detected. For more information, see "Stopping and restarting the host-agent software" on page 137. Then, go to the Enterprise Management window and click **Tools → Rescan** to add the new storage subsystems to the management domain.

- When you add new storage subsystems to existing storage subsystems that are managed using the direct-management method, be sure to specify the IP addresses for both controllers.

Continue with "Setting up alert notifications."

Setting up alert notifications

After you add devices to the management domain, you can set up alert notifications to report critical events on the storage subsystems. The following alert-notification options are available:

- Notification to a designated network management station (NMS) using Simple Network Management Protocol (SNMP) traps
- Notification to designated e-mail addresses
- Notification to designated alphanumeric pagers (requires separately supplied software to convert e-mail messages)

Note: You can only monitor storage subsystems within the management domain. If you do not install the Event Monitor service, the Enterprise Management window must remain open. If you close the window, you will not receive any alert notifications from the managed storage subsystems. Refer to the Enterprise Management window online help for additional information.

Alert notification with SNMP traps

To set up alert notification to an NMS using SNMP traps, perform the following steps:

1. Insert the IBM DS4000 Storage Manager Version 9.1x CD into the CD-ROM drive on an NMS. You need to set up the designated management station only once.

2. Copy the `SM9_R1.MIB` file from the `SM9MIB` directory to the NMS.

3. Follow the steps required by your NMS to compile the management information base (MIB) file. (For details, contact your network administrator or see the documentation specific to your particular storage management product.)

4. Continue with "Naming storage subsystems."

Alert notification without SNMP traps

To set up alert notification without using SNMP traps, select **Storage subsystem -> Edit -> Configure alerts** from the Enterprise Management window.

Naming storage subsystems

To name your storage subsystem, perform the following steps:

1. In the Enterprise Management window, Right-click the storage subsystem and select **Rename**. The Rename Storage Subsystem window opens as shown in Figure 19.
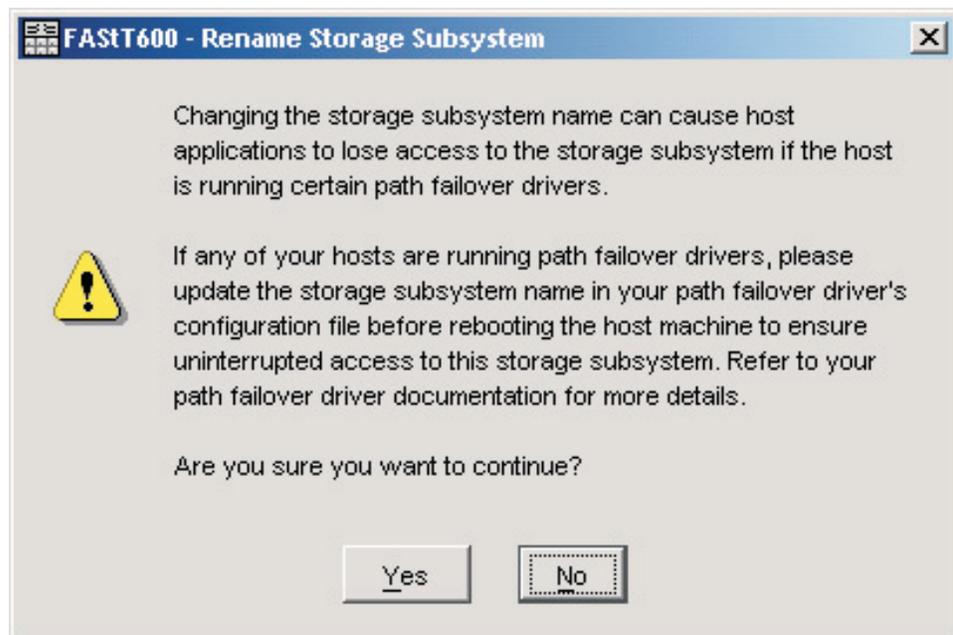
Figure 19. Rename Storage Subsystem window

2. Type the name of the storage subsystem (see Table 27 on page 183). Then click **OK**. Click **Yes** on the warning screen to continue.

3. Repeat this procedure for each unnamed storage subsystem. For more information, see the topic on renaming storage subsystems in the Subsystem Management window online help.

4. Proceed to "Downloading controller firmware, NVSRAM, ESM firmware" on page 117.

Downloading controller firmware, NVSRAM, ESM firmware

> **Important**
>
> The following procedures assume you using controller firmware at version 6.10.xx.xx or later. If you are using an earlier version, refer to the following IBM web site for the appropriate firmware version documentation:
>
> For the most recent Storage Manager readme files for your operating system, see the following Web site:
>
> www-1.ibm.com/servers/storage/support/disk/
>
> Click the link for your storage server. When the page opens, click the **Download** tab, then click the **Storage Manager** tab. Follow the links to the readmes.

Note: Access the latest versions of DS4000 storage subsystem controller firmware, NVSRAM, and DS4000 Storage Expansion Enclosure ESM firmware at the IBM Web site:

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

Important:

1. IBM supports firmware download with I/O, sometimes referred to as ″concurrent firmware download," with some DS4000 storage subsystems. Before proceeding with concurrent firmware download, check the readme file packaged with the firmware code or your particular operating system's DS4000 Storage Manager host software for any restrictions to this support.

2. Suspend all I/O activity while downloading firmware and NVSRAM to a DS4000 storage subsystem with a single controller or you will not have redundant controller connections between the host server and the DS4000 Storage Server.

This section provides instructions for downloading DS4000 storage server controller firmware and NVSRAM, DS4000 Storage Expansion Enclosure ESM firmware, and drive firmware. Normally, the DS4000 storage subsystem firmware download sequence starts with controller firmware, followed by the NVSRAM and then the ESM firmware, and concludes with the drive firmware.

Important: Always check the DS4000 storage subsystem controller firmware readme file for any controller firmware Dependencies and Prerequisites before apply the firmware updates to the DS4000 storage subsystem. Updating any components of the DS4000 storage subsystem firmware without complying with the Dependencies and Prerequisites may cause down time (to fix the problems or recover). Contact IBM support if you have any questions regarding the appropriate download sequence for a particular version of firmware.

If your controller's existing firmware is 06.1x.xx.xx or later, you will have the option to select the NVSRAM for download at the same time that you upgrade/download the new controller firmware. Additionally, you will have the option to download the firmware and NVSRAM immediately, but activate it later, when it may be more appropriate. See the online help for more information.

Note: The option to activate firmware at a later time is not supported on the DS4400.

Downloading controller or NVSRAM firmware

This section provides instructions for downloading DS4000 storage server controller firmware and NVSRAM. Normally, the DS4000 storage subsystem firmware download sequence starts with controller firmware, followed by the NVSRAM and then the ESM firmware, and concludes with the drive firmware.

To download firmware version 06.1x.xx.xx or later, and NVSRAM, perform the following steps:

1. From the Enterprise Management window, select a storage subsystem.
2. Click **Tools → Manage Device**. The Subsystem Management window opens.
3. Click **Advanced → Maintenance → Download → Controller firmware...**. The download firmware window opens as illustrated in Figure 20 on page 119.

   Note: DS4000 Storage Server with controller firmware version 06.1x.xx.xx and higher supports the downloading of the NVSRAM file together with the firmware file. Therefore, the following window will display only if your exiting controller firmware is of version 06.1x.xx.xx or higher. This download feature is not supported in DS4000 storage servers with controller firmware 05.4x.xx.xx and earlier. If your exiting controller firmware is of version 05.4x.xx.xx or lower, only a window for downloading firmware will display.
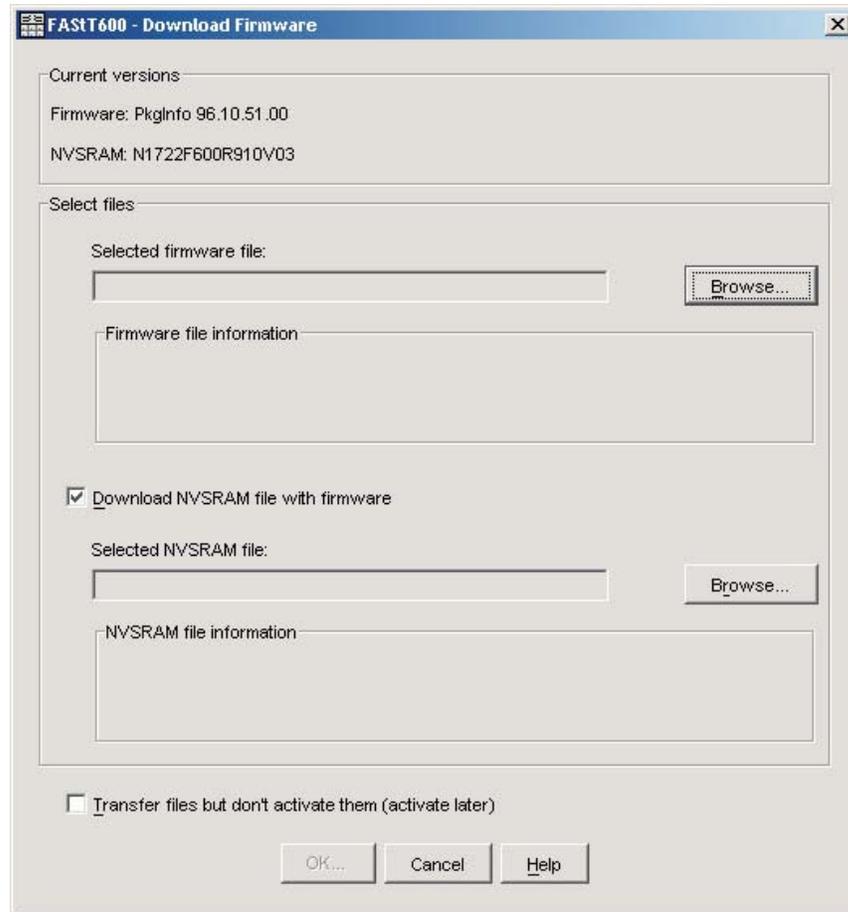
Figure 20. Download Firmware window

4. Click **Browse** next to the `Selected firmware file:` field to identify and select the file with the new firmware.

5. Optionally:

   - Select the **Download NVSRAM file with firmware** option and click **Browse** next to the `Selected NVSRAM file:` field to identify and select the file and identify and select the correct NVSRAM filename.

   - If you choose to transfer and activate immediately, do not select **Transfer files but don't activate them (activate later)**. Otherwise, click the box to select **Transfer files but don't activate them (activate later)**. To activate the firmware at a later time, in the Subsystem Management window, click **Advanced → Maintenance → Activate Controller Firmware**.

Downloading ESM firmware

This section provides instructions for downloading DS4000 Storage Expansion Enclosure ESM firmware. Normally, the DS4000 storage subsystem firmware download sequence starts with controller firmware, followed by the NVSRAM and then the ESM firmware, and concludes with the drive firmware.

Steps for downloading the ESM firmware: Perform the following steps to download the ESM firmware:

1. In the DS4000 storage subsystem Subsystem Management window, select **Advanced → Maintenance → Download → ESM firmware...**. A Download Environmental Card Firmware window opens.

2. Click **Select All** to direct the download to all enclosures. You can also select one enclosure or combinations of enclosures by pressing the `cntl` key while selecting the individual enclosures.

3. Click **Browse** to identify and select the filename of the ESM firmware file and click **Start** to begin the ESM firmware download.

4. A Confirm Download window opens. Type *Yes* and click **OK** to start the download process.

5. Click **Cancel** to close the window when the ESM firmware download to all selected enclosures is complete.

   Note: Suspend all I/O activity while ESM firmware downloads if you select multiple enclosures for downloading ESM firmware. If you select only one enclosure for download at a time, you can download ESM firmware while the server conducts I/O activity. However, IBM recommends that you suspend all I/O activity to perform firmware upgrades.

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. This resolves any ESM firmware mismatch conditions automatically.

To enable automatic ESM firmware synchronization, ensure that your system meets the following requirements:

- The Storage Manager Event Monitor must be installed and running
- The DS4000 storage subsystem must be defined in the Enterprise Management window of the Storage Manager client (SMclient)

Note: Storage Manager 9.16 currently supports automatic ESM firmware synchronization with EXP810 storage expansion enclosures only. Contact IBM for information about support for other types of storage expansion enclosures in the future. To correct ESM firmware mismatch conditions in storage expansion enclosures without automatic ESM firmware synchronization support, you must download the correct ESM firmware file by using the ESM firmware download menu function in the SMclient Subsystem Management window.

Downloading drive firmware

> **Important:**
> The following procedures assume you using controller firmware at version 6.10.xx.xx or later. If you are using an earlier version refer to the following IBM web site for the appropriate firmware version documentation:
>
> www.ibm.com/servers/storage/support/disk/

This section provides instructions for downloading DS4000 drive firmware. See the online help for additional information.

Important:

1. IBM supports firmware download with I/O, sometimes referred to as ″concurrent firmware download″. This feature is not supported for drive firmware.

2. Before starting the drive firmware download process:

- Stop all I/O activity before downloading drive firmware to a DS4000 Storage Server.
- Unmount the file systems on all logical drives accessing the drives that you select for firmware upgrade.
- Complete a full backup of all data residing on the drives that you select for firmware upgrade.

Downloading Storage Manager version 9.1x drive firmware

To download drive firmware for DS4000 Storage Manager version 9.1x, perform the following steps:

1. From the Enterprise Management window, select a storage subsystem.
2. On the Enterprise Management window's menu bar, click **Tools → Manage Device**. The Subsystem Management window opens.
3. On the Subsystem Management window's menu bar, click **Advanced → Maintenance → Download → Drive Firmware/Mode pages ...**. The Download Drive Firmware wizard window opens to the Introduction page. Read the instructions displayed and click **Next**.

   Note: Storage Manager version 9.1x offers you the option to download and update up to four different firmware file types simultaneously. Previous Storage Manager versions did not offer this capability.

4. Click **Browse** to locate the server directory that contains the firmware that you plan to download.
5. Select the firmware file that you plan to download and click **OK**. The file appears listed in the ″Selected Packages″ window pane.
6. Select the firmware file for any additional drive types that you intend to download and click **OK**. Additional files appear listed in the ″Selected Packages″ window pane. A maximum total of four drive types are possible.
7. Click **Browse** to repeat step 6 until you have selected each firmware file that you plan to download.
8. When you have finished specifying the firmware packages for download, select **Next**.
9. The Select Drive window opens, containing two tabs, a **Compatible Drives** tab and an **Incompatible Drives** tab. The **Compatible Drives** tab contains a list of the drives compatible to the firmware package types that you selected. From that list, select the drives to which you plan to download the drive firmware that you selected in steps 6 and 7.

   Note: The firmware that you propose to download should be listed on the **Compatible Drives** tab. If your particular drives' product ID matches the firmware type, however, and it is not listed as compatible on the tab, contact your IBM technical support representative for additional instructions.

10. Select the **Compatible Drives** tab.

    Press and hold the **Ctrl** key while using your mouse to select multiple drives individually, or press and hold the **shift** key while using your mouse to select multiple drives listed in series. The compatible firmware that you selected in steps 5 and 6 will download to the drives that you select.

11. Click **Finish** to initiate download of the drive firmware to each compatible drive that you selected in step 9.

12. The Download Drive Firmware warning opens and prompts: ″Do you want to continue?″ Type **yes** and click **OK** to start the drive firmware download.

13. The Download Progress window opens. Do not intervene until the download process completes.

14. Every drive scheduled for firmware download will be designated as `in progress` until `successful` or `failed`.

    Note: Complete the following two steps if you receive a failure.

    a. Click the **Save as** button to save the error log.

    b. On the Subsystem Management window's menu bar, click **Advanced →Trouble Shooting → Open Event Log** and complete the following tasks necessary to save the storage subsystem event log before contacting your IBM Service Representative and proceeding to step 16.

       1) Click the **Select all** button.

       2) Click **Save the Storage Subsystem Event Log**.

15. When the **Close** button appears active, the drive firmware download process is complete.

16. Click **Close** to exit the Download Progress window.

17. Use either of the following procedures to determine or verify what level of drive firmware resides on a particular drive:

    • Right-click on that drive in the Logical/Physical View in the Subsystem Management window and click **Properties**. The associated drive firmware version will be listed in the drive properties table.

    • Right-click on **Storage Subsystem → View Profile** in the Logical/Physical View of the Subsystem Management window.

Downloading Storage Manager version 8.x drive firmware

To download drive firmware for DS4000 Storage Manager version 8.x, perform the following steps:

1. From the Enterprise Management window, select a storage subsystem.

2. Click **Tools → Manage Device**. The Subsystem Management window opens.

3. Click **Advanced → Download → Drive Firmware**. The Download Drive Firmware window opens. It presents a list of all installed drives.

4. From the list of all installed drives, select the drive to which you plan to download drive firmware.

   Press and hold the **Ctrl** key while using your mouse to select multiple drives singly, or press and hold the **shift** key while selecting multiple drives in series by using your mouse pointer.

5. Click **Browse** to identify the directory that contains the drive firmware that you intend to download.

6. Select the file containing the drive firmware that you intend to download.

7. Select **Start**. The Confirm Download window appears.

8. Type **yes** when the Confirm Download window prompts: `Are you sure you want to continue?`

9. The download begins and the Status window indicates progress. Do not intervene until the download process completes.

10. When the **Cancel** button appears active, the download process is complete. Press **Cancel** to close the Status window.

11. To determine or verify the level of drive firmware residing on a particular drive, click **View → Subsystem Profile** in the Logical/Physical View of the Subsystem Management window.

Creating arrays and logical drives

Important: You should create a storage subsystem profile and save it in a safe place whenever you modify the arrays and logical drives in your storage subsystem. This profile contains detailed controller information including logical and physical disk configuration information that you can use to help recover the configuration in the event of a catastrophic failure. Do not save the profile in the logical drives that are created in the DS4000 storage subsystem whose profile was collected and saved.

To create a storage subsystem profile, select **Storage Subsystem → View Profile** in the Storage Subsystem Management window and click the **Save As** button when the Storage Subsystem Profile window opens. In addition, using firmware version 06.1x.xx.xx, you can also select **Advanced → Troubleshooting → Collect All Support Data** as shown in Figure 21 to collect all the various types of inventory, status, diagnostic and performance data from this storage subsystem and save them to a single compressed file.
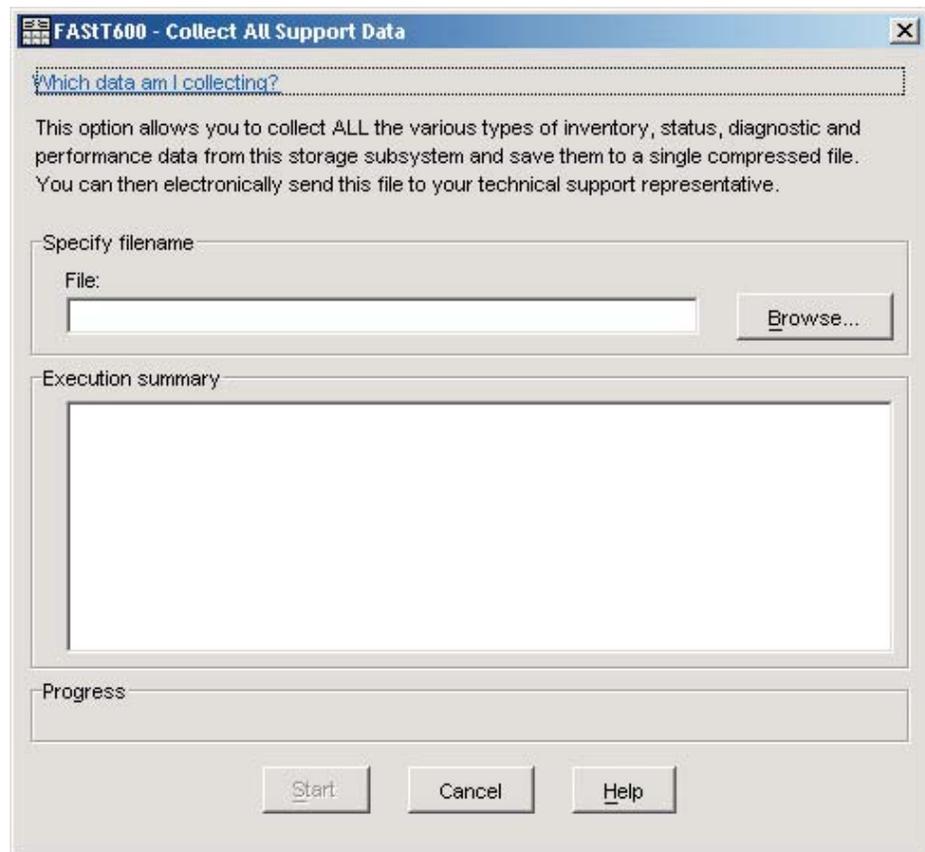
Figure 21. Collect All Support Data window

An *array* is a set of fibre channel or SATA hard drives that are logically grouped together to form a RAID (Redundant Array of Independent Disks).

A *logical drive* is a logical structure, which is the basic structure that you create to store data on the storage subsystem. The operating system recognizes a logical drive as a single drive. Choose a RAID level to meet application needs for data availability and maximize fibre-channel I/O performance.

Maximum number of drives:

1. For firmware levels 05.3x.xx.xx and lower, the maximum number of hard drives supported for each array is 30 if the hard drive capacities are 73.4 GB or less and 14 if the hard drive capacities are 146 GB.

2. For firmware levels 5.4x.xx.xx and later, however, the maximum number of drives supported in an array is 30, regardless of the hard drive capacity. Each array can be divided into from 1 to 256 logical drives.

To create arrays and logical drives, perform the following steps:

1. From the Enterprise Management window, select a storage subsystem.

2. Click **Tools → Manage Device**. The Subsystem Management window opens.

3. Click the **Logical/Physical View** tab.

4. Select **Total Unconfigured Capacity** or **Free Capacity** node. The Logical Drive Create wizard starts. Follow the online instructions to create arrays and logical drives. See also "Creating logical drives from free or unconfigured capacity."

5. Proceed to "Verifying and defining the default host type" on page 126.

Note: For cluster configurations, if you add or delete logical drives, you must make them known to both nodes A and B.

Creating logical drives from free or unconfigured capacity

Perform the following steps to create logical drives from free or unconfigured capacity nodes in the Subsystem Management window.

1. Select either **Free Capacity** node or **Total Unconfigured Capacity** node and then click **Logical Drive → Create**.

   The Introduction (Create Logical Drive) window opens.
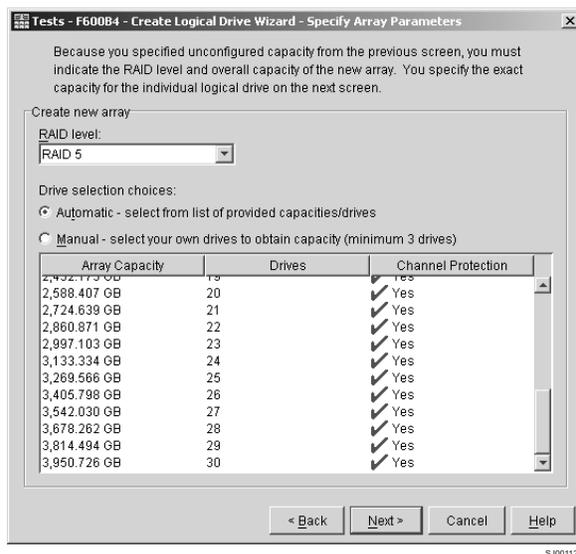
Figure 22. Create Logical Drive window

2. The Introduction (Create Logical Drive) window indicates the amount of free or unconfigured capacity available and provides a link to tips and examples on allocating that additional capacity. Click **Next** to continue.

3. The Specify Array (Create Logical Drive) window opens to allow you to define the parameters for an array that you will create for the logical drive. In this window, specify the following array parameters:

    *   One of the following RAID levels:
        –   RAID-0
        –   RAID-1
        –   RAID-3
        –   RAID-5
    *   The array capacity.

        Select the number of drives that will be used for this array. You can either specify the number of drives in the array and let the storage subsystem select which optimal hard drives in the storage subsystem to use (Automatic_), or you can manually select which hard drives will form the array (Manual_).

        Note: In manual mode, to select multiple drives, you can press and hold the **Ctrl** key and then use the mouse to select the desired hard drive or drives in the available unconfigured optimal hard drive list.

        Click **Next** to continue.
    *   When a box opens stating that you have successfully set the parameters for creating an array, click **OK** to continue. The Specify Capacity/Name (Create Logical Drive) window opens.
4. In the Specify Capacity/Name (Create Logical Drive) window, specify the following logical drive parameters for the logical drive you want to create:

    Logical drive capacity
    The new logical drive capacity can either be the entire unconfigured capacity in an array or a portion of the capacity.

    Units You can choose GB, MB, or TB.

    Logical drive name
    This name must be unique in the storage subsystem.

    Settings
    You can create the logical drive either using the DS4000 storage subsystem default settings or you can select your own customized I/O characteristics, controller ownership, and logical-drive-to-LUN mapping settings.

    If you choose to use the DS4000 storage subsystem default settings, click **Next** then go to step 6 on page 126. If you want to select your own customized settings, click **Next** then go to step 5.
5. The Customize Advanced Logical Drive Parameters (Create Logical Drive) window opens. In the Customize Advanced Logical Drive Parameters (Create Logical Drive) window, specify the following settings:

    *   The appropriate I/O characteristics (the I/O characteristics type, segment size, and cache read-ahead multiplier)

        The I/O characteristics settings can be manually specified or automatically set based on the selection of one of the following expected logical drive usages: file system, database, or multimedia.

        Click **Next**. The Specify Logical Drive-to-LUN Mapping (Create Logical Drive) window opens.

6. In the Specify Logical Drive-to-LUN Mapping (Create Logical Drive) window, specify how you want the logical drive-to-LUN mapping to be mapped to the individual logical drive.

The logical drive-to-LUN mapping preference can be one of the following two settings:

Default mapping
The Automatic setting specifies that a LUN is automatically assigned to the logical drive using the next available LUN within the default host group. This setting grants logical drive access to host groups or host computers that have no specific logical drive-to-LUN mappings (those that were designated by the default host group node in the Topology view). If the Storage Partition feature is not enabled, you must specify the Automatic setting. In addition, you can also change the host type to match host's operating system.

Map later using the Mappings View
This setting specifies that you are not going to assign a LUN to the logical drive during creation. This setting enables you to define a specific logical drive-to-LUN mapping and create storage partitions using the Mappings Defined option. When you enable storage partitioning, specify this setting.

7. Click **Finish** to create the logical drive. The Creation Successful (Create Logical Drive) window opens and states that the logical drive was successfully created.

8. Indicate in the Creation Successful (Create Logical Drive) window if you want to create the logical drive from the same array, if there is free capacity, or from a different array if there is no capacity in the array in which the logical drive was just created. Click **Yes** and go to step 9. If you do not want to create another logical drive, click **No** and continue with step10.

9. The Allocate Capacity (Create Logical Drive) window opens. Select if you want to create the new logical drive from free capacity on the same array, free capacity on a different array, or from unconfigured capacity (create a new array). Then continue with step 4 on page 125.

10. The Completed (Create Logical Drive) window opens. Click **OK**.

11. Register the logical drive with the operating system.

After you create logical drives with automatic logical drive-to-LUN mappings, follow the appropriate instructions in the Installation and Support Guide for your operating system to enable the operating system to discover the new logical drive.

Verifying and defining the default host type

Before you use the logical drives in a host computer, you must specify the correct host type. For information on available host types, see "Host type options" on page 128. The host type determines how the storage subsystem controllers will work with each particular operating system on the hosts to which it is connected. If all of the host computers connected to the same storage subsystem are running the same operating system, and you do not want to define partitioning, you can define a default host type.

To verify the current default host type, perform the following steps:

1. In the Subsystem Management window, click **Storage subsystem** → **View profile**. A Storage Subsystem Profile window opens.

2. Click the **Mappings** folder tab and scroll down to NVSRAM Host Type Index
   Definitions. The host type name of the index that has the word DEFAULT next
   to it is the default host type.

3. Click **Close**.

To define a default host type, perform the following steps:

1. Click **Storage subsystem → Change → Default host-type**. The Default
   Host-type window opens.

2. From the pull-down list, select the host type.

3. Click **OK**.

If you have hosts with different operating systems or if you want to define partitions
for the hosts, continue with "Configuring heterogeneous hosts."

Configuring heterogeneous hosts

The heterogeneous hosts feature enables hosts running different operating systems
to access a single storage subsystem. Previous releases of DS4000 Storage
Manager (versions 7.02 or earlier) required that hosts run the same operating
system in order to access a single storage subsystem.

Overview of heterogeneous hosts

Host computers can run completely different operating systems (for example,
Solaris) or variants of the same operating system. When a host type is specified in
the Define New Host Port window, the heterogeneous hosts feature enables the
controllers in the storage subsystem to tailor their behavior (such as LUN reporting)
to the needs of the host.

Important: To use the heterogeneous host feature, you must meet the following
conditions:

- You must enable storage partitioning.
- During host-port definition, you must set each host type to the appropriate
  operating system so that the firmware on each controller can respond correctly to
  the host.

Note: Partitioning is a premium feature. If you disable partitioning, you *must*
      contact your IBM technical support representative to obtain a key to enable
      partitioning again. This is not a standard feature with the DS4300.

Storage Partitioning: Defining a host group

A *host group* is an entity in the Storage Partitioning topology that defines a logical
collection of host computers that require shared access to one or more logical
drives. You can grant individual hosts in a defined host group access to storage
partitions, independently of the host group. You can make logical drive-to-LUN
mappings to the host group or to an individual host in a host group.

If you have purchased a Storage Partitioning premium feature, ensure that the
premium feature is enabled.

Steps for defining a host group: Complete the following steps to define a host
group.

Before you begin: Note the following information.

- Create the host group at the storage subsystem level. Do not create host groups
  at the default group level.

Exception: If you are running a DS4000 configuration without partitioning enabled, you can use the default host group.

1. Click the **Mappings View** tab on the Subsystem Management window.

2. In the Topology section of the Mappings window, highlight the name of the storage subsystem, and click **Mappings —> Define —> Host Group**.

   Note: Make sure that the storage subsystem is highlighted in the left panel of the Subsystem Management window. Do not highlight Undefined Mappings.

3. Type a name for the new host group. Click **Add**, and then click **Close**.

4. Highlight the new host group and click **Mappings —> Define —> Host**.

5. Type the name of the host to which the storage subsystem is attached. Click **Add**, and then click **Close**.

6. Highlight the host that you just added, then right-click and select **Define Host Port**.

7. Select the host port identifier (WWPN) for the first HBA (for example, 10:00:00:00:c9:24:0c:3f). If you do not see the identifier that you are looking for, see the note at the end of this procedure.

8. Change the host type and click **Add**.

   Important: Failure to change the host type from the default might cause undesired results. See "Host type options" for a list of host types you can use for each host operating system.

9. If you are configuring an additional HBA to this partition, choose the host port for the next HBA and click **Add**, and then click **Close**.

Important: If you do not see the host port identifier that you want in the host port identifier drop-down menu, you can enter it manually. Otherwise, verify that the switch is properly zoned and cabled.

Host type options: The following host type options are available for specification.

1. **Windows**
   - Windows NT® Non-clustered (SP5 or later)
   - Windows NT Clustered (SP5 or later)
   - Windows 2000/Server 2003 Non-clustered
   - Windows 2000/Server 2003 Clustered
   - Windows 2000/Server 2003 Non-clustered (Supports VERITAS Dynamic Multipathing [DMP])
   - Windows 2000/Server 2003 Clustered (Supports VERITAS Dynamic Multipathing [DMP])

2. **Linux**
   - Linux

     This host type is intended for use with fibre channel HBA multipath failover/failback device driver (non-RDAC).
   - LNXCL

     This host type is intended for use with RDAC as the multipath failover/failback device driver.

3. **NetWare**
   - NetWare-IBMSAN

This host type is intended for use with IBMSAN as multipath failover/failback device driver.

- NetWare Failover

  This host type is intended for use with Novell native multipath failover/failback device driver.

4. **VMware ESX Server**

   Currently, a VMware-specific host type is not available for DS4000 storage subsystems. Use one of the following Linux host types for your VMware ESX Server host:

   - Linux

     Use this host type for VMware ESX Server 2.0.

   - LNXCL

     Use this host type for VMware ESX Server 2.1 or 2.5.

Mapping LUNs to a partition

This section includes the following topics:

- "Mapping LUNs to a new partition"
- "Adding LUNs to an existing partition"

Mapping LUNs to a new partition

When mapping LUNs for the first time to a newly created partition, complete the following steps to map LUNs to the partition:

1. Select the Mappings view of the Subsystem Management window.
2. In the Topology section, right-click the host on which you want to map LUNs, and select **Define Storage Partitioning**. The Define Storage Partitioning window opens.
3. In the Define Storage Partitioning window, select **Host**, then click **Next**.
4. Select the logical drive by name, on the right side of the window.
5. Accept the default LUN ID, or change it, then click **Add**.
6. Repeat step 5 for each LUN that you want to map to the partition.

Adding LUNs to an existing partition

When adding LUNs to an existing partition, complete the following steps to map the new LUNs to the partition:

1. Select the Mappings view of the Subsystem Management window.
2. In the Topology section, right-click the host on which you want to map LUNs, and select **Define Additional Mappings**. The Define Additional Mapping window opens.
3. In the Define Additional Mapping window, select the following options, and then click **Add**:
   - Host group or host
   - Logical unit number (LUN)(0-255)
   - Logical drive

Repeat these steps for each LUN that you want to add to the partition.

Creating a FlashCopy logical drive

A FlashCopy logical drive is a logical point-in-time image of a logical drive, called a base logical drive. A FlashCopy logical drive has the following features:

- It is created quickly and requires less disk space than an actual logical drive.
- It can be assigned a host address, so that you can perform backups by using the FlashCopy logical drive while the base logical drive is online and accessible.
- You can use the FlashCopy logical drive to perform application testing or both scenario development and analysis. This does not effect the actual production environment.
- The maximum number of FlashCopy logical drives allowed is one half of the total logical drives supported by your controller model.

For additional information about the FlashCopy feature and how to manage Flash Copy logical drives, refer to the Storage Manager Subsystem Management online help.

Note: FlashCopy is a premium feature. Contact your IBM reseller or IBM marketing representative for more information.

Important: The FlashCopy drive cannot be added or mapped to the same server that has the base logical drive of the FlashCopy logical drive in a Windows 2000, Windows Server 2003, or NetWare environment. You must map the FlashCopy logical drive to another server.

Perform the following steps to create a FlashCopy logical drive:

1. To ensure that you have the accurate point-in-time image of the base logical drive, stop applications and flush cache I/O to the base logical drive.
2. Open the Subsystem Management window. From the Logical View, right-click the base logical drive.
3. Select **Create FlashCopy® Logical Drive**. The Create FlashCopy Logical Drive Wizard starts.
4. Follow the on-screen instructions.
5. Refer to the Subsystem Management online help for instructions on how to add the FlashCopy logical drive to the host.

Using VolumeCopy

The VolumeCopy feature is a firmware-based mechanism for replicating logical drive data within a storage array. This feature is designed as a system management tool for tasks such as relocating data to other drives for hardware upgrades or performance management, data backup, or restoring snapshot volume data. Users submit VolumeCopy requests by specifying two compatible drives. One drive is designated as the Source and the other as the Target. The VolumeCopy request is persistent so that any relevant result of the copy process can be communicated to the user. For more information about this feature, see the *IBM TotalStorage DS4000 Storage Manager 9 Copy Services User's Guide*, or contact your IBM reseller or marketing representative.

Using the Remote Mirror option

The Remote Mirror option is a premium feature. It is used for online, real-time replication of data between storage subsystems over a remote distance. In the event of a disaster or unrecoverable error at one storage subsystem, the Remote Mirror option enables you to promote a second storage subsystem to take over responsibility for normal input/output (I/O) operations. For more information about this feature, see the *IBM DS4000 Remote Mirror Option Installation and User's Guide*, or contact your IBM reseller or marketing representative.

Performing other storage-subsystem management tasks

The following list includes other storage subsystem management tasks that you can perform:

- Locating a storage subsystem
- Viewing a storage subsystem profile or event log
- Entering or changing a storage subsystem password
- Creating and managing logical drives and arrays
- Using the Performance Monitor
- Creating storage partitions (if applicable) and heterogeneous hosts
- Viewing or changing media scan settings
- Increasing capacity of an array or logical drive
- Changing RAID level for an array
- Monitoring read-link-status error counts

Note: To create storage partitions, you must obtain the worldwide name or port of each host adapter in every host connected to the storage subsystem.

For more information about these and other storage subsystem management tasks, refer to the appropriate topics in the Subsystem Management online help.

Chapter 9. Completing storage management tasks for Windows hosts

This chapter provides information about how to add or delete logical drives, create FlashCopy logical drives, use the hot_add and SMdevices utilities, start and stop the host-agent software, and uninstall Storage Manager components in Windows host operating system environments.

Using the storage management software for Windows

This section provides information about how to add or delete logical drives, create FlashCopy logical drives, use the hot_add and SMdevices utilities, start and stop the host-agent software, and uninstall Storage Manager components in a Windows operating system environment.

Adding or deleting logical drives

Use the following procedures to add or delete logical drives in a standard (noncluster) and a cluster configuration.

Standard (noncluster) configuration for Windows 2000

Use the following procedures to create or delete logical drives in a standard server environment for Windows 2000.

Creating logical drives: When you create logical drives with the storage management software, you must add the new logical drives to Windows 2000. Each logical drive (not array) is recognized by Windows 2000 as a single drive.

After creating logical drives, run the hot_add and SMdevices utilities that are provided with the storage management software. The hot_add utility adds newly created logical drives to the operating system without requiring a system restart. The SMdevices utility identifies the logical drives by their associated operating system device names. For more information, see "Using the hot_add utility" on page 136 or "Using the SMdevices utility" on page 136.

Deleting logical drives:

Attention: Do not click **Configuration → Reset** if you have data or logical drives that you want to keep. This action resets the controller unit and deletes *all* previously-configured logical drives.

Before you delete logical drives with the storage management software or use **Configuration → Reset**, perform the following steps:
1. Use the Disk Administrator to delete any partitions and to unassign drive letters that are associated with the logical drives.
2. Restart the system to remove the configuration information.

Attention: You must use the Disk Administrator to delete OS partitions and unassigned drive letters before you delete logical drives or reset the configuration in Storage Manager. Take this action to avoid damage to your registry information.

Cluster server configuration for Windows 2000

Use the following procedures to create or delete logical drives in a cluster server environment for Windows 2000.

Creating logical drives: To add logical drives in a Windows 2000 cluster server environment, perform the following steps:

1. Using the IBM DS4000 Storage Manager Client, create arrays and assign them to the appropriate host group by using storage partitioning.
2. Use the hot_add utility to add the new logical drives to node A.
3. Using the Disk Administrator, create, format, and assign drive letters to the disk partitions on the new logical drives.
4. Use the hot_add utility to add the new logical drives to node B.
5. Using the Disk Administrator, ensure that the drive letters assigned to the disk partitions on the logical drives are the same on both node A and node B.
6. Restart node A. Then use the Cluster Administrator to create cluster physical disk resources using the new disk partitions on the new logical drives.
7. Bring the cluster resources online in node A.
8. Use cluster administrator to move the cluster physical disk resources to node B.
9. Verify that the resources come online in node B.

Deleting logical drives:

Attention: Do not click **Configuration → Reset** in the Storage Manager Client Storage Subsystem management window if you have data or logical drives that you want to keep. This action resets the controller unit and deletes *all* previously-configured logical drives.

Before you delete logical drives with the storage management software or use **Configuration → Reset** in the Storage Manager Client Storage Subsystem management window, perform the following steps:

1. Use the Cluster Administrator to delete the cluster physical disk resources that own the logical drives that will be deleted.
2. Use the Disk Administrator to delete any partitions and to unassign drive letters that are associated with the logical drives.
3. Restart the system to remove the configuration information.

Attention: You must use the Cluster Administrator and Disk Administrator to delete the cluster physical disk resources, delete OS partitions, and unassigned drive letters before deleting logical drives or resetting the configuration in Storage Manager. This avoids damage to your registry information.

Standard (non-clustered) configuration for Windows Server 2003

Use the following procedures to create or delete logical drives in a standard environment.

Creating logical drives: When you create logical drives with the storage management software, you must add the new logical drives to the Windows Server 2003 operating system. Each logical drive (not array) is recognized by Windows Server 2003 as a single disk drive.

After creating logical drives, run the hot_add and SMdevices utilities that are provided with the storage management software. The hot_add utility adds newly created logical drives to the operating system without requiring a system restart. The SMdevices utility identifies logical drives by their associated operating system device names. For more information, see "Using the hot_add utility" on page 136 or "Using the SMdevices utility" on page 136.

Deleting logical drives:

Attention: Do not click **Configuration → Reset** in the Storage Manager Client Storage Subsystem management window if you have data or logical drives that you want to keep. This action resets the controller unit and deletes *all* previously-configured logical drives.

Before you delete logical drives with the storage management software or use **Configuration → Reset** in the Storage Manager Client Storage Subsystem management window, perform the following steps:

1. Use the Disk Administrator to delete any partitions and to unassign drive letters that are associated with the logical drives.
2. If possible, restart the system to remove the configuration information.

Attention: You must use the Disk Administrator to delete the cluster physical disk resources, delete OS partitions, and unassigned drive letters before you delete logical drives or reset the configuration in Storage Manager. This action avoids damage to your registry information.

Cluster server configuration for Windows Server 2003

Use the following procedures to create or delete logical drives in a cluster server environment.

Creating logical drives: To add logical drives in a Windows Server 2003 cluster server environment, perform the following steps:

1. Use the IBM DS4000 Storage Manager Client program to create arrays and logical drives and use storage partitioning to assign them to the appropriate cluster host group.
2. Use the hot_add utility to add the new logical drives to the cluster node that is currently owned by the cluster quorum resource.
3. Use the Disk Administrator program to create, format, and assign drive letters to the disk partitions on the new logical drives.
4. In each of the rest of the cluster nodes in the cluster configuration, use the hot_add utility to add the new logical drives to the cluster node.
5. In the first cluster node, use the Cluster Administrator program to create cluster physical disk resources using the new disk partitions on the new logical drives.

    Note: If the new disk does not show up in the available disk pull-down list when you go through the Cluster Administrator program, you might have to reboot the server.

6. Bring the cluster resources online in the first cluster node.
7. Use the Cluster Administrator to move the newly-created cluster physical disk resources to other nodes in the cluster configuration.
8. Verify that the resources come online in other nodes in the cluster configuration.

Deleting logical drives:

Attention: Do not click **Configuration → Reset** in the Storage Manager Client Storage Subsystem management window if you have data or logical drives that you want to keep. This action resets the controller unit and deletes *all* previously-configured logical drives.

Before you delete logical drives with the storage management software or use **Configuration → Reset** in the Storage Manager Client Storage Subsystem management window, perform the following steps:

1. Use the Cluster Administrator to delete the cluster physical disk resources that own the logical drives that will be deleted.
2. Use the Disk Administrator to delete any partitions and to unassign drive letters that are associated with the logical drives.
3. If possible, restart the cluster nodes to remove the configuration information.

Attention: You must use the Cluster Administrator and Disk Administrator to delete the cluster physical disk resources, delete OS partitions, and unassigned drive letters before you delete logical drives or reset the configuration in Storage Manager. This action avoids damage to your registry information.

Using the hot_add utility

The hot_add utility enables you to add new logical drives without restarting the system. The utility registers the new logical drives with the operating system so that you can use Disk Administrator to create partitions, add device names, and so on. The hot_add utility is part of the SMutil software package. If you run the program twice and the new logical drives are not displayed in the Disk Administrator window, you must either run fibre-channel diagnostics or restart (reboot) the host.

When you finish creating logical drives on a particular storage subsystem, go to the host that is attached to that storage subsystem and perform the following steps to use the hot_add utility:

1. From a DOS or command prompt, change to the directory
   `<installation_directory>\Util`

   ...where `installation_directory` is the directory in which you installed the SMutil.

   The default directory is `c:\Program Files\IBM_FAStT\Util`.
2. From a DOS or command prompt, type the following command:
   `hot_add`
3. Press **Enter**. The new logical drives are available through the Disk Administrator.

Using the SMdevices utility

The SMutil software includes a utility called SMdevices that you can use to view the storage subsystem logical drive that is associated with a particular operating system device name. This utility is helpful when you want to create drive letters or partitions by using Disk Administrator.

When you finish creating the logical drives on a particular storage subsystem, go to the host that is attached to that storage subsystem, and perform the following steps to use SMdevices:

1. From a DOS or command prompt, change to the directory
   `<installation_directory>\Util`

   ...where `installation_directory` is the directory in which you installed the SMutil.

   The default directory is `c:\Program Files\IBM_FAStT\Util`.
2. Type:
   `SMdevices`

3. Press **Enter**. The software displays device identification information. For example, you might see the following information.

```
\\.\PHYSICALDRIVEx [Storage Subsystem Finance, Logical Drive DEBIT, LUN xx,

WWN <worldwide_name>]
```

where:
- *x* is the Disk number that displays in Disk Administrator
- *Finance* is the name of the storage subsystem
- *DEBIT* is the name of the logical drive
- *xx* is the LUN associated with the logical drive
- *worldwide_name* is the worldwide name for the logical drive

Using the SMrepassist utility

You can use the SMrepassist utility to perform the following tasks:
- Flush cached data for a logical drive.

Important: The FlashCopy drive can not be added or mapped to the same server that has the base logical drive of the FlashCopy logical drive in a Windows 2000, Windows Server 2003, or NetWare environment. You must map the FlashCopy logical drive to another server.

To flush cached data in a logical drive, perform the following steps:
1. From a DOS or command prompt, change to the directory `<installation_directory>\Util`

   ...where `installation_directory` is the directory in which you installed the SMutil.

   The default directory is `c:\Program Files\IBM_FAStT\Util`.
2. Type the following command:

   `smrepassist -f logical_drive_letter:`

   where *logical_drive_letter* is the operating system drive letter that was assigned to the disk partition created on the logical drive.
3. Press **Enter**.

Stopping and restarting the host-agent software

You must stop and restart the host-agent software if you add additional storage subsystems to the management domain of the host-agent software. When you restart the service, the host-agent software discovers the new storage subsystems and adds them to the management domain.

Note: If none of the access logical drives are detected after a restart, the host-agent software automatically stops running. Make sure that there is a good Fibre Channel connection from the host to the SAN to which the storage subsystem is connected. Then restart the host or cluster node so that new host-agent-managed storage subsystems can be discovered.

Windows 2000

To stop and restart the host-agent software, perform the following steps:
1. Click **Start –> Programs –> Administrative Tools –> Services**. The Services window opens.
2. Right-click **IBM FAStT Storage Manager Agent**.

3. Click **Restart**. The IBM DS4000 Storage Manager Agent stops and then starts again.

4. Close the Services window.

Windows Server 2003

To stop and restart the host-agent software, perform the following steps:

1. Click **Start –> Administrative Tools –> Services**. The Services window opens.

2. Right-click **IBM FAStT Storage Manager Agent**.

3. Click **Restart**. The IBM DS4000 Storage Manager Agent stops and then starts again.

4. Close the Services window.

Uninstalling storage management software components

If you are upgrading from any Storage Manager version 8.x or 9.10, it will be necessary for you to remove all of the currently installed software before installing Storage Manager 9.14. No reboot is required after removing a Storage Manager software package version 8.3x or earlier. Existing storage array mappings and storage partition configurations are retained during software removal and will be recognized by the new client software.

Use the following procedure to uninstall one or more of the components of Storage Manager 8.x or 9.10. If you are uninstalling components released with an earlier version of the storage management software, use the uninstall procedure that came with the version of the storage management software that you are currently running.

Important: Do not uninstall the RDAC unless instructed by an IBM technical support representative. The host-agent package requires RDAC to function properly. If you uninstall RDAC in a coexistence environment, you will lose fibre-channel I/O path failover support for both the version 8.xx and version 9.xx of Storage Manager.

Uninstalling Storage Manager version 9.12 or later

1. Click **Start → Settings → Control Panel**. The Control Panel window opens. Select **Add/Remove programs**. The Add/Remove Programs Properties window opens.

2. Look for the entry IBM DS4000/FAStT Storage Manager Host Software v09.xx.x5.yy where xx or yy will be the main release (ie. 12) and the version (ie. 08) values, respectively.

3. Select the above entry and click **Change/Remove** button. The Uninstall Program opens.

4. Click **Next**. The Uninstall options window opens.

5. Select either to uninstall all installed DS4000 Host-software packages or uninstall certain specific packages only and click **Next**.

6. If you choose to uninstall a certain host-software package, a **Choose Product Features** window will be opened to allow you selecting the host-software package(s) that you want to uninstall. Click **Uninstall** to start the uninstallation process. Otherwise, the program will begin the uninstallation of all of the installed host-software packages.

7. Click **Done** when the window open to complete the DS4000 host-software uninstallation process. If you are uninstalling RDAC, you will need to reboot the host server.

> **Note:** Starting with DS4000 Storage Manager 9.12, it is possible to update the installed host-software with the newer versions without uninstalling the

existing installed version first. (The DS4000 Storage Manager host-software packages must be a later version than the installed Storage Manager version 9.12 host-software packages.) Just click **OK** when you are prompted that existing versions of the host-software were already installed in the host server and whether you want to updated them or not. Use the uninstallation instructions only when, for some reason, you are not able to update the existing installed host-software or you do not want the DS4000 Storage Manager host-software packages installed on the server.

Uninstalling Storage Manager version 8.x or 9.10

1. Click **Start** → **Settings** → **Control Panel**. The Control Panel window opens. Select **Add/Remove programs**. The Add/Remove Programs Properties window opens.

   Note: Uninstall the Storage Manager components in the following order:
   a. SMagent
   b. SMutil
   c. RDAC
   d. SMclient

2. Select the component you want to uninstall from the list of programs (for example, IBM DS4000 Storage Manager Client).

3. Click **Add/Remove**. The Confirm File Deletion window opens.

4. Click **Yes** to start the uninstallation process.

5. When the uninstallation is complete, click **OK**. If you are uninstalling RDAC version 08.4x.xx.xx or newer, you will need to reboot the host server

Appendix A. Installing previous Storage Manager versions in a NetWare configuration

This appendix describes how to install the Storage Manager versions 9.10 through 9.15 in standard (noncluster) and cluster server configurations in the NetWare 6.0 and 6.5 operating system environments.

Note: Although DS4000 Storage Manager 9.16 is not currently supported on NetWare, controller firmware version 06.16.xx.xx does support DS4000 storage subsystem attachment to a NetWare host.

If you have existing storage systems, read "Installation types" on page 27 and "Storage subsystem management methods" on page 16.

To ensure proper installation, complete all preparation tasks described in "Planning and preparing for NetWare installation."

Important: Always check the Storage Manager readme file for your operating system before installing the software. A readme file contains important information that was not available when this guide was prepared.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Planning and preparing for NetWare installation

Note: Servers with AMD, AMD64 or Intel EM64T processor architecture do not have Storage Manager 9.1x host software support when their operating systems are written in AMD64 or EM64T native code. If the IA-32 version of the operating system is installed and is running in compatibility mode on the AMD64 or EM64T servers, then you can use the appropriate IA-32 software package. Contact your IBM resellers or representatives for the latest information about Storage Manager 9.1x host software support for AMD64 or EM64T.

Table 21 on page 142 shows the installation sequence for Storage Manager software components and provides information to help you plan for the installation of the storage management software.

Important:

- If you are upgrading from Storage Manager version 8.x, remove the current software before installing Storage Manager version 9.1x.
- No reboot is required during the client software installation process. The Event Monitor software is installed automatically during client software installation.

Installation overview

You must install Storage Manager software components on both management stations and host computers.

Table 21 on page 142 shows the installation sequence for Storage Manager software components.

Table 21. Software component installation sequence in a Novell NetWare 6.0 environment

System type	Software installation sequence
Management station	Storage Manager 9.1x Client (SMclient)

Host computer and cluster node	1. Storage Manager 9.1x Client (SMclient)
	
	The Storage Manager 9.1x Client software package also includes the following host software components.
	
	  a. Storage Manager 9.1x Utility (SMutil)
	
	    This required component contains the hot_add and SMdevices utilities.
	
	  b. Storage Manager 9.1x Agent (SMagent)
	
	    This optional component is necessary if you intend to use the host-agent management method.
	
	2. Fibre Channel Host Bus Adapter device driver
	
	3. `LSIMPE.cdm` driver and NetWare native failover device driver

Important: Be sure to complete the following activities before you install Storage Manager 9.1x.

1. Uninstall Storage Manager 8.4x or 9.10. See "Uninstalling Storage Management 8.4x software components" on page 144 or "Uninstalling Storage Management 9.1x software components" on page 155.

2. Install the host bus adapter.

To install the storage management software in a NetWare 6.0 or 6.5 operating system environments, you *must* install the software on each host computer in the following order:

1. Fibre Channel Host Bus Adapter device driver
2. LSIMPE.cdm driver and NetWare native failover device driver
3. NetWare Agent component of Qlogic SANsurfer

NetWare software requirements

Table 22 lists the disk space that is required for installing the Storage Manager software in a NetWare environment. During the installation of each software package, you may need up to 130 MB of free disk space.

Table 22. Installation requirements for NetWare by software package

Package	Disk space requirement
Storage Manager 9.1x Client (SMclient)	65 MB
LSIMPE.CDM driver	2 MB
Qlogic SANsurfer (see the Notes at the end of the table)	2 MB
IBM HA device driver	2 MB

Notes:

1. Qlogic SANsurfer replaces FAStT MSJ.

2. Another 160 MB on a separate Microsoft Windows computer is required to install the actual Qlogic SANsurfer program. This program will work with the installed agent in the NetWare server to allow for the IBM DS4000 and FC2, FC2-133 Fibre Channel Host Bus Adapter maintenance and troubleshooting.

NetWare operating system requirements

Each management station, host computer, or cluster node requires one of the following operating systems.

Important: Check the Storage Manager readme files for the latest supported operating system and host software versions.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Management stations
- Windows 2000 Server with Service Pack 4
- Windows 2000 Professional with Service Pack 4
- Windows 2000 Advanced Server with Service Pack 4
- Windows XP
- Windows Server 2003 with SP1

Host computers
- Novell NetWare 6.0 with Service Pack 4
- Novell NetWare 6.5 with Service Pack 2

Cluster nodes
- Novell NetWare 6.0 with Service Pack 4 and NCS 1.6
- Novell NetWare 6.5 with Service Pack 2 and NCS 1.7

IBM DS4000 Storage Manager Version 9.1x software for NetWare

Note: Servers with AMD, AMD64 or Intel EM64T processor architecture do not have Storage Manager 9.1x host software support when their operating systems are written in AMD64 or EM64T native code. If the IA-32 version of the operating system is installed and is running in compatibility mode on the AMD64 or EM64T servers, then you can use the appropriate IA-32 software package. Contact your IBM resellers or representatives for the latest information about Storage Manager 9.1x host software support for AMD64 or EM64T.

The Storage Manager Version 9.1x software package contains the following software components for NetWare:
- The following component is installed on both the host and management station.
    - Storage Manager 9.1x Client (SMclient)
- The following components are installed only on the host.
    - LSIMPE.CDM

    Versions of this component appear on the latest IBM fibre channel HBA device driver for NetWare, on Novell NetWare Support Packs and on the Novell web site. Always select the latest version of this component for use. Download this software component from the following Web site:

    support.novell.com

> **Recommendation:** In a Novell Netware environment, you should manage the DS4000 storage subsystem using the direct (out-of-band) method.

Uninstalling Storage Management 8.4x software components

If you are upgrading from any Storage Manager version 8.4x, it will be necessary for you to remove the current software before installing Storage Manager 9.1x. No reboot is required after removing a Storage Manager software package. Existing storage array mappings and storage partition configurations are retained during software removal and will be recognized by the new client software.

Use the following procedure to uninstall one or more of the components of Storage Manager 8.4x. If you are uninstalling components released with an earlier version of the storage management software, use the uninstall procedure that came with the version of the storage management software that you are currently running.

1. From the Xserver Graphical Console, click **Novell → Install**.

   The Installed Products window opens.

2. In the list of currently installed products, select the component you want to remove from the list and click **Delete**.

   The name of the Storage Manager packages are:

   a. Storage Manager Agent. IBM recommends direct (out-of-band) management in Netware environment.

   b. Storage Manager Utility

   c. Storage Manager (this is the client)

3. Click **OK** in the Confirm Product Deletion window to proceed with the uninstallation. Repeat step 2 to remove each Storage Manger component.

4. A *Please Wait* pop-up window displays while the package uninstalls.

5. The Installed Products window will display again when the uninstallation is complete.

Storage Manager 9.14 or 9.15 Client

This section provides instructions for installing Storage Manager 9.1x Client on management stations and host computers.

Before you install the software, make sure that:

- The management station or host computer has at least 140 MB of available disk space.
- All programs are closed.
- The HBA and the driver are installed.

Important:

- When you install Storage Manager 9.1x client software on a stand-alone host and manage storage subsystems through the fibre-channel I/O path rather than through the network, you must install the TCP/IP software on the host and assign an IP address to the host.
- Modify these instructions as required for your particular installation.

Installing Storage Manager 9.1x Client (SMclient)

Perform the following steps to install SMclient:

1. Insert the IBM DS4000 Storage Manager installation CD into the CD-ROM drive.
2. Based on your version of Novell NetWare, perform one of the following actions:
   - Novell NetWare 6.0 with SP 4 or later, proceed with step 3.
   - Novell NetWare 6.5 with SP 2 or later, proceed with step 4.
3. To mount the installation CD, if needed, type the following command from the System Console and press **Enter**.

   `load CDROM`
4. To copy the *zip* file from the installation CD to the `sys:\volume` in the host NetWare system, type the following command from the System Console and press **Enter**.

   `copy cd<CDname>:\Netware\filename.zip  SYS:\`

   ...where `filename.zip` is the name of the *zip* file containing the IBM DS4000 Storage Manager host software for NetWare.

   In the NetWare Console window, unzip the `filename.zip` file using the following command:

   `unzip -o SYS:\filename.ZIP`

   The system extracts the `install.ncf` file and the `instdata` directory to the temporary location specified.

   ...where `SYS:\` is the *zip* file's temporary location.
5. From the System Console window, type the following command, and press **Enter**.

   `sys:/install`

   The Please Wait window displays while the software is loading. When the software is loaded, the Introduction window displays.
6. Select **Next**.

   The License Agreement window displays.
7. Read and select the option that accepts the terms of the License Agreement.
8. Select **Next**.
9. The Choose Install Folder window opens. Click the **Choose** button to select a folder different than the default folder listed. The default folder name is `StorageManager`.
10. Click **Next** to continue.
11. The 20-Second Delay dialog displays.
12. Select **OK**.
13. The Select Installation Type window displays.
14. Ensure that for the host, the Typical (Full) Installation installation type is selected.
    - The full installation type involves installation of the following components:
      – SMclient
      – SMagent
      – SMutil
    - The custom installation type allows you to manually select the options for installation.
    - The management station only installation type involves installation of only SMclient.

    The selected installation type is indicated in blue text.
15. Select **Next**.

If the software already exists, the Overwrite Warning dialog displays.

16. Select **OK**.

   The Pre-Installation Summary window displays.

17. Select **Install**.

   The Installing window displays while the software is loading. When the software is loaded, the Install Complete window displays.

18. Select **Done**.

   The Restart The GUI dialog displays.

19. Read and select **OK**.

Verifying the Storage Manager 9.1x Client installation

Perform the following steps to restart the GUI and to verify that the packages were successfully installed:

1. From the Novell menu, select **Close GUI...**.

   The Close GUI dialog displays.

2. Select **OK**.

3. To restart the GUI, type the following command from the System Console, and press **Enter**.

   `startx`

4. Select **Novell → Programs**, and verify that the IBM DS4000 Client program name displays in the Programs list.

5. Open the file browser and select the install folder named: `sys:\storagemanager`. You will see Client, Agent, and Util folders if you selected the Typical (Full Installation) option during the installation procedure.

6. Verify that `SMagent.ncf` files reside in the `SYS:\StorageManager\Agent` directory. See "Stopping and starting the host-agent software" on page 154.

7. Verify that the `hot_add.ncf` and `SMdevices.ncf` files reside in the folder that you installed the NetWare Host software. Its default location is `SYS:\StorageManager\util`.

8. Depending on success or failure of the installation, do one of the following:

   If the IBM DS4000 Storage Manager 9 Client Enterprise Management window displays, the installation was successful. Perform activities detailed in "Removing the temporary files" and Chapter 8, "Completing storage management installation and configuration," on page 109

   If the IBM DS4000 Storage Manager Client does not display, a failure has occurred and the installation was unsuccessful. Repeat the steps detailed in "Installing Storage Manager 9.1x Client (SMclient)" on page 144 and "Verifying the Storage Manager 9.1x Client installation." If the failure persists, refer to Storage Manager 9.1x Release Notes or contact your IBM technical support representative.

Removing the temporary files

Use the following procedure to remove the temporary installation files from the temporary directory.

1. Using the NetWare File Browser, select and delete the `install.ncf` file and the `InstData` directory in the `SYS:\` volume

   Note: This file and directory are in the root of the `SYS:\` volume unless the user placed them elsewhere. Delete them using the file browser delete function.

2. Choose one of the following actions:
- **Storage management software is required on other systems** — For each system that will be used as a storage management station or host, perform the software removal and installation procedures described in "Planning and preparing for NetWare installation" on page 141 and "Installing Storage Manager 9.1x Client (SMclient)" on page 144.
- **Storage management software installation is complete is completed on all systems** — See "Starting the host agent manually" on page 154.

Installing the NetWare fibre channel HBA device driver

An IBM fibre-channel host bus adapter (HBA) provides the interface between a host server and a DS4000 storage subsystem. IBM DS4000 fibre-channel HBAs are high-performance, direct memory access, bus-master, host adapters that are designed for high-end systems. These HBAs support all fibre-channel peripheral devices that support private-loop direct-attach and fabric-loop attachment. The Novell NetWare native failover device driver enables your operating system to communicate with the fibre-channel HBA.

See the readme file included in the driver package for installation instructions associated with your operating system. For more information, see the Installation and User's Guide for your particular fibre-channel HBA model. Additional information can also be found in Appendix E, "Host bus adapter settings," on page 185.

Note: Depending on your controller's firmware version, change the LUNs per target BIOS setting from the default value of 0 to 31 or 255 for IBM DS4000 fibre channel HBA. In addition, review the device driver readme for any other required modifications to the default HBA BIOS and host operating system registry settings to ensure optimal performance. If you make any changes to the HBA BIOS settings, the machine will reboot automatically.

The current readme file and latest multipath I/O device driver are available at the following Web site:

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

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Continue with "Installing Qlogic SANsurfer" on page 148.

Installing the LSIMPE driver and NetWare native failover device driver

The NetWare native failover device driver is available in NW5.1 SP7 or later, NW6.0 SP3 or later, and in NW6.5 SP1a or later.

Note: Always use the Novell NetWare native failover device in the latest SP for a particular NetWare operating system version. In addition, use the later version of the LSIMPE.CDM file from either the latest Novell Support Pack or the version that is included with the IBM Fibre Channel HBA device driver for NetWare which is available at the IBM DS4000 support web site.

The LSIMPE.CDM driver is used in a Novell NetWare environment to enable the Novell native multipath device driver to recognize the NetWare host-mapped logical drives that were created on DS4000 storage subsystems. The LSIMPE.CDM driver is a custom driver module that is packaged with the IBM DS4000 Host Adapter driver

and the Novell operating system distribution CD. In case of a failure along the I/O path, the Novell native multipath device driver sends the I/O requests through the alternate path and Auto-Volume Transfer (AVT) moves the logical drive within the DS4000 storage subsystem.

See the current IBM Fibre Channel HBA device driver readme file for the current `LSIMPE.CDM` driver, and the pointer to the Novell native multipath device driver installation instructions.

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

Continue with "Installing the NetWare fibre channel HBA device driver" on page 147.

Installing Qlogic SANsurfer

After you install IBM DS4000 Storage Manager, consider installing the Qlogic SANsurfer Storage Management Suite. You can use this diagnostic application to verify the status of the fibre channel connections before you use the storage subsystem.

For information about installing and using this software, see the *IBM TotalStorage DS4000 Problem Determination Guide* or see the Storage Manager online help.

Note: Qlogic SANsurfer replaces FAStT MSJ, and serves the same function as FAStT MSJ.

Setting up a Novell NetWare DHCP server

To directly manage storage subsystems through the Ethernet connection to each controller, you will need to set up a DHCP or BOOTP-compatible server and configure the following options:
- Router/Gateway
- DNS Server
- Hostname
- DNS

A Novell NetWare DHCP server automatically assigns IP addresses and other configuration information to clients upon request or when the clients are restarted.

Perform the following steps to set up a Novell NetWare DHCP server:
1. Install DNS/DHCP Services, either during or after installing NetWare 6.
2. Install the DNS/DHCP Management Console.
3. Create the DHCP server object.
4. Create the DHCP subnet address.
5. Create the subnet address range.
6. Create the IP address object.
7. Start the DHCP server.

Each of these tasks is described in detail in the sections that follow.

Adding Novell DNS/DHCP Services during the NetWare 6.0 installation

Perform the following steps to add Novell DNS/DHCP Services during the NetWare installation:

1. From the Installation Options window, select **Custom**.
2. From the Components window, select the **Novell DNS/DHCP Services** check box.
3. Follow the on-screen instructions to complete the NetWare installation.

Adding Novell DNS/DHCP Services after the NetWare 6.0 installation

Perform the following steps to add Novell DNS/DHCP Services after the NetWare installation:

1. Insert the NetWare 6.0 Installation CD into the CD-ROM drive. Then mount the CD as a volume.
2. Load NWCONFIG and select **Product Options**.
3. Select **Install a Product not Listed**.
4. Press **F3** and specify the volume name of the CD. The X Server-Graphical Console window opens.
5. In the **Additional Products and Services** dialog box, select the **Novell DNS/DHCP Services** check box.
6. Follow the on-screen instructions to complete installation.

Note: Installing the DNS/DHCP Service will extend the Novell Directory Services (NDS) schema and create the following NDS objects:
   - DNSDHCP-GROUP Group object
   - DNS/DHCP Locator object
   - RootServerInfo Zone object

Installing the DNS/DHCP Management Console

Perform the following steps to install the DNS/DHCP Management Console and NetWare Administrator snap-in files on the client workstation you will use to administer DNS and DHCP:

1. If you have not done so, install the latest version of Novell Client 32 on your workstation.
2. From the workstation, run the `SYS:PUBLIC\DNSDHCP\SETUP.EXE` program.
3. Install the DNS/DHCP Management Console on the local hard-disk drive.
4. Install the NetWare Administrator snap-in files in the `SYS:PUBLIC\WIN32` directory.
5. Restart the workstation.
6. To start the DNS/DHCP Management Console, double-click the shortcut icon on the desktop, type the NDS tree name, and click **Launch**.

Note: You can install the DNS/DHCP Management Console on a workstation, or you can access it from the Tools menu of the NetWare Administrator utility.

Creating the DHCP server object

Use the DHCP Management Console to create a DHCP server object. You can create a DHCP server object under any of the following objects:
- Organization (O)
- Organization Unit (OU)
- Country (C)
- Locality (L)

Perform the following steps to create a DHCP server object:

1. From the DHCP Management Console, click the **DHCP Service** tab.
2. In the left pane, select **Our Network**.
3. Click **Create**. The Create New DHCP Object window opens.
4. Select **DHCP Server**. Click **OK**. The Create DHCP Server window opens.
5. Select a server. Click **Create**. This creates the DHCP server object, called DHCP_servername, in NDS.
6. In the DHCP Management Console, locate the icon for the DHCP server object at the bottom of the DHCP Service tab. The server object displays with a red line through it, indicating that the DHCP server has not been started.
7. Continue with "Creating the DHCP subnet object."

Creating the DHCP subnet object

Perform the following steps to create a DHCP subnet object for each of the subnets for which you want to assign addresses:

1. In the DNS/DHCP Management Console, click the **DHCP Service** tab.
2. Select **Our Network** or the **DHCP Server Object**.
3. Click **Create**. The Create New DHCP Object window opens.
4. Select **Subnet**. Then click **OK**. The Create Subnet window opens.
5. For each subnet, type the following information:
   - Subnet name
   - NDS context
   - Subnet address
   - Subnet mask
   - Default DHCP Server
6. Click **Create**. The DHCP subnet object is created and displayed in the DNS/DHCP Management Console.

Creating the subnet address range

Perform the following steps to create a subnet address range object:

1. From the DNS/DHCP Management Console, click the **DHCP Service** tab.
2. Select the subnet object under which you want to create the subnet address range object. Then click **Create**. The Create New DHCP Record window opens.
3. Select **Subnet Address Range**. Then click **OK**. The Create New Subnet Address Range window opens.
4. Type the following information for the subnet address range:
   - Subnet address range name
   - Starting address
   - Ending address
5. Click **Create**.
6. Select the **Define Additional Properties** check box. Then set the Range Type to **Dynamic BOOTP and DHCP**.

Creating the IP address object

Use the DNS/DHCP Management Console to create IP address objects. You use IP address objects for the following purposes:

- To exclude an IP address from assignment
- To assign an IP address manually to a specific host

- To record dynamic IP address leases

Perform the following steps to create an IP address object:
1. From the DNS/DHCP Management Console, click the **DHCP Service** tab.
2. Select the subnet object of the target IP address. Then click **Create**.
3. Select **IP Address**. Click **OK**. The Create IP Address window opens.
4. In the **IP Address** field, type the IP address for the first controller.
5. In the **Assignment** field, select **Manual**.
6. In the **Client Identifier** field, specify the MAC address.
7. In the **MAC Address** field, enter the hardware Ethernet MAC address for the controller.
8. Select the **Define Additional Properties** check box.
9. In the **Hostname** field, type the eight-character name for the controller.
10. In the **Usage** field, select **Permanent**.
11. Repeat steps 3 through 10 for each controller.

Starting the DHCP server

To start the DHCP server, at the DHCP server console, type:

`LOAD DHCPSRVR`

The DHCP server can now respond to client requests and assign IP addresses.

Notes:
1. To load the DHCP server automatically each time the server starts, place the DHCPSRVR command in the `SYS:\SYSTEM\AUTOEXEC.NCF` directory.
2. For additional information about setting up, configuring, or using Novell DNS/DHCP Services, see either the Novell Documentation CD or to the following Web site:

   www.novell.com/documentation/

Verifying the TCP/IP protocol and setting up the host or DNS table

The normal default installation process will install the TCP/IP software package.

Perform the following steps to set up the host or DNS table. Make sure that the host names for the controller match the IP addresses for the controllers.

Important: To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data after you complete these steps.

1. Update either the host table or the DNS table to specify a host name to associate with an IP address. If you do not have a DNS table, edit the two host tables that are found in the `sys:etc\hosts` directories. (Your directory will be different if the operating system is not installed on the root.)

   To set up the host tables for the controllers, open the hosts file that is located in the `\etc\` directory. Use a text editor to update the host file to create the following IP address and controller name entries. For example:

   Mappings of host names and host aliases to IP addresses

   `127.0.0.1   loopback lb local host loopback address`

   Examples from a fictitious network:

```
129.47.4.2 ta tahiti ta.some.com loghost
129.47.6.40 osd-frog
129.47.6.144 sj-in5 in5
197.67.172.71 sj-in1 in1
```

Configuring storage management

After you install Storage Manager, complete the tasks that are described in Chapter 8, "Completing storage management installation and configuration," on page 109. These tasks include the following:

- Performing an initial automatic discovery of storage subsystems
- Adding devices
- Naming storage subsystems
- Creating arrays and logical drives
- Downloading controller firmware and NVSRAM
- Verifying and defining the default host type
- Setting up alert notifications

Using the storage management software for NetWare

This section provides information on how to add or delete logical drives using the hot_add and SMdevices utilities, start and stop the host-agent software, and uninstall Storage Manager components in a NetWare operating system environment.

Adding or deleting logical drives

Use the following instructions to add or delete logical drives in a standard (noncluster) configuration.

Creating logical drives

When you create new logical drives with the storage management software, you must add the new logical drives to Novell NetWare. Refer to the Novell NetWare documentation for details about adding a drive. Novell NetWare recognizes each logical drive (not array) as a single drive.

After creating logical drives, run the hot_add and SMdevices utilities that are provided with the storage management software. The Hot Add utility adds newly created logical drives to the operating system, and the SMdevices utility identifies logical drives by their associated operating system device names. For information about how to use these utilities, see "Using the hot_add utility" on page 153 and "Using the SMdevices utility" on page 153.

Deleting logical drives

Important: If you have data or logical drives that you want to keep, do not click **Configure → Reset Configure**. This will reset the controller unit and delete *all* previously-configured logical drives.

Before you delete logical drives with the storage management software or use **Configure → Reset Configuration**, stop all input and output activity to the affected storage subsystem. Then dismount any Novell NetWare volumes that are associated with the logical drives.

Using the hot_add utility

The hot_add utility enables you to add new logical drives without restarting the system. The utility registers the new logical drives with the operating system so that you can use nwconfig to create partitions, add device names, and so on. The hot_add utility is part of the Storage Manager 9.1x Utility package.

When you finish creating logical drives on a particular storage subsystem, go to the host that is attached to that storage subsystem, and perform the following steps to use the hot_add utility:

1. From the Server Console, type:

   ```
   InstalationFolder(ie. SYS:\StorageManger)\Util\hot_add
   ```

2. Press **Enter**.

   The new logical drives are available through the NetWare Disk Manager.

Using the SMdevices utility

The Storage Manager 9.1x Utility software package includes a utility called SMdevices that you can use to view the storage subsystem logical drive that is associated with a particular operating-system device name. This utility is helpful when you want to create drives, volumes, or a combination of both for the logical drive using the nwconfig program.

When you finish creating the logical drives on a particular storage subsystem, go to the host that is attached to that storage subsystem, and perform the following steps to use SMdevices:

1. From the Server Console type:

   ```
   InstalationFolder(ie. SYS:\StorageManger)\Util\SMdevices
   ```

2. Press **Enter**.

   The software displays device identification information. For example, you might see the following:

   Note: Note: IN NW6.5, the following information is displayed in the Logger window instead of on the same NetWare Console window screen.

```
V596-A3-D0:0[Storage Subsystem MARKETING, Logical Drive DEBIT,
LUN 0, WWN <600a0b800007545c0000008d3a308b6e>]

V596-A3-D0:1 [Storage Subsystem MARKETING, Logical Drive DEBIT, LUN 1,
WWN <600a0b80000756ec000000a93a307d2a>]

V596-A3-D0:1F [Storage Subsystem MARKETING, Logical Drive Access volume,
LUN 31, WWN <600a0b800007545c0000009000000000>]

Where V596-A3-D0:0;
```

The numbers at the beginning of each line constitute the device name. The device name identifies the adapter or device as follows:

Vendor number [V596]. A unique number specific to the device vendor.

Adapter number [A3]. The instance number of an adapter registered with NWPA. In the example, A3 identifies the first instance of an adapter installed in the server.

Device number [D0]. The number of the disk or other device.

Logical unit number [0,1,1F]. The LUN identifies individual devices when more than one device is attached to one bus.

Storage Subsystem [x]. The storage subsystem name.

Logical Drive [x]. The logical drive name.

LUN [x]. The logical unit number associated with the logical drive.

WWN [x]. The worldwide name for the logical drive.

Stopping and starting the host-agent software

Use the procedures in the following sections to stop and start the host-agent software installed on the host or cluster node.

Notes:

1. The `smagent.nlm` module will remain loaded after the agent `java` service ends until you reboot the server.

2. If an access logical drive is not detected after a restart, the host-agent software will automatically stop running. Restart the host or cluster node so that new host-agent-managed storage subsystems will be discovered.

3. SMagent requires that JAVA version 1.4.2 or later be installed. Unpredictable behavior may result if versions earlier than version 1.4.2 version are installed.

Stopping the host-agent software

You must stop the host-agent software if you want to add storage subsystems. When you restart the service, the host-agent software discovers the new storage subsystems and adds them to the management domain.

Perform the following steps to stop the host-agent software:

1. From the system console, press **Ctrl+Esc**, and then select **System Console**.

2. At the prompt, type:

   ```
   java -show
   ```

   Look for the following line:

   ```
   "devmgr.versioned.agent.AgentServer.............QQQ"
   ```

   where *QQQ* is the process ID.

3. At the prompt type the following:

   ```
   java -killQQQ
   ```

   where *QQQ* is the process ID from the **java -show** command.

4. Press **Enter**.

Starting the host agent manually

To add storage subsystems, start the host-agent software manually either when you start the system or if it is already stopped.

Perform the following steps to start the host agent manually:

1. From the system console, press **Ctrl+Esc**, and then select **System Console**.

2. At the prompt, type:

   ```
   smagent
   ```

3. Press **Enter**.

   The agent will start and display the following message when UTM LUNs are scanned:

   ```
   Activating
   ```

4. Return to ConsoleOne. Press **Ctrl+Esc**, and then click **Xserver → Graphical Console**.

Uninstalling Storage Management 9.1x software components

Use the following procedure to uninstall one or more of the components of Storage Manager 9.1x.

1. From the Xserver Graphical Console, type the following command and press **Enter**.

    ```
    sys:\storage manager\suiteuninstall.ncf
    ```

    The Uninstall window opens.

2. Select **Next**.

    The Uninstall Options window opens.

3. Select the **Complete Uninstall** option.

4. Select **Next**.

    When the software removal completes, the Uninstall Complete window opens.

5. Select **Done**.

    The Restart the GUI dialog opens.

6. Select **OK**.

7. From the Novell Menu select *Close GUI...*

    The Close GUI dialog opens.

8. Select **Yes**.

9. To restart the GUI, from the System Console, type the following command, and press **Enter**.

    ```
    startx
    ```

10. Using the NetWare File Browser, select and delete the `install.ncf` file and `InstData` directory in the `SYS:\` volume. This file and the directory are in the root of the `SYS:\` volume, unless the user choose to place it elsewhere.

    Note: Do not perform this step if you already deleted the files required for installation when you installed the IBM DS4000 Storage Manager host software for NetWare.

11. Are you installing a new version of the software?

    Yes. See Appendix A, "Installing previous Storage Manager versions in a NetWare configuration," on page 141.

    No. You have completed this procedure.

NetWare operating system limitations

This appendix contains information about how to operate the storage management software in a NetWare environment. For the most up-to-date information, always check the most recent DS4000 Storage Manager readme file for NetWare.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Note: These limitations may only occur when you manage storage subsystem with older firmware versions.

Table 23 on page 156 lists the limitations that apply when you use the IBM DS4000 Storage Manager Version 9.1x with Novell NetWare.

Table 23. Novell NetWare limitations and workarounds

Limitation	Workaround
If you are upgrading controller firmware in IBM FAStT500 storage controller (M/T 3552) with 512MB Cache, you will have to stop I/O and reboot both controllers before upgrading firmware followed by NVSRAM. You can reboot the controllers either by power cycling the storage subsystem or by pressing the Reset button on both controllers. The **Reset** button is located on the right of the indicator lights in the opening on the front of each controller unit. To determine Storage Controller cache level, perform the following: 1. On a storage management station start the client software and select a storage subsystem. 2. Select **Tools → Manage Device** to open the Subsystem Management Window. 3. Highlight the Storage Subsystem that you are upgrading and then select **Storage Subsystem → Profile**. It may take a little time for it to create the Storage Subsystem profile. 4. Under the Controllers heading is an entry that displays information similar to the following example: `Cache/processor size (MB): 256/32` If this setting is listed as 512/32 you will need to arrange to perform this upgrade procedure at a time that you can stop I/O to the Storage Subsystem in order to ensure a successful firmware download and installation.	None.
The system might display the DS4000 Storage Manager dialog windows as cropped without the vertical and horizontal scroll bars.	Move the mouse pointer over the edge of the window until the mouse pointer changes to a window resize pointer. Left-click your mouse; hold to grip the window's edge and resize the window.

Table 23. Novell NetWare limitations and workarounds (continued)

Limitation	Workaround
Storage Manager prompts you for a password if all hard disk drives are removed from the storage subsystem. After removing all drives from a storage subsystem (or powering on the controller only without any drive expansion enclosures), the IBM DS4000 Storage Manager software will prompt you for a password when trying to start the software or trying to perform protected operations. Any password entered will fail. Password information is stored on a reserved area of each hard disk drive on the storage subsystem. Each drive stores a mirrored copy of the password data. When there are no drives in the storage subsystem, the storage management software does not find the password data when you attempt password protected operations. Add one drive to the storage subsystem and retry the operation.	Since the RAID controller unit should not be powered on until the expansion units are attached and powered on, this should be done by powering off the RAID controller unit, properly attaching all expansion units (with drives installed), to the RAID controller unit and powering them on, and then powering the RAID controller unit back on. At this point the storage subsystems can be re-discovered and managed using the IBM DS4000 Storage Manager 8.3 software.
It is possible to circumvent IBM DS4000 storage subsystem hardware and software designs for redundant pathways from the host system. This is accomplished by connecting a single host adapter from the host system to one of the controller mini-hubs, and then connecting this mini-hub to the mini-hub of the other controller, creating a Fibre Channel-Arbitrated Loop (FC-AL) between the host adapter and the two IBM DS4000 storage subsystem controllers. This configuration leaves no redundant path to the host system.	When connecting two mini-hubs together, always connect the IN port of one mini-hub to the OUT port of the other mini-hub or visa-versa. Do not connect the IN port of one to the IN port of the other mini-hub or the OUT port of one mini-hub to the OUT port of the other mini-hub. This configuration is not supported by IBM.
Dynamically changing the cache read ahead multiplier setting via the storage manager client may result in an error message indicating the operation has failed. Despite the error message, the request to change the cache read ahead multiplier will remain queued to the controllers and will eventually complete when I/O activity to the storage subsystem has subsided.	In order to avoid the error message and any delays in the cache read ahead multiplier value changing, it is recommended to change the cache read ahead multiplier when the subsystem is in a quiesced state.
If the SMagent is running on the NetWare server and a fiber-optic cable is pulled or a path failure occurs, the NetWare server might end.	Stop the SMagent and manage the DS4000 using the direct (out-of-band) method of management. See "Stopping the host-agent software" on page 154 and use the procedure for uninstalling the SMagent software.
Clicking a vertical scroll arrow (either up or down) causes the scroll box to move all the way to the opposite end of the scroll bar.	This is a known defect in the Java Runtime Environment. Click the scroll box and slide it until you reach the desired position in the Help window.

Table 23. Novell NetWare limitations and workarounds (continued)

Limitation	Workaround
Logical drive migration (removing a set of drives that are configured with logical drives from one storage subsystem for insertion into another storage subsystem) is not supported because it could cause loss of configuration.	Either use the migration instructions in the *IBM TotalStorage DS4000 Fibre Channel Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* or contact an IBM technical support representative for assistance in performing this procedure.
When you manage storage subsystems through the host-agent software and use the storage management software to download controller firmware, the download process can take up to 10 minutes to complete.	None.
The controller firmware does not recognize or communicate with a single controller until slot A is populated. This limitation does not apply to storage subsystems that were originally configured with two controllers.	When you configure a new storage subsystem with a single controller, you must place the controller in slot A.
Public loop configurations (managed hubs that are attached to switches) are not supported.	None.
Multipath failover will work only if the storage controllers are in active/active mode.	When you configure the storage subsystem, change both controllers to active status.
When you remove a fan or power supply field replaceable unit (FRU) from a storage subsystem while the system is running, the storage management software does not report an error message, and the component is not reported as missing. **Note:** Fan and power supply FRU failures are reported.	Replace the missing fan or power supply FRUs immediately to ensure redundancy. Make sure that the fan or power supply FRU is properly seated in the controller unit.
Your windows and online Help displays a brownish hash pattern when you run in 256-color mode.	Run the Storage Manager 8.4 application in a higher display mode.
When performing a redundancy check (parity scan) from the storage management application, machine type 3542 (FAStT200) can take several minutes longer than machine type 3526 (IBM Netfinity Fibre Channel RAID Controller Unit) and 3552 (FAStT500) controller platforms.	None.
When attempting to manage a storage subsystem where the RAID controller unit does not have access to logical drives, Storage Manager prompts you for a password. This occurs even if no password has been set up. The automatic discovery locates and identifies each storage subsystem as two separate storage subsystems.	Ensure that at least one IBM DS4000 EXP700 Storage Expansion Unit with at least one logical drive is properly attached to the IBM DS4400 RAID controller unit in each storage subsystem being managed. The RAID controller unit should not be powered on until the expansion units are attached and powered on. Power off the RAID controller unit, properly attach all expansion units with the drives installed to the RAID controller unit, and power them on; then, power on the RAID controller unit. At this point, the storage subsystems can be rediscovered and managed by using the DS4000 Storage Manager software.

Table 23. Novell NetWare limitations and workarounds (continued)

Limitation	Workaround
You might not see the maximum number of drives during Automatic Configuration if you are using drives of different capacities.	Use Manual Configuration to select individual drives and select the maximum number of drives allowed.
When you connect an IBM TotalStorage DS4000 EXP700 Storage Expansion Unit to a FAStT200, the drive speed must be set to 1 Gbps.	None.
When you issue a Subsystem Management command from the IBM DS4000 Storage Manager client, the command may be cached. If so, the system issues the error: `Error 21 - The Operation cannot complete because a...` is in progress. The IBM DS4000 Storage Manager client will run such cached commands as soon as the controller resources become available.	Wait for at least ten minutes; then, check to see if the IBM DS4000 Storage Manager client has run the command. If it has not, reissue the command.

Appendix B. Installing Storage Manager 9.10 Client

Storage Manager 9.10 Client

This section describes how to install SMclient on management stations and host computers that run Windows operating systems.

Before you install the software, make sure that the management station or host computer has at least 80 MB of available disk space.

Important: When you install SMclient on a stand-alone host and manage storage subsystems through the fibre-channel I/O path rather than through the network, you must install the TCP/IP software on the host and assign an IP address to the host.

Installing SMclient

To install SMclient on Windows operating systems, perform the following steps:

1. Insert the IBM DS4000 Storage Manager Version 9.10 CD into the CD-ROM drive.
2. Click **Start → Run**. The Run window opens.
3. Click **Browse**. The Browse window opens.
4. Select the CD-ROM drive.
5. Select the folder that is associated with your operating system.

Operating System	Folder
Windows 2000 or Advanced Server	\Win32\SMclient
Windows Server 2003 (32 bit)	\WS03_32bit\SMClient
Windows Server 2003 (64 bit)	\WS03_64bit\SMClient[1]

1. To be used for servers with Intel architecture 64-bit (IA-64) processors only. Servers with AMD AMD64 or Intel EM64T processor architecture have no Storage Manager 9.10 host software support when their operating system are written in AMD64 or EM64T native code. If the IA-32 version of the operating system is installed in the AMD64 or EM64T servers, then you can use the IA-32 software package. Be certain to access the appropriate package.

   Click **Open**.
6. Select the displayed .exe file. Click **Open**. The InstallShield Wizard window opens; then, the Prepare to Install window (showing the software unpacking progress) opens, after which the Welcome window opens.
7. Click **Next**. The Controller Firmware Warning window opens. Read the information and click **OK**. The Copyright window opens. Read the information and click **OK**.The End User License Agreement window opens.
8. Perform the following procedures:
   a. Read the license agreement and click **Yes**. The Choose Destination Location window opens.
   b. Click **Browse** to change the destination location. Click **Next** to continue with the installation.
   c. The Event monitor window opens. Click **Yes** if you want to install the Event Monitor. Otherwise, click **No**.
   d. The Setup Status window opens showing the installation progress. When the installation is complete, the Operation Complete window opens.
   e. Click **Finish**.

f. Continue with "Verifying the SMclient installation."

Verifying the SMclient installation

To verify that you installed SMclient correctly on Windows operating systems, perform the following steps:

1. Perform one of the following steps depending on your operating system:
   - For Windows 2000, click **Start → Programs**.
   - For Windows Server 2003, click **Start → All Programs**.

2. Verify that `IBM FAStT Storage Manager 9 Client` displays in the Program list. If the appropriate software version displays, go to step 3.

   Otherwise, repeat "Installing SMclient" on page 161. If the appropriate software version associated with your operating system still does not display, a failure has occurred. Contact your IBM technical support representative.

3. If you installed the optional Event Monitor service, go to "Verifying the Event Monitor installation." Otherwise, continue to step 4.

4. If you are installing SMclient on a host computer, go to "RDAC" on page 163. Otherwise, go to Chapter 8, "Completing storage management installation and configuration," on page 109.

Verifying the Event Monitor installation

This section describes how to verify that you installed the Event Monitor service correctly on Windows operating systems.

Windows 2000

To verify that you installed the Event Monitor service correctly, perform the following steps:

1. Click **Start → Programs → Administrative Tools → Services**. The Services window opens.

2. Verify that the IBM DS4000 Storage Manager 9 Event Monitor service displays with the startup type `Automatic` and status `Started`. If it does not display, click **Start**. If it does not start, reinstall the SMclient. If the failure persists, call your IBM technical support representative.

3. If you are installing the storage management software on a host computer, go to "RDAC" on page 163. Otherwise, go to Chapter 8, "Completing storage management installation and configuration," on page 109.

Windows Server 2003

To verify that you installed the Event Monitor service correctly, perform the following steps:

1. Click **Start → Administrative Tools → Services**. The Services window opens.

2. Verify that the IBM DS4000 Storage Manager 9 Event Monitor service displays with the startup type `Automatic` and status `Started`. If it does not display, click **Start**. If it displays but does not start, reinstall the SMclient. If the failure persists, call your IBM technical support representative.

3. If you are installing the storage management software on a host computer, go to "RDAC" on page 163. Otherwise, go to Chapter 8, "Completing storage management installation and configuration," on page 109.

RDAC

This section describes how to install RDAC on Windows operating systems. You must install RDAC on each host computer. RDAC contains the multipath device driver that is necessary for controller failover support.

Before you install the software, ensure that the following conditions are met:
- You have Administrator privileges on the host computer.
- The host computer has at least 2 MB of available disk space.
- All programs are closed.
- You have installed the host bus adapter and driver.

If you are installing RDAC on Windows 2000 or Windows Server 2003, continue with "Installing the RDAC."

Installing the RDAC

To install RDAC on Windows operating systems, perform the following steps:
1. Insert the IBM DS4000 Storage Manager Version 9.10 CD into the CD-ROM drive.
2. Click **Start → Run**. The Run window opens.
3. Click **Browse**. The Browse window opens.
4. Select the CD-ROM drive.
5. Select the directory that is associated with your operating system.

Operating System	Directory
Windows 2000 Server or Advanced Server	\Win32\SMrdac\W2K
Windows Server 2003 for 32-bit processors	\WS03_32bit\SMrdac
Windows Server 2003 for 64-bit processors	\WS03_64bit\SMrdac[1]

1. To be used for servers with Intel architecture 64-bit (IA-64) processors only. Servers with AMD AMD64 or Intel EM64T processor architecture have no Storage Manager 9.10 host software support when their operating system are written in AMD64 or EM64T native code. If the IA-32 version of the operating system is installed in the AMD64 or EM64T servers, then you can use the IA-32 software package. Be certain to access the appropriate package.

6. Select the displayed .exe file. Click **Open**. The InstallShield Wizard window opens; then, the Welcome window opens.
7. Click **Next**. The End User License Agreement window opens.
8. Click **Yes** to start the installation. The Installation/Removal status window opens displaying the RDAC installation progress. Continue with step 9.
9. After the installation is complete, the Operation Complete window opens.
10. Select **Yes I want to restart my computer now**. Click **Finish**.
11. Continue with "Verifying the RDAC installation."

Verifying the RDAC installation

This section describes how to verify that you installed RDAC correctly on Windows operating systems.

Windows 2000
To verify that you installed RDAC correctly, perform the following steps:

1. Click **Start → Programs → Administrative Tools → Computer Management**. The Computer Management window opens. Go to the `\System Tools\System Information\Software environment\drivers` directory.
2. Scroll through the list and select one of the following device drivers:
   - `rdacbus`
   - `rdacdisk`

   The `rdacbus` option always displays. The `rdacdisk` option displays only when you have disks.
3. Verify that either `rdacbus` or `rdacdisk` displays with the state type `Running` and status `OK`. If neither does, repeat the procedure in "Installing the RDAC" on page 163. If the failure persists, call your IBM technical support representative. Otherwise, continue as follows:
   - If you are managing the storage subsystems using the host-agent method, continue with "Storage Manager 9.10 Agent."
   - If you are managing your storage subsystems using the direct-management method, go to "Storage Manager 9.10 Utility" on page 166.

Windows Server 2003

To verify that you installed RDAC correctly, perform the following steps:

1. Click **Start → All Programs → Accessories → System Tools → System information**. The System Information window opens. Go to the `\System Summary\Software Environment\System Drivers` list.
2. Scroll through the list and select one of the following device drivers:
   - rdacbus
   - rdacdisk

   `rdacbus` is always shown. `rdacdisk` displays only when you have disks.
3. Verify that either `rdacbus` or `rdacdisk` displays with the state type `Running` and status `OK`. If it does not display, repeat the procedure in "Installing the RDAC" on page 163. If the failure persists, call your IBM technical support representative. Otherwise, continue as follows:
   - If you are managing the storage subsystems using the host-agent method, continue with "Storage Manager 9.10 Agent."
   - If you are managing your storage subsystems using the direct-management method, go to "Storage Manager 9.10 Utility" on page 166.

Storage Manager 9.10 Agent

This section describes how to install SMagent software on Windows operating systems. You *must* install the SMagent software if you want to manage the storage subsystem using the host-agent management method.

Before you install the software, ensure that the following conditions are met:
- You have Administrator privileges on the host computer.
- The host computer has at least 1 MB of available disk space if the SMclient is installed with the Event Monitoring service.
- The host computer has at least 40 MB of available disk space if the SMclient program is not installed with the Event Monitoring service.
- RDAC is installed on each host computer. If not, see "RDAC" on page 163.
- All storage subsystems are connected to the host computer and are powered on.

Installing SMagent

To install SMagent on Windows operating systems, perform the following steps:

1. Close all programs.
2. Insert the IBM DS4000 Storage Manager Version 9.10 CD in the CD-ROM drive.
3. Click **Start → Run**. The Run window opens.
4. Click **Browse**. The Browse window opens.
5. Select the CD-ROM drive
6. Select the folder that is associated with your operating system.

Operating System	Folder
Windows 2000	\Win32\SMagent
Windows Server 2003 (32 bit)	\WS03_32bit\SMAgent
Windows Server 2003 (64 bit)	\WS03_64bit\SMAgent[1]

1. To be used for servers with Intel architecture 64-bit (IA-64) processors only. Servers with AMD AMD64 or Intel EM64T processor architecture have no Storage Manager 9.10 host software support when their operating system are written in AMD64 or EM64T native code. If the IA-32 version of the operating system is installed in the AMD64 or EM64T servers, then you can use the IA-32 software package. Be certain to access the appropriate package.

    Then, click **Open**.

7. Select the displayed .exe file. Click **Open**. The InstallShield window opens, showing the status of the file unpacking. The Welcome window opens.
8. Click **Next**. The End User License Agreement window opens.
9. Read the license and click **Yes** to begin the installation. The software installation ends, and the Operation Complete window opens.
10. Click **Finish**.
11. Continue with "Verifying the SMagent installation."

Verifying the SMagent installation

This section provides instructions on how to verify that you installed SMagent correctly on Windows operating systems.

Windows 2000

To verify that you installed the SMagent correctly, perform the following steps:

Note: Make sure that all storage subsystems are connected to the host computer and are powered on.

1. Click **Start → Programs → Administrative Tools → Services**. The Services window opens.
2. Scroll through the list of services until you find IBM DS4000 Storage Manager 9 Agent.
3. If IBM DS4000 Storage Manager 9 Agent does not display with a startup type of `Started`, click **Start**. If the status does not change to `Started`, see Table 23 on page 156 for a possible cause. Otherwise, reinstall SMagent. If the problem persists, contact your IBM technical support representative.
4. Perform one of the following steps:
   - If you plan to use the host-agent software to manage one or more storage subsystems, go to "Storage Manager 9.10 Utility" on page 166.

- If you do not plan to use the host-agent software to manage one or more storage subsystems, perform the following procedure to disable the host-agent service:

    a. Click **Start → Programs → Administrative Tools → Computer Management**. The Computer Management window opens.

    b. Click **Services**.

    c. From the list of displayed services, right-click **IBM FAStT Storage Manager 9 Agent**.

    d. Click **Properties → Startup Type → Manual**.

    e. Click **OK**.

5. Continue with "Storage Manager 9.10 Utility."

Windows Server 2003

To verify that you installed the SMagent correctly, perform the following steps.

Note: Make sure that all storage subsystems are connected to the host computer and are powered on.

1. Click **Start → Administrative Tools → Services**. The Services window opens.

2. Scroll through the list of services until you find IBM DS4000 Storage Manager 9 Agent.

3. If IBM DS4000 Storage Manager 9 Agent does not display with a startup type of `Started`, click **Start**. If the status changes to `Started`, go to step 4. If not, see Table 23 on page 156 for a possible cause. Otherwise, reinstall IBM DS4000 Storage Manager 9 Agent. If the problem persists, contact your IBM technical support representative.

4. Perform one of the following steps:

    - If you plan to use the host-agent software to manage one or more storage subsystems, see "Storage Manager 9.10 Utility."

    - If you do not plan to use the host-agent software to manage one or more storage subsystems, perform the following steps to disable the host-agent service:

        a. Click **Start → Administrative Tools → Computer Management**. The Computer Management window opens.

        b. Click **Services**.

        c. From the list of displayed services, right-click **IBM FAStT Storage Manager 9 Agent**.

        d. Click **Properties** from the pull-down menu. The IBM DS4000 Storage Manager 9 Agent Properties window opens.

        e. In the Startup Type list, select **Manual**. Click **OK**.

        f. The IBM DS4000 Storage Manager 9 Agent Properties window closes.

5. Continue with "Storage Manager 9.10 Utility."

Storage Manager 9.10 Utility

This section describes how to install SMutil on host computers that run both Windows operating systems. This component contains utilities that will register and map new logical drives to the operating systems.

Installing SMutil

To install SMutil on Windows operating systems, perform the following steps:

1. Close all programs and insert the IBM DS4000 Storage Manager Version 9.10 installation CD in the CD-ROM drive.
2. Click **Start → Run**. The Run window opens.
3. Click **Browse**. The Browse window opens.
4. Select the CD-ROM drive.
5. Select the folder that is associated with your operating system.

Operating System	Folder
Windows 2000 Advanced Server	\Win32\SMutil
Windows Server 2003 for 32-bit processors	\WS03_32bit\SMUtil
Windows Server 2003 for 64-bit processors	\WS03_64bit\SMUtil[1]

1. To be used for servers with Intel architecture 64-bit (IA-64) processors only. Servers with AMD AMD64 or Intel EM64T processor architecture have no Storage Manager 9.10 host software support when their operating system are written in AMD64 or EM64T native code. If the IA-32 version of the operating system is installed in the AMD64 or EM64T servers, then you can use the IA-32 software package. Be certain to access the appropriate package.

    Then click **Open**.
6. Select the displayed .exe file. Click **Open**. The InstallShield Wizard window opens, displaying the status of the files unpacking. The Welcome window opens.
7. Click **Next**. The End User License Agreement window opens.
8. Click **Yes** to begin the installation. After the installation is complete, the Operation Complete window opens.
9. Click **Finish**.
10. Continue with "Verifying the SMutil installation."

Verifying the SMutil installation

To verify that you installed the SMutil correctly on Windows operating systems, perform the following steps:
1. Go to the `<installation_directory>\Util` directory.

    ...where `installation_directory` is the directory in which you installed the SMutil.

    The default directory is `c:\Program Files\IBM_FAStT\Util`.
2. Verify that the directory contains the following files:
    - `hot_add.bat`
    - `SMdevices.bat`
    - `SMrepassist.exe`

    If it does not, reinstall the SMutil by using the procedure in "Installing SMutil" on page 166. If the problem persists, contact your IBM technical support representative.
3. Go to Chapter 8, "Completing storage management installation and configuration," on page 109.

Appendix C. Operating system limitations

This appendix contains the following sections:
- "Windows operating system limitations"
- "Linux operating system limitations" on page 178
- "VMware ESX Server operating system limitations" on page 181

Windows operating system limitations

This appendix contains information about how to operate the storage management software in a Windows 2000, or Windows Server 2003 environment. For the most up-to-date information, always check the most recent DS4000 Storage Manager readme file for Windows 2000 or Windows Server 2003.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Limitations of Windows operating systems

Table 24 on page 170 explains limitations that apply when you use the IBM DS4000 Storage Manager Version 9.1x with Windows 2000 and Windows Server 2003.

Note: These limitations may only occur when you manage storage subsystem with older firmware versions.

Table 24. Windows operating system limitations and workarounds

Limitation	Workaround
If you are upgrading controller firmware in IBM FAStT500 storage controller (M/T 3552) with 512MB Cache, you will have to stop I/O and reboot both controllers before upgrading firmware followed by NVSRAM. You can reboot the controllers either by power cycling the storage subsystem or by pressing the Reset button on both controllers. The **Reset** button is located on the right of the indicator lights in the opening on the front of each controller unit.	None.

To determine Storage Controller cache level, perform the following:

1. On a storage management station start the client software and select a storage subsystem.

2. Select **Tools → Manage Device** to open the Subsystem Management Window.

3. Highlight the Storage Subsystem that you are upgrading and then select **Storage Subsystem → Profile**. It may take a little time for it to create the Storage Subsystem profile.

4. Under the Controllers heading is an entry that displays information similar to the following example:

   `Cache/processor size (MB):  256/32`

If this setting is listed as 512/32 you will need to arrange to perform this upgrade procedure at a time that you can stop I/O to the Storage Subsystem in order to ensure a successful firmware download and installation.

Table 24. Windows operating system limitations and workarounds (continued)

Limitation	Workaround
Storage Manager prompts you for a password if all hard disk drives are removed from the storage subsystem. After removing all drives from a storage subsystem (or not powering on drives and only the controller), the IBM DS4000 Storage Manager software will prompt you for a password when trying to start the software or trying to perform protected operations. Any password entered will fail. Password information is stored on a reserved area of each hard disk drive on the storage subsystem. Each drive stores a mirrored copy of the password data. When there are no drives in the storage subsystem, the storage management software does not find the password data when you attempt password protected operations. Add one drive to the storage subsystem and retry the operation.	Since the RAID controller unit should not be powered on until the expansion units are attached and powered on, this should be done by powering off the RAID controller unit, properly attaching all expansion units (with drives installed), to the RAID controller unit and powering them on, and then powering the RAID controller unit back on. At this point the storage subsystems can be rediscovered and managed using the IBM DS4000 Storage Manager software.
If you get "`Error 21 - The Operation cannot complete because a  ...  is in progress`" error when you issue a Subsystem Management command from the IBM DS4000 Storage Manager Client, the command may be cached for execution when the storage subsystem was busy with other tasks even though the Storage Manager GUI returned a "command not be able to execute" error. If the command is cached, the IBM DS4000 Storage Manager Client will run the command as soon as the controller resources are available.	Wait for at least ten minutes after an issued command failed to execute and check to see whether the command has been run. If not, re-attempt the command.
When the server HBA ports are directly connected to the DS4000 storage subsystem controllers, do not download firmware and NVSRAM files to the controllers with IOs being generated to the LUNs in the DS4000 storage subsystem. There is no IOs restriction in SAN Fabric environment, for example, when the HBA port are connected to the DS4000 storage subsystem controller ports via Fibre Channel switches.	None.
When using the RDAC package from the Storage Manager 8.40 host-software package or earlier, rebooting a host server might cause its mapped LUNs move to a non-preferred path.	Either use the DS4000 Storage Manager client program to redistribute the LUNs to their preferred path or upgrade the RDAC driver to the version that is packaged with Storage Manager host software version 9.1 or later.

Table 24. Windows operating system limitations and workarounds (continued)

Limitation	Workaround
Dynamically changing the cache read ahead multiplier setting via the storage manager client may result in an error message indicating the operation has failed. Despite the error message, the request to change the cache read ahead multiplier will remain queued to the controllers and will eventually complete when I/O activity to the storage subsystem has subsided.	In order to avoid the error message and any delays in the cache read ahead multiplier value changing, it is recommended to change the cache read ahead multiplier when the subsystem is in a quiesced state.
In xSeries x330 server, when two of the Dynamic disks are mirrored together by the Windows OS and the LUN that these disks are defined on failovers/failbacks, the server might hang after failover.	None.
There are no host type for the Windows Server 2003 in the host-type pull-down menu in the Defined host port or Changing default Host Type window.	Windows 2000 and Windows Server 2003 share the following host type options: • Windows 2000/Server 2003 non-clustered • Windows 2000/Server 2003 clustered If the above entries are not displayed in the host-type pull down window, use these host type options for the default host type for Windows Server 2003 host port or for the host type of the defined port of an FC HBA that is installed in a Windows Server 2003 server instead. • Windows 2000 non-clustered • Windows 2000 clustered
If you click a vertical scroll arrow either up or down, the scroll box will move all the way to the opposite end of the scroll bar.	This is a known defect in the Java Runtime Environment. Click the scroll box and slide it until you reach the position that you want in the Help window.
Data or configuration loss might occur during a logical drive migration. Logical drive migration consists of removing configured physical drives from one storage subsystem and inserting them into another storage subsystem.	Either use the migration instructions in the *IBM TotalStorage DS4000 Fibre Channel Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* or contact an IBM technical support representative for assistance in performing this procedure.
Array migration is not supported because it could cause loss of configuration and data. Array migration consists of removing a set of drives configured with arrays from one storage subsystem and inserting them into another storage subsystem.	Either use the migration instructions in the *IBM TotalStorage DS4000 Fibre Channel Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* or contact an IBM technical support representative for assistance in performing this procedure.
If you manage storage subsystems through the host-agent software and use the storage management software to download controller firmware, the download process can take up to 10 minutes to complete.	None.

Table 24. Windows operating system limitations and workarounds (continued)

Limitation	Workaround
When you configure a new storage subsystem with a single controller, you must place the controller in slot A. The controller firmware cannot recognize or communicate with a single controller until slot A is populated. This restriction does not apply to storage subsystems that were originally configured with two controllers.	None.
The following loop configuration is not supported: IBM Fibre Channel Hub (machine type 3523) in conjunction with the IBM Fibre Channel Switch (machine types 2109 S16 and 2109 S08) or the IBM Fibre Channel Switch (machine types 3534 F08 and 2109 F16).	None.
A controller failover occurs in an active/active controller pair, and ownership of arrays transfers from the failed preferred owner to the other controller of the repair. The failed controller is replaced and brought online. The array ownership is not automatically transferred back to the preferred controller owner.	Immediately after you replace the controller, click **Storage subsystem → Redistribute Arrays** in the Subsystem Management window to redistribute arrays back to their preferred controller owners. For more information, refer to the Enterprise Management online help.
After adding a host device to the management domain of more than five clients, the host-agent-managed storage subsystems attached to that host become unresponsive.	Make sure that a single instance of the host-agent software communicates with no more than five clients.
When you connect a DS4000 EXP700 Storage Expansion Unit to a FAStT200, you must set the drive speed to 1 Gbps.	None.

Table 24. Windows operating system limitations and workarounds (continued)

Limitation	Workaround
After you install the host-agent software, the host displays the error message `Service Error 100`.	The cause includes: • The host-agent software does not find any controllers with firmware version 04.00.02.00 or later. Upgrade the firmware to the latest firmware level from the IBM support Web site at: www.ibm.com/support/ For more information, see "Direct-management method workaround" on page 177. • The access logical drive has been removed from NVSRAM or the storage partition defined for the host. Perform one of the following tasks: – Manage the storage subsystem by using the direct-management method. See "Direct-management method workaround" on page 177. – Define the access logical drive for the host and restart SMagent. See"SMagent workaround for defining additional access LUN mapping" on page 177. • The NVSRAM on the controllers in a storage subsystem that you want to manage contains an access logical drive LUN that is in use by another logical drive, or is not supported by the operating system or installed patches. For example, the access logical drive is configured at LUN 31, and the operating system and service packs support only eight LUNs. Perform one of the following tasks: – Manage the storage subsystem by using the direct-management method. See "Direct-management method workaround" on page 177. – Change the LUN mapping for the host-access logical drive to a LUN that is not in use and is supported by the operating system either from a different computer that has management access to the storage subsystem, or establish a direct management connection to the storage subsystem from the current host. For more information, see "SMagent workaround for changing existing access LUN mapping" on page 178.
Auto LUN/Array Transfer is not enabled. If a controller fails over arrays to the alternate controller and the failed controller is replaced and brought back online, the arrays will not automatically transfer to the preferred controller.	Manually select the Redistribute Logical Drives menu option in the IBM DS4000 Storage Manager client GUI.
A brownish hash pattern displays in the dialog windows and in online help when operating in 256-color mode.	Run the DS4000 Storage Manager application in a higher display mode.

Table 24. Windows operating system limitations and workarounds (continued)

Limitation	Workaround
The system might display the DS4000 Storage Manager dialog windows as cropped without the vertical and horizontal scroll bars.	Move the mouse pointer over the edge of the window until the mouse pointer changes to a window resize pointer. Left-click your mouse; hold to grip the window's edge and resize the window.

The controller in the IBM DS4000 storage subsystem with firmware 05.3x.xx.xx is connected to a SAN with more than 64 host connections per controller port that can log into the controllers, exceeding the maximum number of host connections that can be seen and log into the controller.	Either use the switch zoning function or rearrange the SAN connections so that only the following maximum number of host connections can be seen and log into the controller as follows:
	• The following DS4000 storage subsystems have two ports per controller – one per minihub slot.
	  – DS4500, Machine Type 1742
	  – DS4400, Machine Type 1742
	  – FAStT500, Machine Type 3552
	• The DS4300, machine type 1722 has two ports per controller.
	• The FAStT200, machine type 3542 has only one port per controller.

It is possible to circumvent IBM DS4000 storage subsystem hardware and software designs for redundant pathways from the host system. This is accomplished by connecting a single host adapter from the host system to one of the controller minihubs, and then connecting this minihub to the minihub of the other controller, creating a Fibre Channel-Arbitrated Loop (FC-AL) between the host adapter and the two IBM DS4000 storage subsystem controllers. This configuration leaves no redundant path to the host system.	When connecting two minihubs together, always connect the `IN` port of one minihub to the `OUT` port of the other minihub or vice versa. Do not connect the `IN` port of one to the `IN` port of the other minihub or the `OUT` port of one minihub to the `OUT` port of the other minihub. Nevertheless, this configuration is not supported by IBM.
When you issue a Subsystem Management command from the IBM DS4000 Storage Manager client, the command may be cached. If so, the system will issue the error: `Error 21 – The Operation cannot complete because a... is in progress`. The IBM DS4000 Storage Manager client will run such cached commands as soon as the controller resources become available.	Wait for at least ten minutes; then, check to see if the IBM DS4000 Storage Manager client has run the command. If it has not, reissue the command.
You must always uninstall IBM DS4000 Storage Manager RDAC before you uninstall the host bus adapter driver. Failure to do so may result in a hung system or blue screen.	None.

Table 24. Windows operating system limitations and workarounds (continued)

Limitation	Workaround
When you upgrade the DS4000 Storage Subsystem controller firmware from any version 05.00.xx.xx (or earlier) to version 05.2x.xx.xx (or later), the controller returns the first four bytes of the firmware revision to the Product Revision Field of the SCSI LUN inquiry data. Windows 2000 uses this Product Revision data as part of its LUN identification method. In doing so, Windows 2000 incorrectly interprets your upgrade of the firmware revision level and subsequent Product Revision data change to mean that you have also removed LUNs with the original Product Revision data from the server. When the DS4000 Storage Manager hot_add utility later executes the `scan for hardware changes` task, or when you select the **Scan For Hardware Changes** menu option of the Devices folder in the Computer Management window, Windows 2000 displays the `Unsafe Removal of Devices` dialogs for the original LUNs. The devices cited in these dialogs are RDAC Virtual Disks and `xxxx` SCSI devices, where `xxxx` represents either `1722` (DS4300), `1742` (DS4400), `3552` (FAStT500) or `3542` (FAStT200), depending on the machine type of the DS4000 storage subsystem from which Windows 2000 had mapped the original LUNs. Under these circumstances, the Windows 2000 server will lose connectivity to the LUNs in the DS4000 Storage Subsystem whose controller firmware you updated. This problem will not occur when you upgrade the DS4000 Storage Subsystem controller firmware from version 05.20.xx.xx to version 05.3x.xx.xx or later because the Product Revision data field was fixed at `0520`.	After you apply the new DS4000 Storage Subsystem controller firmware and NVSRAM, you must perform one of the following procedures reconnect DS4000 storage subsystems to their logical drives: • Re-scan the server for hardware changes. • Add the logical drives back to the server. • Reboot all of the Windows 2000 servers that originally had LUNs mapped in the affected DS4000 Storage Subsystem.

Table 24. Windows operating system limitations and workarounds (continued)

Limitation	Workaround

After using the Microsoft Cluster Administrator to configure a server cluster, the disk timeout value in the system registry is changed to an incorrect value.	Complete the following procedure to change the disk timeout value to the correct value after the server cluster configuration is complete.
	1. Select **Start → Run**.
	2. Type the following command and press **Enter**:
	`regedit`
	The Registry Editor is displayed.
	3. From the left pane of the Registry Editor, navigate to the directory:
	`HKEY_LOCAL_MACHINE\System\`
	`CurrentControlSet\Services\Disk`
	4. From the right pane of the Registry Editor, double-click **TimeOutValue**.
	The `Edit DWORD Value` dialog is displayed.
	5. In the **Value Data** text area, type decimal `60` (or the value to which your system was previously set), and press **Enter**.
	6. Under **Base**, select **Hexadecimal**.
	7. Select **OK**.

Direct-management method workaround

Perform the following steps for the direct-management method workaround:

1. Connect the two controller Ethernet ports to the network.
2. Follow the direct-management setup instructions in Chapter 2, "Preparing for installation," on page 41 to manage the subsystem directly.
3. Open the Storage Manager Enterprise Management window. Click **Edit → Add device**.
4. Type the IP address for the first controller and click **Add**.
5. Repeat to add the IP address of the additional controllers.
6. Click **Close**.
7. Right-click the newly added storage subsystem and select **Manage Device**. The Subsystem Management window for the storage subsystem opens. Proceed with the storage subsystem management tasks.

SMagent workaround for defining additional access LUN mapping

Perform the following steps to define additional access LUN mapping for SMagent:

1. Go to a different computer that has management access to the storage subsystem, or establish a direct management connection to the storage subsystem from the current host.
2. Start the IBM DS4000 Storage Manager Client and open the Subsystem Management window for the storage subsystem.
3. Click the **Mappings View** tab.
4. Right-click the **Default Group** and select **Define Additional mappings**.
5. Select **Access**.
6. From the LUN drop-down menu, select Logical Unit Number (LUN) 31.
7. Click **Add** to define the access LUN.

8. Click **Close**. In the Define Mapping pane, a LUN with the Access name displays.

9. Close the window and restart the host. When the host restarts, the SMagent service starts.

SMagent workaround for changing existing access LUN mapping

Perform the following steps to change existing access LUN mapping:

1. Go to a different computer that has management access to the storage subsystem, or establish a direct management connection to the storage subsystem from the current host.

2. Start the IBM DS4000 Storage Manager Client and open the Subsystem Management window for the storage subsystem.

3. Click the **Mappings View** tab.

4. From the topology pane, select the **Default Group** or the corresponding host partition.

5. Right-click **Access** and select **Change Mapping**. A Change Mapping window opens.

6. From the LUN drop-down menu, select the LUN that your operating system supports. If it is not available, you must remove one of the existing storage partitioning mappings.

7. Click **OK**.

8. Close the window and restart the host. When the host restarts, the SMagent service starts.

Linux operating system limitations

This appendix contains information that is specific to operating the storage management software in a Linux environment. For the most up-to-date information, always check the most recent DS4000 Storage Manager readme files for Linux.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Note: These limitations may only occur when you manage storage subsystem with older firmware versions.

Table 25 on page 179 lists the limitations that apply when you use the IBM DS4000 Storage Manager Version 9.1x with Linux.

Table 25. Linux limitations and workarounds

Limitations	Workaround
If you are upgrading controller firmware in IBM FAStT500 storage controller (M/T 3552) with 512MB Cache, you will have to stop I/O and reboot both controllers before upgrading firmware followed by NVSRAM. You can reboot the controllers either by power cycling the storage subsystem or by pressing the Reset button on both controllers. The **Reset** button is located on the right of the indicator lights in the opening on the front of each controller unit. To determine Storage Controller cache level, perform the following: 1. On a storage management station start the client software and select a storage subsystem. 2. Select **Tools → Manage Device** to open the Subsystem Management Window. 3. Highlight the Storage Subsystem that you are upgrading and then select **Storage Subsystem → Profile**. It may take a little time for it to create the Storage Subsystem profile. 4. Under the Controllers heading is an entry that displays information similar to the following example: `Cache/processor size (MB): 256/32` If this setting is listed as 512/32 you will need to arrange to perform this upgrade procedure at a time that you can stop I/O to the Storage Subsystem in order to ensure a successful firmware download and installation.	None.
Storage Manager prompts you for a password if all hard disk drives are removed from the storage subsystem. After removing all drives from a storage subsystem (or powering on the controller only without any drive expansion enclosures), the IBM DS4000 Storage Manager software will prompt you for a password when trying to start the software or trying to perform protected operations. Any password entered will fail. Password information is stored on a reserved area of each hard disk drive on the storage subsystem. Each drive stores a mirrored copy of the password data. When there are no drives in the storage subsystem, the storage management software does not find the password data when you attempt password protected operations. Add one drive to the storage subsystem and retry the operation.	Since the RAID controller unit should not be powered on until the expansion units are attached and powered on, this should be done by powering off the RAID controller unit, properly attaching all expansion units (with drives installed), to the RAID controller unit and powering them on, and then powering the RAID controller unit back on. At this point the storage subsystems can be re-discovered and managed using the IBM DS4000 Storage Manager 8.3 software.

Table 25. Linux limitations and workarounds (continued)

Limitations	Workaround
The DS4000 Storage Management dialog windows may be displayed cropped without the vertical and horizontal scroll bars.	Move the mouse pointer over the edge of the window until the mouse pointer changes to window resize pointer, left click and hold to grip the window edge to resize it.
Dynamically changing the cache read ahead multiplier setting via the storage manager client may result in an error message indicating the operation has failed. Despite the error message, the request to change the cache read ahead multiplier will remain queued to the controllers and will eventually complete when I/O activity to the storage subsystem has subsided.	In order to avoid the error message and any delays in the cache read ahead multiplier value changing, it is recommended to change the cache read ahead multiplier when the subsystem is in a quiesced state.
It is possible to circumvent IBM DS4000 storage subsystem hardware and software designs for redundant pathways from the host system. This is accomplished by connecting a single host adapter from the host system to one of the controller mini-hubs, and then connecting this mini-hub to the mini-hub of the other controller, creating a Fibre Channel-Arbitrated Loop (FC-AL) between the host adapter and the two IBM DS4000 storage subsystem controllers. This configuration leaves no redundant path to the host system.	When connecting two mini-hubs together, always connect the IN port of one mini-hub to the OUT port of the other mini-hub or visa versa. Do not connect the IN port of one to the IN port of the other mini-hub or the OUT port of one mini-hub to the OUT port of the other mini-hub. This configuration is not supported by IBM.
Vixel Rapport 2000 fibre-channel hubs using controllers with firmware version 04.01.02 cause problems, including damage to data, system instability, and disrupted loop activity.	Do not use Vixel Rapport 2000 fibre-channel hubs when your system is operating in a controller or an I/O path fault-tolerant environment.
The maximum number of physical drives allowed in a single RAID 5 logical drive is 29. The maximum number of physical drives allowed in a single RAID 1 logical drive is 28.	None.
After removing all drives from a storage subsystem, you are prompted for a password at software startup or when you perform protected operations, all passwords you enter fail.	Add one of the drives to the storage subsystem and attempt the operation again.
Removing a set of drives that are configured with logical drives from one storage subsystem for insertion into another storage subsystem is not supported because it might cause loss of configuration.	Either use the migration instructions in the *IBM TotalStorage DS4000 Fibre Channel Hard Drive and Storage Expansion Enclosure Installation and Migration Guide* or contact an IBM technical support representative for assistance in performing this procedure.
A standard non-network configuration is not supported when the Linux host does not have the TCP/IP software installed.	Install the TCP/IP software on the Linux host computer and assign the host a static IP address.
Multipath failover will work only if the storage controllers are in active/active mode.	When you configure the storage subsystem, change both controllers to active status.

Table 25. Linux limitations and workarounds (continued)

Limitations	Workaround
The controller firmware does not recognize or communicate with a single controller until slot A is populated. This restriction does not apply to storage subsystems that were originally configured with two controllers.	When you configure a new storage subsystem with a single controller, you must place the controller in slot A.
Your windows and online help display a brownish hash pattern when you run in 256-color mode.	Run the Storage Manager application in a higher display mode.
When you perform a redundancy check (parity scan) from the storage management application, machine type 3542 (FAStT200) can take several minutes longer than machine type 1742 (DS4400) and 3552 (FAStT500) controller platforms.	None.
You might not see the maximum number of drives during Automatic Configuration if you are using drives of different capacities.	Use Manual Configuration to select individual drives and select the maximum number of drives allowed.
When you connect an IBM TotalStorage DS4000 EXP700 Storage Expansion Unit to a FAStT200, the drive speed must be set to 1 Gbps.	None.
When you issue a Subsystem Management command from the IBM DS4000 Storage Manager client, the command may be cached. If so, the system will issue the error: `Error 21 - The Operation cannot complete because a... is in progress.` The IBM DS4000 Storage Manager client will run such cached commands as soon as the controller resources become available.	Wait for at least ten minutes; then, check to see if the IBM DS4000 Storage Manager client has run the command. If it has not, re-issue the command.

VMware ESX Server operating system limitations

This appendix contains information about how to operate the storage management software in a VMware ESX Server environment. For the most up-to-date information, see the most recent DS4000 Storage Manager readme file for VMware ESX Server.

See "Readme files and concepts" on page 1 to find out how to access the most recent Storage Manager readme files on the Web.

Table 26 lists the limitations that apply when you use IBM DS4000 Storage Manager Version 9.1x with VMware ESX Server.

Table 26. VMware ESX Server limitations and workarounds

Limitations	Workaround
VMware ESX 2.0 clustering function is not supported. Clustering between guest operating systems is not supported.	None. For information about possible support in future releases, contact your IBM service representative or submit an RPQ.

Table 26. VMware ESX Server limitations and workarounds (continued)

Limitations	Workaround
The maximum number of guest operating systems that are supported on each VMware ESX 2.0 server is 16.	None. For information about possible support in future releases, contact your IBM service representative or submit an RPQ.
New logical drives cannot be successfully created and assigned to a guest operating system.	Although a guest operating system can scan for new logical drives dynamically, the guest operating system must be powered off before new logical drives can be created within VMware ESX Server and assigned to that guest.
When you issue a Subsystem Management command from the IBM DS4000 Storage Manager client, the command may be cached. If so, the system will issue the error: `Error 21 - The Operation cannot complete because a...` `is in progress.` The IBM DS4000 Storage Manager client will run such cached commands as soon as the controller resources become available.	Wait for at least ten minutes; then, check to see if the IBM DS4000 Storage Manager client has run the command. If it has not, reissue the command.

Appendix D. Storage subsystem and controller information record

Table 27 provides a data sheet for recording storage subsystem names, management types, Ethernet hardware addresses, and IP addresses. Make a copy of this table and complete the information for your storage subsystems and controllers. Use the information to set up the BOOTP table for the network server and the host or Domain Name System (DNS) table. The information is also helpful if you add storage subsystems after initial installation. The column headings show a page reference for detailed instructions about how to obtain the information. For a sample information record, refer to Table 15 on page 47.

Table 27. Storage subsystem and controller information record

Storage subsystem name (page 46)	Management method (page 16)	Controllers-Ethernet and IP addresses, and host name (pages 46 and 50)		Host-IP address and host name (page 50)

Appendix E. Host bus adapter settings

This appendix covers the default settings for a variety of host bus adapters (HBAs) suitable for use with DS4000 storage subsystems.

An HBA is used to connect servers to fibre channel topologies. Its function is similar to that provided by network adapters to access LAN resources. The device driver for an HBA is typically responsible for providing support for a fibre channel topology, whether point-to-point, loop, or fabric.

The Fast!UTIL feature enables you to access and modify an adapter's default settings to optimize its performance.

See also: For detailed HBA support information, see the following Web site:

www-03.ibm.com/servers/storage/support/config/hba/index.wss

Setting host bus adapters

It is often necessary to adjust the settings of your HBA to match the capabilities of your device. This section describes how to access those settings to make the necessary adjustments.

Accessing HBA settings through Fast!UTIL

The Fast!UTIL feature provides access to host bus adapter settings. To access this feature, simultaneously press and hold the **ALT** and **Q** keys or the **Ctrl** and **Q** keys during BIOS initialization. It may take a few seconds for the Fast!UTIL menu to appear. If more than one board is installed, Fast!UTIL prompts you to select a board to configure. After you change adapter settings, Fast!UTIL reboots your system to load the new parameters. Upon entering Fast!UTIL, the following selections are available on the Fast!UTIL Options menu:

- Configuration Settings
- Loopback Test
- Select Host Adapter

You will Access the host bus adapter settings through the **Configuration Settings** menu in Fast!UTIL. See "Host adapter settings" and "Advanced Adapter Settings" on page 186 for detailed information on the settings.

Host adapter settings

Access the host bus adapter settings through the **Configuration Settings** menu in Fast!UTIL and select **Adapter Settings**. The default host bus adapter settings for the FC2-133 HBA are as follows:

Host Adapter BIOS
When this setting is `Disabled`, the ROM BIOS on the FC2-133 HBA is `Disabled`, freeing space in upper memory. This setting must be `Enabled` if you are booting from an fibre channel disk drive attached to the FC2-133 board. The default is `Disabled`.

Frame Size
This setting specifies the maximum frame length supported by the FC2-133 HBA. The default size is `2048`, which provides maximum performance for F-Port (point-to-point) connections.

Loop Reset Delay
  After resetting the loop, the firmware refrains from initiating 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 attempt to use the ID specified in the
  Hard Loop ID setting. The default is `Enabled`.

Hard Loop ID
  If the Adapter Hard Loop ID setting is `Enabled`, the adapter attempts to use
  the ID specified in this setting. The default ID is `125`. It is recommended to
  set this ID to a unique value from `0-125` if there are more than one adapters
  connected to a FC-AL loop and the Adapter Hard Loop ID setting is
  `Enabled`.

Spin Up Delay
  When this bit is set, the BIOS will wait up to five minutes to find the first
  drive. The default setting is `Disabled`.

Connection Options
  This setting defines the type of connection (loop or point to point) or
  connection preference. The default is `2`, which is loop preferred unless
  point-to-point.

Fibre Channel Tape Support
  This setting enables FCP-2 recovery. The default is `Enabled`. It is
  recommended to change this setting to `Disabled` if the HBA is not
  connected to a tape device.

Data Rate
  This setting determines the data rate. When this setting is `0`, the FC2-133
  HBA runs at 1 gbps. When this setting is `1`, the FC2-133 HBA runs at 2
  gbps. When this setting is 2, Fast!UTIL determines what rate your system
  can accommodate and sets the rate accordingly. The default is `2`
  (auto-configure).

Advanced Adapter Settings

Access the following advanced host bus adapter settings through the Configuration
Settings menu in `Fast!UTIL` and select **Advanced Adapter Settings**. The default
settings for the FC2-133 HBA are as follows:

Execution Throttle
  This setting specifies the maximum number of commands executing on any
  one port. When a port's execution throttle is reached, no new commands
  are executed until the current command finishes executing. The valid
  options for this setting are 1-256. The default is `255`.

LUNs per Target
  This setting specifies the number of LUNs per target. Multiple LUN support
  is typically for redundant array of independent disks (RAID) boxes that use
  LUNs to map drives. The default is `0`. For host operating systems other than
  Microsoft Windows, one may need to change this setting to a value other `0`
  to allow the host seeing more than one logical drive from the DS4000
  storage subsystem.

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

setting is yes, the driver initiates a global LIP reset to clear the target device reservations. When this setting is no, the driver initiates a global LIP reset with full login. The default is `No`.

Enable LIP Full Login
This setting instructs the ISP chip to re-login to all ports after any LIP. The default is `Yes`.

Enable Target Reset
This setting enables the 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 seconds the software retries a command to a port returning port down status. The default is `30` seconds.

Link Down Timeout
This setting specifies the number of seconds the software waits for a link down to come up. The default is `60` seconds.

Extended Error Logging
This setting provides additional error and debug information to the operating system. When enabled, events are logged into the Windows NT Event Viewer. The default is `Disabled`.

RIO Operation Mode
This setting specifies the reduced interrupt operation (RIO) modes, if supported by the software driver. RIO modes allow posting multiple command completions in a single interrupt. The default is `0`.

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`.

QLogic host bus adapter settings

Note: The BIOS settings under the Windows column are the default values that are set when the adapters are ordered from IBM as IBM FC-2 (QLA2310) and FC2-133 (QLA2340) FC host bus adapters. If the adapters are not from IBM, the default BIOS may not be the same as the ones defined in the Microsoft Windows column. There is one exception, the default setting for Fibre Channel tape support is enabled.

Table 28 on page 188 covers the default settings for IBM Fibre Channel FC-2 and FC2-133 (QLogic adapter models QL2310 and QL2340) host bus adapter settings (for BIOS V1.35 and later) by operating system as well as the default registry settings for Microsoft Windows OS's. DS4000 products require BIOS V1.43 for these adapters. See the appropriate readme file for the latest updates to these values.

Table 28. QLogic model QL2310 and QL2340 host bus adapter settings (for BIOS V1.35 and later) by operating system

Item	Windows		Linux	NetWare	VMware
	NT	2000 / Server 2003			
BIOS settings					
Host adapter settings					
Host Adapter BIOS	Disabled	Disabled	Disabled	Disabled	
Frame Size	2048	2048	2048	2048	
Loop Reset Delay	5	5	8	5	
Adapter Hard Loop ID	Enabled	Enabled	Enabled	Enabled	
Hard Loop ID (should be unique for each HBA)	125[1]	125[1]	125[1]	125[1]	
Spin Up Delay	Disabled	Disabled	Disabled	Disabled	
Connection Options	2	2	2	2	
Fibre Channel Tape Support	Disabled[3]	Disabled[3]	Disabled[3]	Disabled[3]	
Data Rate	2	2	2	2	
Advanced adapter settings					
Execution Throttle	255	255	255	255	
LUNs per Target	0	0	0	32	
Enable LIP Reset	No	No	No	No	No
Enable LIP Full Login	Yes	Yes	Yes	Yes	Yes
Enable Target Reset	Yes	Yes	Yes	Yes	Yes
Login Retry Count	30	30	30	30	
Port Down Retry Count	30	30	12	30[2]	
Link Down Time Out	60	60	60	60	
Extended Error Logging	Disabled	Disabled	Disabled	Disabled	
RIO Operation Mode	0	0	0	0	
Interrupt Delay Timer	0	0	0	0	
Data Rate	2	2	2	2	
Registry settings[5] (**HKEY_LOCAL_MACHINE** ➔ **System** ➔ **CurrentControlSet** ➔ **Services** ➔ **QL2300** ➔ **Parameters** ➔ **Device**)					
LargeLuns	N/A	N/A	N/A	N/A	
MaximumSGList	0xff	0xff	N/A	N/A	
Registry settings[5] (**HKEY_LOCAL_MACHINE** ➔ **System** ➔ **CurrentControlSet** ➔ **Services** ➔ **QL2300** ➔ **Parameters** ➔ **Device**) under the **DriverParameter** variable.					
BusChange	N/A	0	N/A	N/A	
Registry settings[5] (**HKEY_LOCAL_MACHINE** ➔ **System** ➔ **CurrentControlSet** ➔ **Services** ➔ **Disk**)					
TimeOutValue	0x3C (60 secs)[4]	0x3C (60 secs)[4]	N/A	N/A	

Table 28. QLogic model QL2310 and QL2340 host bus adapter settings (for BIOS V1.35 and later) by operating system (continued)

Notes:

1. This setting must be changed to a unique AL-PA value if there is more than one FC device in the FC-AL loop.

2. For larger configurations with heavy I/O loads, it is recommended to change this value to `70`.

3. This setting should be changed to enable or supported when the HBA is connected to a Tape device only. It is recommended to set it to `Disabled` when connecting to a DS4000 storage subsystem.

4. In certain storage subsystem maximum configuration installations, it may be required to set the TimeOutValue to 120 (decimal). Changing this value to a higher value might affect your application especially when it requires the disk I/O completion acknowledgement within a certain amount of time.

5. Registry settings can be accessed by clicking **Start**, select **Run...**, type **regedit** into the **Open:** field, and then click **OK**.

    Attention: Exercise caution when changing the Windows registry. Changing the wrong registry entry or making an incorrect entry for a setting can introduce an error that prevents your server from booting up or operating correctly.

Note: The BIOS settings under the Windows column are the default values that are set when the adapters are ordered from IBM as IBM FAStT (QLA2200) FC host bus adapters. If the adapters are not from IBM, the default BIOS may not be the same as the ones defined in the Microsoft Windows column. There is one exception, the default setting for Fibre Channel tape support is enabled.

Table 29 covers the default settings for various IBM FAStT FC host bus adapters (QLogic adapter QL220x) models (for BIOS V1.81) by operating system. See the appropriate readme file for the latest updates to these values.

Table 29. QLogic model QL220x (for BIOS V1.81) host bus adapter settings by operating system

Item	Windows		Linux	NetWare
	NT	**2000 / Server 2003**		
BIOS settings				
Host adapter settings				
Host Adapter BIOS	Disabled	Disabled	Disabled	Disabled
Frame Size	2048	2048	2048	2048
Loop Reset Delay	5	5	8	5
Adapter Hard Loop ID	Enabled	Enabled	Enabled	Enabled
Hard Loop ID (should be unique for each HBA)	125[1]	125[1]	125[1]	125[1]
Spin Up Delay	Disabled	Disabled	Disabled	Disabled
Advanced adapter settings				
Execution Throttle	256	256	256	256
>4 Gbyte Addressing	Disabled	Disabled	Disabled	Disabled
LUNs per Target	0	0	0	32
Enable LIP Reset	No	No	No	No
Enable LIP Full Login	Yes	Yes	Yes	Yes
Enable Target Reset	Yes	Yes	Yes	Yes
Login Retry Count	30	30	30	30
Port Down Retry Count	30	30	12	30[2]
IOCB Allocation	256	256	256	256
Extended Error Logging	Disabled	Disabled	Disabled	Disabled
Extended Firmware Settings				
Extended Control Block	Enabled	Enabled	Enabled	Enabled
RIO Operation Mode	0	0	0	0
Connection Options	3	3	3	3
Class 2 Service	Disabled	Disabled	Disabled	Disabled
ACK0	Disabled	Disabled	Disabled	Disabled
Fibre Channel Tape Support	Supported[3]	Supported[3]	Supported[3]	Supported[3]
Fibre Channel Confirm	Disabled	Disabled	Disabled	Disabled
Command Reference Number	Disabled	Disabled	Disabled	Disabled
Read Transfer Ready	Disabled	Disabled	Disabled	Disabled

Table 29. QLogic model QL220x (for BIOS V1.81) host bus adapter settings by operating system (continued)

Response Timer	0	0	0	0
Interrupt Delay Time	0	0	0	0
Registry settings[4] (**HKEY_LOCAL_MACHINE** → **System** → **CurrentControlSet** → **Services** → **QL2200** → **Parameters** → **Device**)				
LargeLuns		1		
MaximumSGList	0x21	0x21		
Registry settings[4] (**HKEY_LOCAL_MACHINE** → **System** → **CurrentControlSet** → **Services** → **Disk**)				
TimeOutValue	0x3C	0x3C		
Registry settings[4] (**HKEY_LOCAL_MACHINE** → **System** → **CurrentControlSet** → **Services** → **QL2200** → **Parameters** → **Device**) under the **DriverParameter** variable				
BusChange		0		

Notes:

1. This setting must be changed to a unique AL-PA value if there is more than one FC device in the FC-AL loop.

2. For larger configurations with heavy I/O loads, it is recommended to change this value to `70`.

3. This setting should be changed to enable or supported when the HBA is connected to a Tape device only. It is recommended to set it to `Disabled` when connecting to DS4000 storage subsystem.

4. Registry settings can be accessed by clicking **Start**, select **Run...**, type **regedit** into the **Open:** field, and then click **OK**.

   Attention: Exercise caution when changing the Windows registry. Changing the wrong registry entry or making an incorrect entry for a setting can introduce an error that prevents your server from booting up or operating correctly.

Appendix F. Additional DS4000 documentation

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

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

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

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

DS4000 Storage Manager Version 9 library

Table 30 associates each document in the DS4000 Storage Manager Version 9 library with its related common user tasks.

Table 30. TotalStorage 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 TotalStorage DS4000 Storage Manager Version 9 Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux, GC26-7706	✔		✔	✔		
IBM TotalStorage DS4000 Storage Manager Version 9 Installation and Support Guide for AIX, UNIX, Solaris and Linux on Power, GC26-7705	✔		✔	✔		
IBM TotalStorage DS4000 Storage Manager Version 9 Copy Services User's Guide, GC26-7707	✔		✔	✔	✔	
IBM TotalStorage DS4000 Storage Manager Version 9 Concepts Guide, GC26-7734	✔	✔	✔	✔	✔	✔

DS4500 Fibre Channel Storage Server library

Table 31 associates each document in the DS4500 (previously FAStT900) Fibre Channel Storage Server library with its related common user tasks.

Table 31. TotalStorage DS4500 Fibre Channel Storage Server document titles by user tasks

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

DS4400 Fibre Channel Storage Server library

Table 32 associates each document in the DS4400 (previously FAStT700) Fibre Channel Storage Server library with its related common user tasks.

Table 32. TotalStorage DS4400 Fibre Channel Storage Server document titles by user tasks

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

DS4300 Fibre Channel Storage Server library

Table 33 associates each document in the DS4300 (previously FAStT600) Fibre Channel Storage Server library with its related common user tasks.

Table 33. TotalStorage DS4300 Fibre Channel Storage Server document titles by user tasks

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

DS4100 SATA Storage Server library

Table 34 associates each document in the DS4100 (previously FAStT100) SATA Storage Server library with its related common user tasks.

Table 34. TotalStorage DS4100 SATA Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4100 Installation, User's and Maintenance Guide, GC26-7733	✔	✔		✔	✔	✔
IBM TotalStorage DS4100 Cabling Guide, 24P8973		✔				

DS4800 Storage Subsystem library

Table 35 associates each document in the DS4800 Storage Subsystem library with its related common user tasks.

Table 35. TotalStorage DS4800 Storage Subsystem document titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
IBM TotalStorage DS4800 Installation, User's and Maintenance Guide, GC26-7748	✔	✔		✔	✔	✔
IBM TotalStorage DS4800 Installation and Cabling Overview, 22R4738		✔				

Other DS4000 and DS4000-related documents

Table 36 associates each of the following documents with its related common user tasks.

Table 36. TotalStorage DS4000 and DS4000–related document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM Safety Information, 33P2406					✔	
IBM TotalStorage DS4000 Quick Start Guide, GC26-7738	✔	✔				
IBM TotalStorage DS4000 Hardware Maintenance Manual, GC26-7702						✔
IBM TotalStorage DS4000 Problem Determination Guide, GC26-7703						✔
IBM Fibre Channel Planning and Integration: User's Guide and Service Information, SC23-4329	✔	✔			✔	✔
IBM TotalStorage DS4000 FC2-133 Host Bus Adapter Installation and User's Guide, GC26-7736		✔			✔	
IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7737		✔			✔	
IBM TotalStorage DS4000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview GC26-7713	✔	✔	✔	✔		
Fibre Channel Solutions - IBM DS4000 EXP500 Installation and User's Guide, 59P5637	✔	✔		✔	✔	✔

Table 36. TotalStorage DS4000 and DS4000–related document titles by user tasks (continued)

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide, GC26-7735	✔	✔		✔	✔	✔
IBM TotalStorage DS4000 EXP810 Storage Expansion Enclosures Installation, User's, and Maintenance Guide, GC26-7798	✔	✔		✔	✔	✔
IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosures Installation and Migration Guide, GC26-7704	✔	✔				
IBM DS4000 Management Suite Java User's Guide, 32P0081					✔	✔
IBM Netfinity Fibre Channel Cabling Instructions, 19K0906		✔				
IBM Fibre Channel SAN Configuration Setup Guide, 25P2509	✔		✔	✔	✔	

Appendix G. 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 software installation package for Windows includes a screen reader software interface. To enable the screen reader, select Custom Installation when using the installation wizard to install Storage Manager 9.14 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 37 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 37. 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.

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Table 37. 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.

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

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

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

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

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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).

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

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

AWT. See *Abstract Windowing Toolkit*.

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

BIOS. See *basic input/output system*.

BOOTP. See *bootstrap protocol*.

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

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

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

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

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

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

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

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

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

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

CRU. See *customer replaceable unit*.

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

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

dac. See *disk array controller*.

dar. See *disk array router*.

DASD. See *direct access storage device*.

data striping. See *striping*.

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

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

DHCP. See *Dynamic Host Configuration Protocol*.

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

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

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

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

DMA. See *direct memory access*.

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

DRAM. See *dynamic random access memory*.

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

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

ECC. See *error correction coding*.

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

EISA. See *Extended Industry Standard Architecture*.

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

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

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

E_port. See *expansion port*.

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

ESD. See *electrostatic discharge*.

ESM canister. See *environmental service module canister*.

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

EXP. See *storage expansion enclosure*.

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

Extended Industry Standard Architecture (EISA). A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to

32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

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

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

FC. See *fibre channel*.

FC-AL. See *arbitrated loop*.

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

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

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

Fibre Channel Protocol (FCP) for small computer system interface (SCSI). A high-level fibre-channel mapping layer (FC-4) that uses lower-level fibre-channel (FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

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

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

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

gigabit interface converter (GBIC). A transceiver that performs serial, optical-to-electrical, and

electrical-to-optical signal conversions for high-speed networking. A GBIC can be hot swapped. See also *small form-factor pluggable*.

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

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

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

GUI.   See *graphical user interface.*

HBA.   See *host bus adapter*.

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

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

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

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

host computer.   See *host*.

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

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

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

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

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

IC.   See *integrated circuit*.

IDE.   See *integrated drive electronics*.

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

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

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

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

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

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

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

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

IP. See *Internet Protocol*.

IPL. See *initial program load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

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

JRE. See *Java Runtime Environment*.

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

LAN. See *local area network*.

LBA. See *logical block address*.

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

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

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

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

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

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

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

LPAR. See *logical partition*.

LUN. See *logical unit number*.

MAC. See *medium access control*.

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

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

MCA. See *micro channel architecture*.

media scan. A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all logical drive data to verify that it can be accessed, and optionally scans the logical drive redundancy information.

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

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

MIB. See *management information base*.

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

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

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

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

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

MSCS. See *Microsoft Cluster Server*.

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

NMI. See *non-maskable interrupt*.

NMS. See *network management station*.

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

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

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

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

N_port. See *node port*.

NVS. See *nonvolatile storage*.

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

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

ODM. See *Object Data Manager*.

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

partitioning. See *storage partition*.

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

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

PDF. See *portable document format*.

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

peripheral component interconnect local bus (PCI local bus). A local bus for PCs, from Intel, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture*, *Extended Industry Standard Architecture*.

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

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

portable document format (PDF). A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by e-mail, the Web, intranets, or CD-ROM; and can be viewed with the

Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

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

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

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

PTF.   See *program temporary fix*.

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

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

RAID set.   See *array*.

RAM.   See *random-access memory*.

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

RDAC.   See *redundant disk array controller*.

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

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

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

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

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

ROM.   See *read-only memory*.

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

RVSD.   See *recoverable virtual shared disk*.

SAI.   See *Storage Array Identifier*.

SA Identifier.   See *Storage Array Identifier*.

SAN.   See *storage area network*.

SATA.   See *serial ATA*.

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

SCSI.   See *small computer system interface*.

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

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

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

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

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

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

SFP. See *small form-factor pluggable*.

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

SL_port. See *segmented loop port*.

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

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

SMruntime. A Java compiler for the SMclient.

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

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

small form-factor pluggable (SFP). An optical transceiver that is used to convert signals between optical fiber cables and switches. An SFP is smaller than a gigabit interface converter (GBIC). See also *gigabit interface converter*.

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

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

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

SRAM. See *static random access memory*.

SSA. See *serial storage architecture*.

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

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

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

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

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

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

storage partition topology. In the DS4000 Storage Manager client, the Topology view of the Mappings window displays the default host group, the defined host group, the host computer, and host-port nodes. The host port, host computer, and host group topological elements must be defined to grant access to host computers and host groups using logical drive-to-LUN mappings.

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

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

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

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

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

switch zoning. See *zoning*.

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

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

TCP. See *Transmission Control Protocol*.

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

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

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

TL_port. See *translated loop port*.

transceiver. A device that is used to transmit and receive data. Transceiver is an abbreviation of transmitter-receiver.

translated loop port (TL_port). A port that connects to a private loop and allows connectivity between the private loop devices and off loop devices (devices not connected to that particular TL_port).

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

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

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

trap recipient. Receiver of a forwarded Simple Network Management Protocol (SNMP) trap. Specifically, a trap receiver is defined by an Internet Protocol (IP) address and port to which traps are sent. Presumably, the actual recipient is a software application running at the IP address and listening to the port.

TSR program. See *terminate and stay resident program*.

uninterruptible power supply. A source of power from a battery that is installed between a computer system and its power source. The uninterruptible power supply keeps the system running if a commercial power failure occurs, until an orderly shutdown of the system can be performed.

user action events. Actions that the user takes, such as changes in the storage area network (SAN), changed settings, and so on.

worldwide port name (WWPN). A unique identifier for a switch on local and global networks.

worldwide name (WWN). A globally unique 64-bit identifier assigned to each Fibre Channel port.

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

write-once read many (WORM). Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered.

WWN. See *worldwide name*.

zoning. (1) In Fibre Channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones. (2) A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

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