IBM

Installation and Support Guide for Intel-based Operating System Environments

IBM TotalStorage FAStT Storage Manager Version 9

Installation and Support Guide for Intel-based Operating System Environments

First Edition (August 2004)

This edition applies to FAStT Storage Manager Version 9.1 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 refers to all version 9.1 software release levels. 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® FAStT Storage Manager Version 9.1 in each of the following Intel® processor-based operating systems:

- Windows® 2000
- Windows Server 2003
- Novell NetWare 6.0 and 6.5
- Red Hat Enterprise Linux Advanced Server 2.1 (formerly Red Hat Linux Advanced Server 2.1)
- United Linux 1.0 IA-64
- United Linux 1.0
  - SuSE Linux Enterprise Server 8 (SLES 8)
  - Turbolinux Enterprise Server 8 (TLES 8)
  - Conectiva Linux Enterprise Edition Powered by United Linux
- VMware ESX Server 2.1

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 FAStT Storage Manager software.
- Upgrade controller firmware, if necessary.
- Identify storage management features that are unique to your installation.

Notes:

1. The controller firmware version 06.10.xx.xx and NVSRAM that ship with the IBM FAStT Storage Manager Version 9.1 support only the following FAStT storage servers:
   - FAStT600 Turbo Option; Machine Type 1722; Model Number 60U
   - FAStT600 Turbo Option; Machine Type 1722; Model Number 60X
   - FAStT700; Machine Type 1742; Model Number 1RU
   - FAStT700; Machine Type 1742; Model Number 1RX
   - FAStT900; Machine Type 1742; Model Number 90U
   - FAStT900; Machine Type 1742; Model Number 90X

2. There is no controller firmware version 6.10.xx for the following FAStT storage servers:
   - FAStT100 — all models
   - FAStT600 — base and SCU models
   - FAStT200
   - FAStT500

   Please contact your IBM reseller or representative regarding any future availability of 6.10.x controller firmware for these FAStT storage servers.

Who should read this document

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

FAStT installation process overview

Figure 1 gives an overview of the FAStT hardware and the FAStT Storage Manager software installation process. Lined arrows in the flow chart indicate consecutive hardware and software installation process steps. Labeled arrows indicate which document provides detailed information about a step.

Install Process	Documentation		
Plan installation	* FC Planning and Integration: User's Guide and Svc Info	Connect Power and Start Server	FAStT Storage Sever Installation Guide
	FAStT Storage Manager Concepts Guide		Fibre Channel Hardware Maintenance and Problem Determination Guide
Install Storage Server/RAID Controller Enclosure(s) in Rack	FAStT Storage Svr Installation Guide	Verify Server operation w/ LEDs	
	FAStT RAID Controller Enclosure Unit Install and User's Guide	Prepare for Installation of SM Software	FAStT Storage Manager Installation and support OS Guides
Install Storage Expansion Unit(s)	FAStT Storage Exp Units Install and User's Guides		
Make FC Connections		Install and Verify SM SW on Host and Workstation	FAStT Storage Manager Copy Services User's Guide
SET Link Speed (1GB or 2GB)	FAStT and HBA Install and User's Guides	Complete SM SW Installation	
Determine Management Method	FAStT Fibre Channel Storage Server Installation Guides	Configure Storage Hardware	Online Help
Out-of-Band In-Band	Fibre Channel Cabling Instructions	Configure Storage Subsystems on Host	
Install Network Hardware; Prep are Network Connection			
For pSeries Server and 6227 or 6228 HBA use only			

Figure 1. Installation process flow by current publications

FAStT Storage Manager Version 9 library

Table 1 on page xiii presents an overview of FAStT Storage Manager product library documents by the common tasks that they address. Click on active links in the tables to access those documents currently available on the Internet. You can access documentation for the other FAStT products at the following Web site:

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

Table 1. TotalStorage FAStT 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 FAStT Storage Manager Version 9 Installation and Support Guide for Intel-based Operating System Environments, GC26-7649	✔		✔	✔		
IBM TotalStorage FAStT Storage Manager Version 9 Installation and Support Guide for AIX, UNIX, Solaris and Linux on Power, GC26-7648	✔		✔	✔		
IBM TotalStorage FAStT Storage Manager Version 9 Copy Services User's Guide, GC26-7660	✔		✔	✔	✔	
IBM TotalStorage FAStT Storage Manager Version 9 Concepts Guide, GC26-7661	✔	✔	✔	✔	✔	✔

How this document is organized

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

Chapter 2, "Preparing for installation," on page 33 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, NetWare, Linux, and UNIX® platforms. It also describes other setup tasks.

Chapter 3, "Installing Storage Manager software in a standard Windows configuration," on page 53 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 61 provides installation instructions for Windows 2000, and Windows 2000 Server software in a cluster server environment.

Chapter 5, "Installing Storage Manager software in a standard NetWare configuration," on page 81 provides installation instructions for the storage management software in standard (noncluster) and cluster server configurations in the NetWare operating system environment.

Chapter 6, "Installing Storage Manager software in a Linux configuration," on page 87 provides installation instructions for the storage management software in a Linux operating system environment.

Chapter 7, "Installing Storage Manager software in a VMware ESX Server configuration," on page 95 provides installation instructions for the storage management software in a VMware ESX Server operating system environment.

Chapter 8, "Completing Storage Manager 9.1 installation," on page 97 discusses completion of Storage Manager software on Windows 2000, Windows 2000 Server, NetWare, and Linux platforms. It provides details on 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, and other storage subsystem management tasks.

Chapter 9, "Using the storage management software for Windows and NetWare," on page 113 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, Windows 2000 Server, and NetWare operating system environments.

Appendix A, "Windows operating system limitations," on page 123 discusses Windows 2000, and Windows Server 2003 operating system limitations and other operating system issues.

Appendix B, "NetWare operating system limitations," on page 131 discusses NetWare operating system limitations and other related operating system issues.

Appendix C, "Linux operating system limitations," on page 133 discusses Linux operating system limitations and other related operating system issues.

Appendix D, "VMware ESX Server operating system limitations," on page 135 discusses VMware ESX Server operating system limitations and other related operating system issues.

Appendix E, "Storage subsystem and controller information record," on page 137 provides a data sheet template that you can use to create a controller information record.

Appendix F, "Additional FAStT documentation," on page 139 provides an overview of the FAStT900, FAStT700, and FAStT600 Fibre Channel Storage Server product libraries, as well as other related documents.

Notices that this document uses

This document contains the following notices 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.
- Go to the IBM Support Web site at:

  www.ibm.com/pc/support/

  to check for technical information, hints, tips, and new device drivers.
- Use an IBM discussion forum on the IBM Web site to ask questions.

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

Using the documentation

Information about your IBM @server xSeries or IntelliStation system and preinstalled software, if any, is available 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 Web site at:

www.ibm.com/pc/support/

and follow the instructions. Also, to order publications through the IBM Publications Ordering System, go to the Web site at:

www.elink.ibmlink.ibm.com/public/applications/publications/cgibin/pbi.cgi/

Web sites

Locate up-to-date information about FAStT Fibre Channel Storage Servers and FAStT Storage Manager 9.1, including documentation and the most recent software, firmware, and NVSRAM downloads at the following Web sites.

IBM xSeries servers
For IBM xSeries information, go to the Web site at:

www.ibm.com/eserver/xseries/

IBM IntelliStation
For IBM IntelliStation information, go to the Web site at:

www.ibm.com/pc/intellistation/

FAStT Fibre Channel Storage Servers
Find the latest information about all of the IBM FAStT Fibre Channel Storage Servers at:

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

IBM TotalStorage products
Find information about all IBM TotalStorage products at:

www.ibm.com/storage

TotalStorage FAStT 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 at:

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

IBM Service
For service information for your IBM products, including supported options, go to the Web site at:

www.ibm.com/pc/support/

FAStT technical support

Find FAStT software downloads, hints and tips, documentation, parts information, HBA and fibre channel support at:

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

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 on a FAStT600 or FAStT900 by using the online tool at:

www.storage.ibm.com/pfeatures.html

IBM Publications Center

Order IBM publications at:

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. For information about which products are supported by Support Line in your country or region, go to the Web site at:

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

For more information about Support Line and other IBM services, go to the Web site at:

www.ibm.com/services/

or, for support telephone numbers, go to the Web site at:

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. For support telephone numbers, go to the Web site at:

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.

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Chapter 1. Introduction

IBM FAStT Storage Manager version 9.1x host software supports new features incorporated into the latest release of controller firmware version 06.10.xx.xx. This version of FAStT Storage Manager also manages FAStT Storage Servers with all general released firmware versions from 04.01.xx.xx through 05.4x.xx.xx. See Table 2 for information on latest supported controller firmware code levels available for all FAStT Storage Server models. New features associated with the 06.10.xx.xx controller firmware are listed in "New features" on page 2. All of the controller firmware versions listed below are available free-of-charge. However, you must purchase an EXP100 Expansion Enclosure or FAStT100 Storage Server to obtain controller firmware code versions 05.41.xx.xx or 05.42.xx.xx, respectively.

Table 2. Current firmware versions by server and environment

Storage server name	Machine type	Model number	Latest controller firmware version for fibre channel environment	Latest controller firmware version for SATA environment
IBM Netfinity Fibre Channel RAID Controller Unit	3526	1RU 1RX	04.01.xx.xx	N/A
FAStT100	1724	100	N/A	05.42.xx.xx
FAStT200 High Availability (HA)	3542	2RU 2RX	05.30.xx.xx	N/A
FAStT200		1RU 1RX		
FAStT500	3552	1RU 1RX		
FAStT600 Base	1722	6LU 6LX	05.34.xx.xx	05.41.xx.xx
FAStT600 Single Controller Unit (SCU)				N/A
FAStT600 Turbo Option		60X 60U	06.10.xx.xx	06.10.xx.xx
FAStT700	1742	1RU 1RX		06.10.xx.xx
FAStT900		90U 90X		06.10.xx.xx

This document provides information on how to prepare, install, configure, and start IBM TotalStorage FAStT Storage Manager Version 9.1 in the following operating system environments:

- Windows 2000
- Windows Server 2003
- Novell NetWare
- Linux
- VMware ESX Server 2.1

Note: For analogous information regarding other operating systems, see the IBM TotalStorage FAStT Storage Manager 9 Installation and Support Guide for AIX, UNIX, Solaris and Linux on Power.

Consult your IBM service representative for any future support of additional operating system environments.

Before you begin the installation of this product, consult the following documentation:

- readme.txt file

  Read this document first. It supplies information associated with operating systems on which you can install Storage Manager software. A readme file is located in the root directory of each of four installation CDs associated with supported operating systems. For the latest installation and user information, refer to the following IBM Web site:

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

- *IBM TotalStorage FAStT Storage Manager Concepts Guide*

  Use this document to become familiar with terminology and features of the IBM TotalStorage FAStT Storage Manager software. To download this book, go to the Web site at:

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

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

- Enterprise Management window help

  Use this online help system to learn more about working with the entire management domain.

- Subsystem Management window help

  Use this online help system to learn more about managing individual storage subsystems.

You can access these help systems from within the Storage Manager 9.1 Client. From either an Enterprise Management or Subsystem Management window, click **Help** or press **F1**.

After you install IBM FAStT Storage Manager Version 9.1, consider installing the FAStT Management Suite Java (FAStT-MSJ) diagnostic program. You can use these programs to verify the status of the fibre channel connections before you use the storage subsystem.

The *IBM FAStT MSJ User's Guide* and the FAStT-MSJ program are located on the IBM FAStT Storage Manager Version 9.1 CD where associated with your particular operating system.

Note: If your FAStT Storage Server is connected to a fibre channel host bus adapter (HBA) in the host server in a SAN environment, consider purchase one of the following software applications helpful for SAN management and troubleshooting.
- IBM Tivoli SAN Manager
- McData SANavigator

New features

This section describes the standard features that are part of the Storage Manager version 9.1 software. Your storage subsystem firmware must be version 6.10.xx.xx if you plan to use any of the features listed in this section. Exceptions associated with the EXP100 Expansion Enclosure and FAStT100 Storage Server are listed in Table 2 on page 1.

The following new features and support have been added to the Storage Manager version 9.1 software:

- Enhanced Remote Mirror functionality

  Besides Metro Mirroring, IBM FAStT Storage Manager now supports Global Mirroring and Global Copy. For details, see the IBM TotalStorage FAStT Storage Manager Version 9 Copy Services User's Guide. More detailed information is also available in 3.

- Staged controller firmware download

  See online help to learn more about this feature.

  Note: The option to activate firmware at a later time is not supported on the FAStT700.

- Parallel drive firmware download

  See online help to learn more about this feature.

- Mixed drive types and improved configuration

  See online help to learn more about this feature.

- Linux MPP-based multipath support

  See the Linux RDAC Failover readme to learn more about this feature.

- Full command line SMcli support

  See online help to learn more about this feature.

Premium features

FAStT100 and FAStT600

- The Enhanced Remote Mirroring feature is not currently supported on either the FAStT100 or FAStT600 Base or Single Controller Unit models. FAStT600 Turbo Option Fibre Channel Storage Servers do support the Remote Mirror feature.

- Storage Partitioning is not a standard feature on the FAStT100 or FAStT600.

Four premium features can be enabled on all FAStT subsystems by purchasing a premium feature key. These include FlashCopy, Remote Mirror option, VolumeCopy, and Storage Partitioning (standard on all but the FAStT600 and FAStT600 Turbo Option). Each of these features is described in the following section.

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 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 on 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.

Enhancements to the Remote Mirror feature for Storage Manager version 9.1 software include:

Delta Logging

- Synchronization previously required a complete recopy of the primary Remote Mirror volume. It now only requires updates to the LBAs that were changed.
- A repository volume is now used to store a queue of outstanding write operations for the secondary Remote Mirror.
- Updates to the secondary Remote Mirror are now a background operation once the connection is restored.

Suspend/Resume

- Uses the delta-logging facility to manage the suspension and resumption of I/O activity with the secondary Remote Mirror.
- Based on the delta logging functionality of outstanding I/O requests.
- Allows suspension and later resumption of asynchronous operation with the secondary Remote Mirror.
- A suspend command stops I/O writes to secondary Remote Mirror.
- A resume command initiates a partial re-synchronous accumulation of log entries and continues primary write synchronization.

Global Copy and Global Mirroring (Asynchronous Write Mode)

- Allows host acknowledgement of a write operation before data is successfully written to the secondary Remote Mirror.
- Uses a repository volume to hold write data until an acknowledgment is received from the secondary Remote Mirror.
- Write Order Consistency allows for write order preservation to the secondary Remote Mirror under asynchronous writes.
- Write order consistency is maintained across all of the volumes configured for this mode of operation.
- Ensures that the write order to a secondary Remote Mirror is the same as the acknowledged order to a host.
- Asynchronous Write Mode without write order consistency is referred to as Global Copy.
- Asynchronous Write Mode with write order consistency is referred to as Global Mirroring.

Read access to secondary Remote Mirror

- Allows direct host Read access to a secondary Remote Mirror.
- Allows for creation of FlashCopy volume of the secondary Remote Mirror volume.
- Allows Read and Write access to the FlashCopy volume of the secondary mirror volume.

Inter-array Communication Diagnostics

- Improves return status for failed Remote Mirror creation requests as follows:
  - Array to fabric connection
  - Array to array communication
  - Array to volume on remote system
- Allows the user to test connectivity between mirrors after Remote Mirror relationships are established.

Increased number of Remote Mirror relationships

The number of Remote Mirror relationships now supported is 64.

> **Note:** The terms Remote Mirror and Enhanced Remote Mirror are used interchangeably throughout this document, the FAStT Storage Manager client program GUI and online help.

Increased maximum distance between nodes

The maximum distance between nodes in Metro Mirroring (synchronous write mode) configurations is increased with this update.

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 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 FAStT Storage Manager client program GUI, and online help.

Storage Partitioning

Storage Partitioning allows the user to present all storage volumes to a SAN through several different partitions by *mapping* storage volumes to a LUN number, each partition presenting LUNs 0 - 255. This volume/LUN mapping applies only to the host port or ports that have been configured to access that LUN. A given storage volume can have only one Host/LUN mapping. This feature allows the total number of configurable storage volumes supported by the array to be much greater than the number of addressable storage devices.

This feature also allows the support of multiple hosts using different operating systems and their own unique disk storage subsystem settings to be connected to the same FAStT Storage Server at the same time (heterogeneous host environment).

Storage Manager 9.1 limitations

Because there is no Storage Manager 9.1-level controller firmware version 06.10.xx.xx and NVSRAM for FAStT100 (1724-100), FAStT200 (3542, all models), FAStT500 (3552, all models), FAStT600 (1722-60U and -60X), or FAStT600 Single Controller Unit (1722-6LU and -6LX), Storage Manager 9.1 features are unavailable

for these products. However, IBM recommends that you use Storage Manager 9.1 host software to manage these Storage Manager servers, provided the installed controller firmware in these models is version 04.10.xx.xx or higher. See Table 2 on page 1.

Supported machine types

Table 3 provides a list of FAStT machine types, their all inclusive supported storage management host software and compatible FAStT Storage Server controller firmware versions.

Table 3. Machine types and supported storage management software

Product name	Machine type	Model	Firmware version	Supported Storage Manager software version
IBM Netfinity® Fibre Channel RAID Controller Unit	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, 9.1
IBM TotalStorage FAStT100 Storage Server	1724	100	5.42.xx.xx (supports FAStT100 only)	8.42, 9.1
IBM FAStT200 Storage Server	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, 9.1
IBM FAStT200 High Availability (HA) Storage Server	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, 9.1
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, 9.1
IBM TotalStorage FAStT600 Fibre Channel Storage Server	1722	6LU 6LX	5.34.xx.xx	8.41.xx.03 or later, 8.42, 9.1
		60U 60X (Base Model)	5.33.xx.xx 5.34.xx.xx 5.40.xx.xx (Turbo Model only)	8.3, 8.4, 8.41, 8.42, 9.1
		60U 60X (Turbo Model)	5.41.xx.xx (supports EXP100 only)	
IBM TotalStorage FAStT700 Fibre Channel Storage Server	1742	1RU 1RX	5.00.xx.xx 5.20.xx.xx 5.21.xx.xx 5.30.xx.xx 5.40.xx.xx 06.10.xx.xx	8.0, 8.2, 8.21, 8.3, 8.41, 8.42, 9.1

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

Product name	Machine type	Model	Firmware version	Supported Storage Manager software version
IBM TotalStorage FAStT900 Fibre Channel Storage Server	1742	90X 90U	5.30.xx.xx 5.40.xx.xx 5.41.xx.xx (supports EXP100 only) 06.10.xx.xx	8.3, 8.4, 8.41, 8.42, 9.1

Notes:

1. Firmware level 05.41.xx.xx provides EXP100 expansion enclosure support only for FAStT600 Base models.

2. Firmware level 5.40.xx.xx and earlier provide support for EXP500 and EXP700 expansion enclosures only.

   Note: Firmware version 6.10.xx.xx provides support for both fibre channel and SATA expansion enclosures, as long as they are not intermixed in the same FAStT Storage Server configuration.

3. Controller firmware versions regulate the function of any given Storage Manager client code version release. You might need to purchase the appropriate firmware upgrade or hardware option to enable the function of your particular Storage Manager client code version release. Storage subsystem firmware must be at version 04.00.02.xx or higher to be managed with Storage Manager versions 8.0, 8.2, 8.21, 8.3, 8.4, 8.41, 8.42, or 9.1.

4. This table associates all compatible controller firmware and management software versions for the various FAStT Storage Server products. To ensure the highest level of compatibility and error-free operation, the controller firmware for all FAStT Storage Server products should be 05.3x.xx.xx-level (except for machine type 3526, for which the latest available firmware level is 04.01.xx.xx.) and the management software version should be 08.4x.xx.xx-level or higher.

Terms to know

If you are upgrading from a previous version of Storage Manager software, some of the terms you are familiar with have changed. It is important that you familiarize yourself with the new terminology. Table 4 provides a list of some of the changed terms. For further information on terminology, see the Help section of the Storage Manager Enterprise Management window, the Storage Subsystem Management window, or the glossary on page 147.

Table 4. New terminology

Term used in previous versions	New term
RAID module	Storage subsystem
Drive group	Array
Volume	Logical drive

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 storage subsystem. You can attach it to the storage subsystem in either of the following ways:

- Through a TCP/IP Ethernet connection to the controllers in the storage subsystem
- 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 input/output (I/O) path

Host computer

A host computer is a system that is directly attached to the 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 FAStT Storage Manager Version 9.1 software for Windows

Storage Manager Version 9.1 contains the following software components for Windows 2000 and Windows Server 2003:

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

Storage Manager 9.1 Client

The Storage Manager 9.1 Client (SMclient) component provides the graphical user interface (GUI) for managing storage subsystems. The SMclient contains two main components:

- **Enterprise Management**. You can use the Enterprise Management component to add, remove, and monitor storage subsystems within the management domain.
- **Subsystem Management**. You can 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 installed, 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.

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 and higher, a maximum of four end-to-end fibre-channel paths from the host to the storage subsystems are supported.

Storage Manager 9.1 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 9.1 Utility

The Storage Manager 9.1 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 116.
- **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 116.
- **SMrepassist utility**. The SMrepassist utility enables you to perform the following tasks:
  - Flush cached data before creating a FlashCopy or VolumeCopy.
  - 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 117.

IBM FAStT Storage Manager Version 9.1 software for NetWare

Storage Manager Version 9.1 contains the following software components for NetWare:

- The following components install on both the host and management station:
  - Storage Manager 9.1 Client (SMclient)
- The following components install 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

IBM FAStT Storage Manager Version 9.1 software for Linux

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

- The following components install on both the host and management station:
  - Storage Manager 9.1 Runtime (SMruntime)

    This component contains the Java JRE for other software packages.
  - Storage Manager 9.1 Client (SMclient)

This component is necessary if you intend to manage the storage subsystem from a host computer or a management station.

- If you choose Linux as the failover multipath driver, the following components install only on the host:

  – Storage Manager 9.1 Utility (SMutil)

  This component packaged with the SMclient package contains the hot_add and SMdevices utilities.

  – Storage Manager 9.1 RDAC (SMRDAC)

  This component provides multipath failover/failback capability.

  – Storage Manager 9.1 Agent (SMagent)

  This component is necessary if you intend to use the host-agent (in band) management method. It requires that you first install RDAC.

- If you choose the QLogic HBA failover driver as the multipath failover/failback driver, the following components install only on the host:

  – Storage Manager 9.1 Utility (SMutil)

  – FAStT Management Suite Java™ (FAStT MSJ)

  This component is optional if you installed RDAC to provide FC HBA diagnostic functions. It is required if you did not install RDAC. It is necessary to configure the LUN failover/failback path information for the Linux fibre channel Host Bus Adapter failover device drivers.

  – IBM FAStT-MSJ QLremote agent

Storage subsystem management methods

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

- The host-agent management method
- The direct management method

> **Note:**
>
> - You must make direct (out-of-band) connection to the FAStT Storage Server in order to obtain the correct host type. The correct host type will allow the FAStT Storage Server 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 FAStT Storage Server management availability and access, IBM recommends that you configure both in-band and out-of-band management connections. In such an arrangement, should either connection type fail, you should still able to manage your storage server using the other connection.
>
> - If you establish management connections from multiple management stations or hosts to the same FAStT Storage Servers, it is best practice to have only one active management connection to the FAStT Storage Server at a time, even though IBM supports up to eight simultaneous active management sessions to a given FAStT Storage Server.
>
> - Storage Manager 9.1 supports only the out-of-band management method for use with the Linux operating system when no Linux RDAC is used.

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 2 on page 12.

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

- Ethernet cables do not need to be run to the controllers.
- A Dynamic Host Configuration Protocol/Bootstrap Protocol (DHCP/BOOTP) server is not needed to connect the storage subsystems to the network.
- The controller network configuration tasks that are described in Chapter 2, "Preparing for installation," on page 33, do not need to be performed.
- A host name or IP address must only be specified 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, the subsystem cannot be managed or monitored.

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

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 31.

Running the
host-agent software

Controller

Controller

Host computer

Fibre Channel
I/O path

Network →

Controller

Controller

Storage subsystems

Note: The host can
act as a management
station also.

Management station
(one or more)

SJ000879
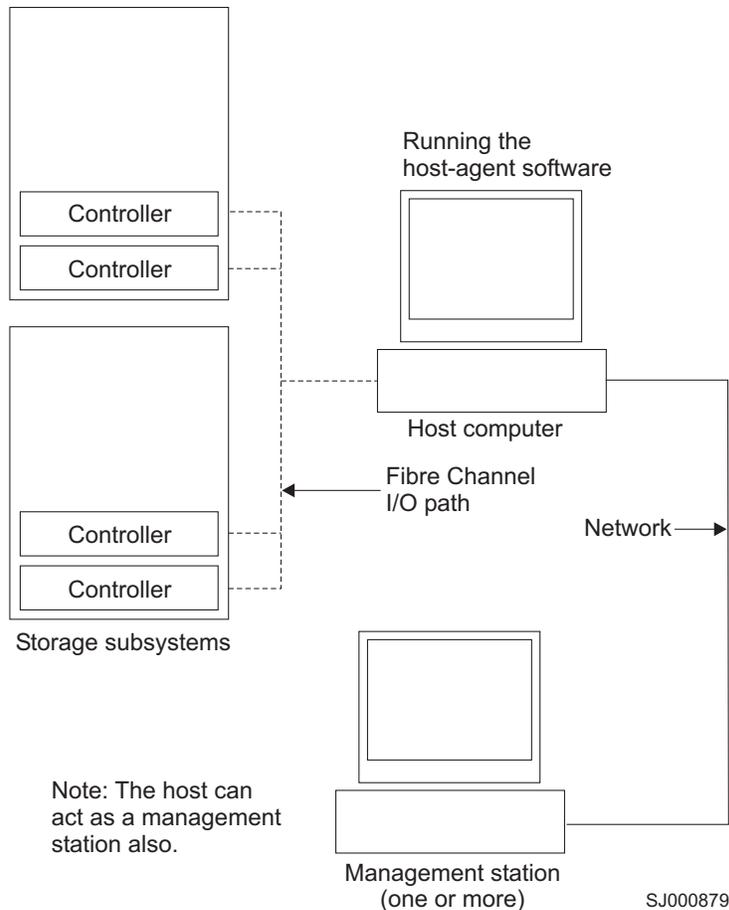
Figure 2. Host-agent (in-band) managed storage subsystems

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, through a cable connected to the RJ-45 connector, to an Ethernet network, as shown in Figure 3 on page 14.

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

- The Ethernet connections to the controllers enable a management station running SMclient to manage storage subsystems that are connected to a host running any of the operating systems that Storage Manager 9.1 supports.
- An access logical drive is not needed 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 33.

You can avoid DHCP/BOOTP server and network tasks by assigning static IP addresses to the controller, or by using a default IP address.

- To assign a static IP address, see the IBM support Web site at:

  www.ibm.com/pc/support/

  Refer to Retain Tip [#]H171389 Unable To Setup Networking Without DHCP/BOOTP.
- Storage subsystem controllers with firmware version 05.00.xx.xx or higher have the following default settings.

Controller	IP address	Subnet mask
A	192.168.128.101	255.255.255.0
B	192.168.128.102	255.255.255.0

Notes:
1. If the storage subsystem controllers have firmware version $05.4x.xx.xx$ or higher, use the Storage Manager Client Program to change the default IP address.
2. You must make a direct management connection to the storage server using the default IP addresses before you can change them.

Figure 3 on page 14 shows a system in which storage subsystems are managed by using the direct-management (out-of-band) method.

```
                    ┌─────────────┐
                    │ Controller  │          ┌──────────┐
                    ├─────────────┤          │          │
                    │ Controller  │          │          │
                    └─────────────┘          │          │
                                             └──────────┘
                    ┌─────────────┐          ┌──────────┐
                    │             │          └──────────┘
                    │ Controller  │            Host computer
                    ├─────────────┤
                    │ Controller  │       ←── Fibre Channel
                    └─────────────┘           I/O path
                  Storage subsystems
                                             ┌──────────┐
                                             │          │
              ←── Ethernet                   │          │
                                             └──────────┘
                                             ┌──────────┐
                                             └──────────┘
                                             Management station
                                             (one or more)  SJ000864
```
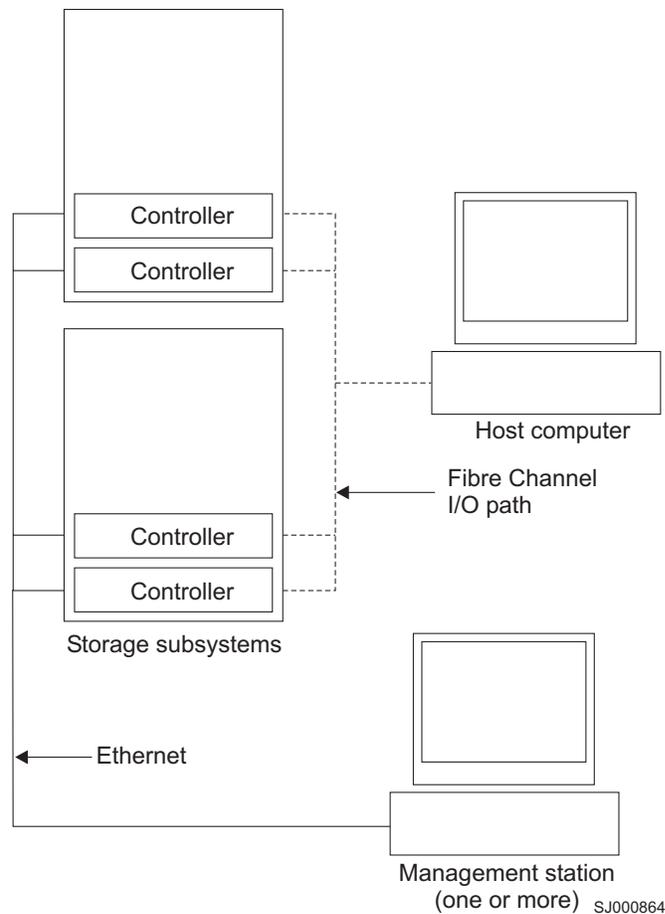
Figure 3. Direct-management (out-of-band) storage subsystems

Reviewing a sample network

Figure 4 on page 15 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 IP addresses, or default 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
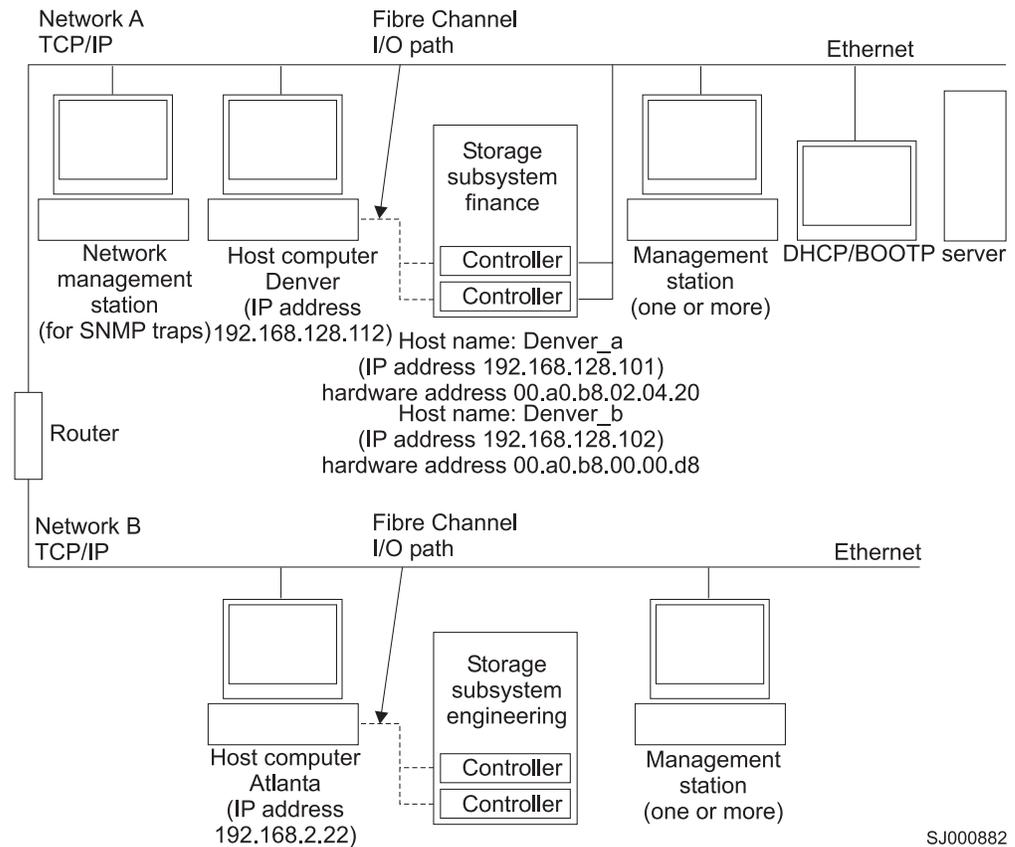
Figure 4. Sample network using directly-managed and host-agent managed storage subsystems

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

You must install the following software components on each host computer:
- RDAC (for Linux, Windows 2000, and Windows Server 2003 only)
- SMutil (for NetWare, Linux, Windows 2000, and Windows Server 2003 only)
- LSIMPE.com (for NetWare only)
- IBM FAStT MSJ and QLRemote agent (for Linux only, if Linux RDAC is not installed)

Note: See the Linux RDAC README in the IBM FAStT Storage Manager for x86 Linux software package for detailed Linux RDAC installation instructions.

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

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

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

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.

Configuration types

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

- Standard (noncluster) configuration
- Cluster server configuration
    - Although there is currently no support for Linux cluster server configurations, you can contact IBM for updates regarding availability of such support in the future.
    - Illustrations of cluster server configurations that follow do not pertain to NetWare or Linux.

Standard (non-cluster) configuration

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

Controller

Controller

RDAC, SMutil,
SMagent

Host computer

Fibre Channel
I/O path

Controller

The SMclient software
can also be installed
on the host computer.

Controller

Storage subsystems

SMclient

Ethernet

Management station   SJ000869
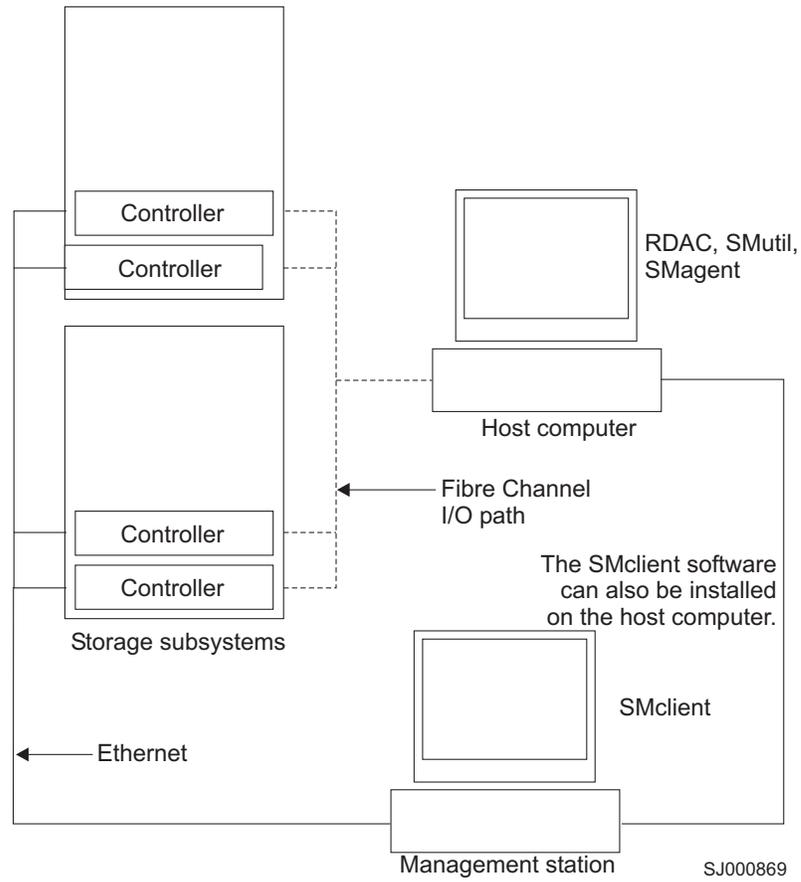
Figure 5. Sample standard (non-cluster) configuration

Cluster server configuration for Windows and NetWare

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
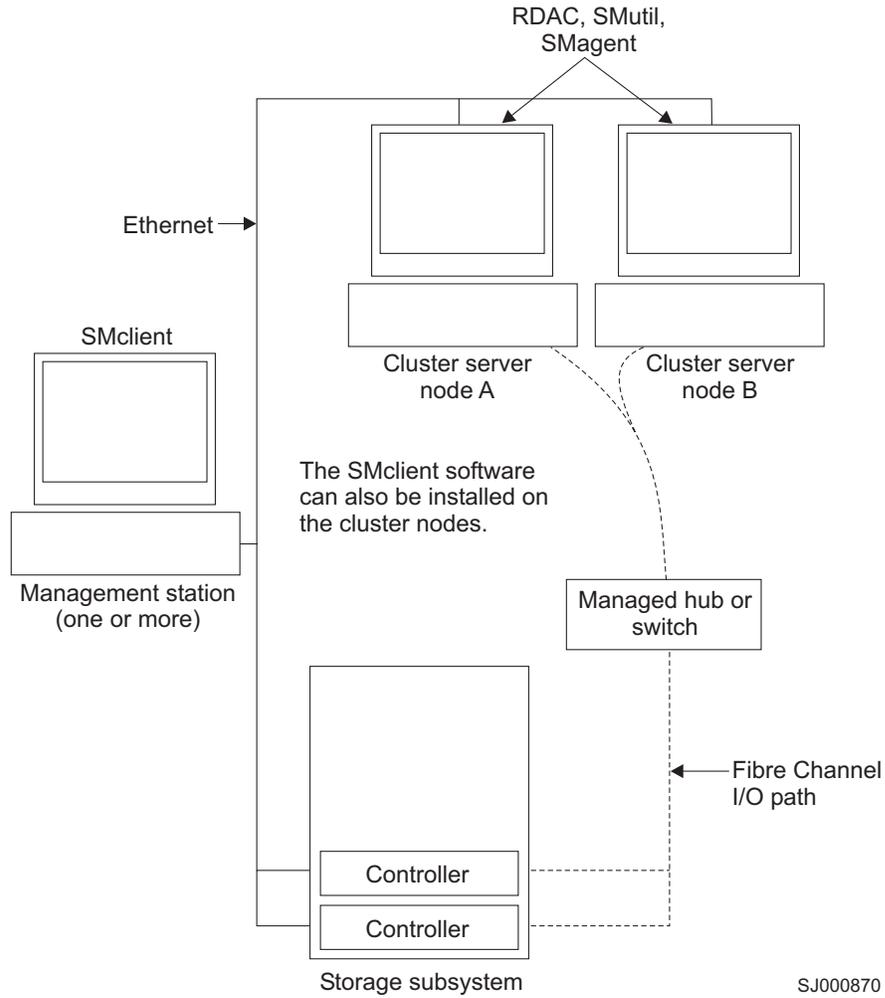
Figure 6. Sample cluster server configuration

Installation types

You can install Storage Manager 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 FAStT Fibre Channel Storage Server using firmware 06.10.xx.xx and you will manage storage subsystems using Storage Manager 9.1.

- **Existing storage subsystem environment**. If you are installing Storage Manager software in an environment with existing storage subsystems, see Table 5 on page 19 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 06.10.xx.xx. The Storage Manager 9.1 RDAC 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 9.1 RDAC on all host computers that have disks defined on storage subsystems that have firmware level 06.10.xx.xx.

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 9.1, except RDAC, so that you can download the new firmware version (06.10.xx.xx) 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 FAStT100 Storage Server. Do not load this controller firmware version on any other FAStT Storage Server.

Table 5. Configurations for existing storage subsystems

Current environment	Planned environment	Action
(Machine type 1742) Existing storage subsystems with controllers that have firmware versions 05.00.xx.xx, 05.2x.xx.xx or 05.3x.xx.xx (Machine type 1722 — Turbo Option model only) Existing storage subsystems with controllers that have firmware version 05.4x.xx.xx	Firmware version 06.10.xx.xx Storage Manager 9.1. **Note:** Firmware version 06.10.xx.xx supports both fibre channel expansion enclosures (EXP500 and EXP700) and SATA expansion enclosures (EXP100) as long as the fibre channel and SATA expansion enclosures are not intermixed.	1. Uninstall Storage Manager 8.4x. See "Uninstalling storage management software components" on page 118 for more information. 2. Install Storage Manager 9.1. See "New installation process" on page 53 for more information. 3. Discover the storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 97 for more information. 4. Download firmware and NVSRAM version 06.10.xx.xx. See "Downloading controller and NVSRAM ESM firmware" on page 102 for more information. **Note:** To incorporate SATA hardware in an existing FAStT600 Turbo, FAStT700, or FAStT900 storage subsystem, use the the upgrade instructions in the EXP100 Installation and User's Guide. Instead of using the version 05.41.xx.xx firmware indicated in that document, however, use the version 06.10.xx.xx firmware.

Table 5. Configurations for existing storage subsystems (continued)

Current environment	Planned environment	Action
(Machine type 1722 — Base Option model only) Existing storage subsystems with controllers that have firmware version 05.4x.xx.xx	Firmware version 5.41.xx.xx Storage Manager 9.1. **Notes:** 1. Perform upgrade of machine types 1742 and 1722 to firmware level 05.41.xx.xx only when you no longer plan to use these storage servers to manage EXP500 and EXP700 storage expansion enclosures equipped with fibre-channel drives. Perform this upgrade only when you plan to use these FAStT Storage Servers only to manage EXP100 expansion enclosures. 2. Firmware version 05.41.xx.xx supports EXP100 expansion enclosures only.	1. This firmware ships as part of the FAStT Storage Manager 8.41 Support for FAStT EXP100 SATA Storage Expansion Unit CD. 2. Uninstall Storage Manager 8.4x. See "Uninstalling storage management software components" on page 118 for more information. 3. Install Storage Manager 9.1. See "New installation process" on page 53 for more information. 4. Follow the instructions to upgrade the controller firmware in the *IBM TotalStorage FAStT EXP100 Installation and User's Guide.*. **Note:** Upgrade the controller firmware using the version supplied on the FAStT Storage Manager 8.41 Support for FAStT EXP100 SATA Storage Expansion Unit CD before downloading controller firmware from the Web. Only after you have done so, access the Web to download controller firmware version 5.41.xx.xx.

Table 5. Configurations for existing storage subsystems (continued)

Current environment	Planned environment	Action
(Machine type 3552) Existing 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 9.1. **Note:** Firmware version level 05.4x.xx.xx does not support machine type 3552.	1. Uninstall previous Storage Manager version. See "Uninstalling storage management software components" on page 118 for more information. 2. Install Storage Manager 9.1. See "New installation process" on page 53 for more information. 3. Discover the storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 97 for more information. If the current controller firmware version number starts with "4.", go to the FAStT technical support Web site listed on page xvii 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 and NVSRAM ESM firmware" on page 102 for more information. 5. Download the latest firmware and NVSRAM version 5.3x.xx.xx from the IBM Web site. See "Downloading controller and NVSRAM ESM firmware" on page 102 for more information.

Table 5. Configurations for existing storage subsystems (continued)

Current environment	Planned environment	Action
(Machine type 3542) Existing storage subsystems with controllers that have firmware versions 04.00.02.xx through 05.3x.xx.xx	Firmware version 5.3x.xx.xx Storage Manager 9.1. **Note:** Firmware version 05.4x.xx.xx does not support machine type 3542.	1. Uninstall the previous Storage Manager software. See "Uninstalling storage management software components" on page 118 for more information. 2. Install Storage Manager 9.1. See "New installation process" on page 53. 3. Discover storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 97 for more information. If the current controller firmware version number starts with "4." , go to the FAStT technical support Web site listed on page xvii 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 and NVSRAM ESM firmware" on page 102 for more information. 5. Download firmware and NVSRAM version 5.3x.xx.xx. See "Downloading controller and NVSRAM ESM firmware" on page 102 for more information.
(Machine type 1724) Existing storage subsystems with controllers that have firmware version 05.42.xx.xx	Firmware version 5.42.xx.xx Storage Manager 9.1. **Note:** Firmware version 06.10.xx.xx does not support Machine type 1724.	1. Uninstall Storage Manager 8.4x. See "Uninstalling storage management software components" on page 118 for more information. 2. Install Storage Manager 9.1. See "New installation process" on page 53 for more information. 3. Discover the storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 97 for more information.

Table 5. Configurations for existing storage subsystems (continued)

Current environment	Planned environment	Action
(Machine types 3526, 3552) Existing storage subsystems with controllers that have firmware versions 04.00.xx.xx through 04.00.01.xx	Firmware version 04.01.xx.xx for machine type 3526 Firmware version 05.3x.xx.xx for machine type 3552 Storage Manager 9.1 **Note:** Firmware version 05.3x.xx.xx does not support machine type 3526. Firmware version 05.4x.xx.xx does not support machine type 3552.	1. Uninstall Storage Manager Version 7.x. See "Uninstalling storage management software components" on page 118 for more information. 2. Install Storage Manager 9.1. See "New installation process" on page 53 for more information. 3. Discover the storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 97 for more information. If the current controller firmware version number starts with ″4.″, go to the FAStT technical support Web site listed on page xvii 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. 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 and NVSRAM ESM firmware" on page 102 for more information.
(Machine types 1722, 1742, 3552, 3542 and 3526) Existing storage subsystems with controllers that have firmware versions 04.01.xx.xx through 05.4x.xx.xx	Remain at existing firmware version. Storage Manager 9.1 **Note:** Storage Manager 9.1 can only manage FAStT Storage Servers with controller firmware versions 04.01.xx.xx or higher.	1. Uninstall older versions of Storage Manager. See "Uninstalling storage management software components" on page 118 for more information. 2. Install Storage Manager 9.1. See "New installation process" on page 53 for more information. 3. Discover the storage subsystems. See "Performing an initial automatic discovery of storage subsystems" on page 97 for more information.
(Machine types 3526, 3542, 3552) Existing storage subsystems with controllers that have firmware versions 04.00.02.xx upto but not including 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 9.1 is 04.01.xx.xx or higher.

Table 5. Configurations for existing storage subsystems (continued)

Current environment	Planned environment	Action
(Machine types 3526, 3552) Existing storage subsystems with controllers that have firmware versions 04.00.xx.xx through 4.00.01.xx	Existing firmware versions Storage Manager 7.10	Set up a separate management station with Storage Manager 7.10 installed to manage the storage subsystems with controllers that have back-level firmware.

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 06.10.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 04.00.xx.xx through 04.00.01.xx, which is managed by a separate management station with Storage Manager 7.10.
- A storage subsystem with controllers running firmware version levels 04.00.02.xx through 05.3x.xx.xx, which is managed with Storage Manager 8.4x.

Important: The common host must have the latest level (9.1) 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 05.3x.xx.xx firmware for FAStT200, FAStT500, FAStT600 Base and 06.10.xx.xx for FAStT600 Turbo, FAStT700, and FAStT900 is available free of charge for download with all fixes and software patches from the following IBM support Web site:

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

Figure 7 shows an example of a Windows environment that includes coexisting storage subsystems.

Version 8.4 of the storage-management software must be installed on either a management station or host.

Important: In a co-existing situation, the common host must have Storage Manager Version 8.4 RDAC and SMagent installed.

Management station

Firmware version 4.x (minimum)

Controller

Controller

Host-agent

Firmware version 5.x

Controller

Controller

Storage subsystems

Fibre Channel I/O path

Host computer

Ethernet

Client software

Version 7.10 of the storage-management software must be installed on a management station.*

*Only to manage existing storage subsystems with firmware version 4.00.xx.xx to 4.00.01.xx.

Management station

SJ001058

Figure 7. Sample coexisting storage subsystems

System requirements

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

Hardware requirements

Table 6 lists the hardware required for installing Storage Manager 9.1.

Table 6. Hardware requirements for Storage Manager 9.1 software

Hardware component	Requirements	Software tested
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 firmware version levels 04.00.02.xx through 05.4x.xx.xx	
Fibre Channel host adapters		The following fibre-channel host adapters were tested with the storage management software: • IBM FAStT host adapter (part number: 00N6881) • An IBM FAStT FC2 Host Bus Adapter (part number 19K1246) or IBM FAStT 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 6. Hardware requirements for Storage Manager 9.1 software (continued)

Hardware component	Requirements	Software tested
Fibre Channel fabric switches (if needed for the desired configuration)		The following fibre-channel fabric switches were tested with the storage management software: • IBM 8-port fibre-channel switch (machine type 2109 S08) • IBM 16-port fibre-channel switch (machine type 2109 S16) • IBM 16-port 2 Gbps fibre-channel switch (machine type 2019 F16) • IBM 8-port 2 Gbps fibre-channel switch (machine type 3534 F08) • IBM 32-port 2 Gbps fibre-channel switch (machine type 2109 F32) • IBM TotalStorage SAN Switch H08 (machine type 2005-H08) • IBM TotalStorage SAN Switch H16 (machine type 2005-H16) • INRANGE IN-VSN FC/9000 2 Gbps fibre-channel directors (machine types 2042-01 and 2042-128) • McDATA 4500 Sphereon 2 Gbps 16-, 24-, and 32-port fibre-channel switch (machine types 2031-216, 2031-224, and 2032-232) • McDATA Intrepid 6140 2 Gbps directors (machine type 2032-140) • CISCO MDS 9209 2 Gbps multilayer director (machine types 2062-D07 and 2062-T07) • CISCO MDS 9216 2 Gbps multilayer fabric switch (machine type 2062-D01) For specific fibre-channel switch setup requirements: • Read the switch documentation. • Go to the Web site at: www.ibm.com/storage/fcswitch/

Table 6. Hardware requirements for Storage Manager 9.1 software (continued)

Hardware component	Requirements	Software tested

Management station (for client software)	Your management station computer requires:
	
	• 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 running the storage management software smoothly without video artifacts, you might need to upgrade the server video adapter.	

> **Note:** For more information about host adapters, fabric switches, and managed hubs, go to the following ServerProven™ Web sites at:
>
> www.ibm.com/pc/us/compat/
>
> www.ibm.com/storage/disk/fastt/supserver.htm

Firmware requirements

To use all of the features of Storage Manager 9.1, your storage subsystem must contain controllers with firmware version 06.10.xx.xx for machine types 1722 (Turbo

Option model only) and 1742 (all models). To manage storage subsystems with Storage Manager 9.1, your storage subsystems must contain controllers with firmware versions 04.01.xx.xx or higher.

Table 7 lists firmware upgrades that are not currently possible.

Table 7. Firmware upgrades that are not possible

Machine type	Impossible firmware version upgrade
3552 and 3542	04.xx.xx.xx through 5.3x.xx.xx to 06.10.xx.xx
1722 (Base and Single Controller Unit models)	05.3x.xx.xx to 06.10.xx.xx
1724	05.42.xx.xx to 06.10.xx.xx

For more information on this subject, contact your IBM reseller or IBM marketing representative.

Storage Manager 9.1 also supports four premium feature options:
* Storage Partitioning
* FlashCopy
* VolumeCopy
* Remote Mirror

Windows software requirements

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

Note: The disk space listed in Table 5 is for the packages after the installation. During the installation of each software package, you might need up to 140 MB of free disk space.

Table 8. Installation requirements for Windows by software package

Package	Disk space requirement (Windows 2000)	Administrator privilege (Windows 2000)
SMclient	80 MB	Not required / Not required
RDAC	2 MB / 2 MB	Required
SMagent	1 MB / 1 MB if SMclient is installed. 40 MB / 40 MB if SMclient is not installed.	Required
SMutil	2 MB / 2 MB	Required

Windows operating system requirements

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

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
- Windows Server 2003, Standard Edition
- Windows Server 2003, Enterprise Edition

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
- Windows Server 2003, Standard Edition
- Windows Server 2003, Enterprise Edition

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

NetWare software requirements

Table 9 lists the disk space that is required for installing the Storage Manager 9.1 software in a NetWare environment. During the installation of each software package, you may need up to 120 MB of free disk space.

Table 9. Installation requirements for NetWare by software package

Package	Disk space requirement
Storage Manager 9.1 Client (SMclient)	50 MB
LSIMPE.CDM driver	2 MB
IBM FAStT Management Suite Java (FAStT-MSJ)	2 MB
IBM HA device driver	2 MB

NetWare operating system requirements

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

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

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

Linux software requirements

Table 10 lists the disk space that is required for installing Storage Manager 9.1 in a Linux environment.

Table 10. Installation requirements for Linux by software package

Package	Disk space requirement
Storage Manager 9.1 Client (SMclient)	50 MB on /opt, 2 MB on /tmp
IBM FAStT Management Suite Java (FAStT-MSJ)	50 MB
Storage Manager 9.1 RDAC	2 MB
Storage Manager 9.1 Agent (SMagent)	2 MB
Storage Manager 9.1 Utility (SMutil)	7 MB on /opt
IBM Host Adapter device driver	1 MB
Storage Manager 9.1 run time (SMruntime)	70 MB on /opt, 1 MB on /var

Linux operating system requirements

Table 11 lists the minimum operating system and kernel levels required by each management station or host computer.

Table 11. Management station or host computer by minimum operating system and kernel levels

Operating system	Kernel
Red Hat Linux Advanced Server 2.1	2.4.9-e.43 or higher
Red Hat Enterprise Linux Advanced Server 3.0	2.4.21-9.0.3.el or higher
SuSE Linux Enterprise Server Version 8 (SLES 8)	2.4.21-215 or higher

Notes:
1. Red Hat Enterprise Linux Advanced Server 2.1 supports a maximum of 128 logical drives per storage partition.
2. Red Hat Enterprise Linux Advanced Server 3.0 support 256 logical drives per partition.
3. SuSE Linux Enterprise Server 8 supports a maximum of 256 logical drives per storage partition.

Number of supported logical drives

With controller firmware 05.40.xx.xx and higher, 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 higher and NetWare 6.5 with SP2 or higher, support up to 256 logical drives per storage subsystem (LUNs 0-255) when you use IBM-approved FAStT 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 FAStT 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 FAStT adapters and their supported device drivers.
- Windows Server 2003 supports a maximum of 255 LUNs (LUNs 0 through 254) when you use IBM-approved FAStT adapters and their supported device drivers.
- The maximum number of logical drives that a FAStT storage subsystem supports with firmware version 05.4x.xx.xx depends on the model of the FAStT storage subsystem. See Table 12.

Table 12. Maximum number of logical drives per storage server

Model Type	Maximum logical drives	Maximum logical drives per storage unit partition	Maximum FlashCopy logical drives
1742	2048 (See notes 3 and 5)	256 (See notes 4 and 6)	1024 (See note 2)
1722	1024 (See notes 1 and 5)	256 (See notes 4 and 6)	512 (See note 2)

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 higher, the firmware reserves one logical drive for use by the system.
2. Maximum of four FlashCopy logical drives for each standard logical drive.
3. Maximum of 64 Remote Mirror pairs.
4. 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.
5. For firmware version levels 05.2x.xx.xx and higher, the maximum number of logical drives includes the FlashCopy repository logical drives 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.
6. For firmware version level 05.4x.xx.xx and higher, 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.

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 either Storage Manager 9.1 host software for a particular operating system. When you have completed Storage Manager 9.1 software component installation procedures, perform the procedures in Chapter 8, "Completing Storage Manager 9.1 installation," on page 97 and Chapter 9, "Using the storage management software for Windows and NetWare," on page 113.

See the *FAStT Storage Manager 9.1 Support for FAStT EXP100 SATA Storage Expansion Unit CD* for additional information as well as firmware associated with FAStT EXP100 Storage Expansion Unit.

Planning and preparing for Windows installation

Table 13 contains information about where you need to install the Storage Manager software components.

Table 13. Software component installation in a Windows environment

System type	Software installation sequence
Management station	SMclient

Host computer and cluster node	1. SMclient
	  • Optional component
	  • Necessary if you intend to manage the storage subsystem from the host computer.
	  • See "Storage Manager 9.1 Client" on page 54.
	2. RDAC
	  • Required component
	  • See "RDAC" on page 56.
	3. SMagent
	  • Optional component
	  • Necessary if you intend to use the host-agent management method.
	  • See "Storage Manager 9.1 Agent" on page 57
	4. SMutil
	  • Required component
	  • Contains the hot_add, SMdevices, and SMrepassist utilities
	  • See "Storage Manager 9.1 Utility" on page 59.

Planning and preparing for NetWare installation

Table 14 on page 34 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 9.1.
- No reboot is required during the client software installation process. The event monitor software is installed automatically during client software installation.

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

System type	Software installation sequence
Management station	Storage Manager 9.1 Client (SMclient).

Host computer and cluster node	1. Storage Manager 9.1 Client (SMclient)
	
	This optional component is necessary if you intend to manage the storage subsystem from a host computer.
	
	See "Storage Manager 9.1 Client" on page 82.
	
	   a. Storage Manager 9.1 Agent (SMagent)
	
	     This optional component packaged with the SMclient package is necessary if you intend to use the a host-agent management method.
	
	   b. Storage Manager 9.1 Utility (SMutil)
	
	     This required component packaged with the SMclient package contains the hot_add, SMdevices, and SMrepassist utilities.
	
	2. IBM Host Adapter device driver (QL2x00)
	
	See "Installing the NetWare fibre channel HBA device driver" on page 85.
	
	3. LSIMPE.CDM and Novell native multipath failover drivers.
	
	See "Installing the LSIMPE driver and NetWare native failover device driver" on page 85.

Planning and preparing for Linux installation

Table 15 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 15. 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 9.1 runtime (SMruntime) 2. Storage Manager 9.1 Client (SMclient) See "Installing the Storage Manager 9.1 Client (SMclient)" on page 91.

Table 15. 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 9.1 RDAC (required)
	
	   This component provides failover/failback capability. See "RDAC" on page 56.
	
	3. Storage Manager 9.1 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.
	
	   See "Installing Storage Manager 9.1 Agent (SMagent)" on page 93.
	
	4. IBM FAStT Management Suite Java 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 IBM FAStT Management Suite Java" on page 93.
	
	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 94.
	
	2. IBM FAStT Management Suite Java and QLRemote (required)
	
	   This package is required if you did not install RDAC (step 4). 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 FAStT-MSJ package and the Linux FC HBA failover device driver for information needed to set up the failover/failback path.
	
	   See "Installing IBM FAStT Management Suite Java" on page 93.

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.

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

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 specific to the hardware components.
2. Establish a naming convention for the storage subsystems connected to the network. See "Step 1: Naming the storage subsystems" on page 36 for more information.

3. Record the storage subsystem names and management types in Appendix E, "Storage subsystem and controller information record," on page 137. An example of a completed information record is shown in Table 16 on page 37.

   Note: Throughout the remaining steps, you will need to return to Appendix E, "Storage subsystem and controller information record," on page 137 to record information such as hardware Ethernet addresses and IP addresses.

4. (For a directly-managed system only) 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 37 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 39.

   (For a host-managed system only) 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 39.

6. (For a directly-managed system only) 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 47.

8. (For a directly-managed system only) 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 47.

9. 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 displays storage-subsystem names with the prefix Storage Subsystem. Therefore, if you rename a storage subsystem to 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 E, "Storage subsystem and controller information record," on page 137).

Table 16 shows a sample information record for the network shown in Figure 4 on page 15. This network contains storage subsystems that are managed by using both the direct-management and host-agent-management method.

Table 16. 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

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." 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 39.

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.

To identify the hardware Ethernet MAC address for machine types 3542 and 1722, 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 8 on page 38. 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 E, "Storage subsystem and controller information record," on page 137).
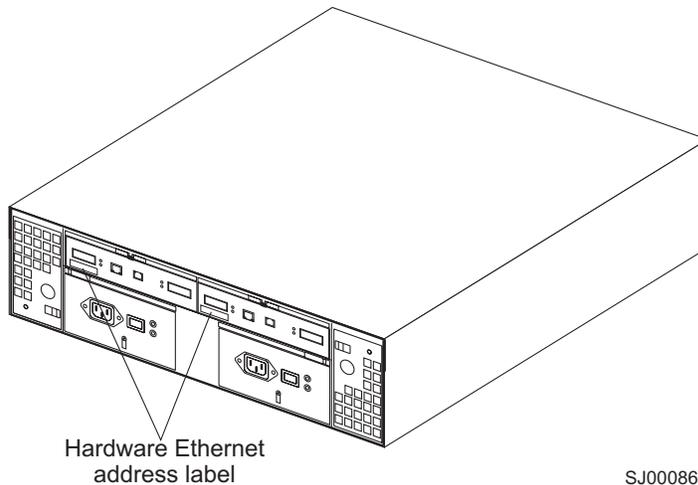
Figure 8. Locating the Ethernet MAC address (machine types 3542, 1724, and 1722)

To identify the hardware Ethernet MAC address for machine types 3552, 1724, and 1742, perform the following steps:

1. Remove the front bezel from the storage subsystem, as shown in Figure 9. Carefully pull the bottom of the bezel out **1** to release the pins. Then slide the bezel down **2** .
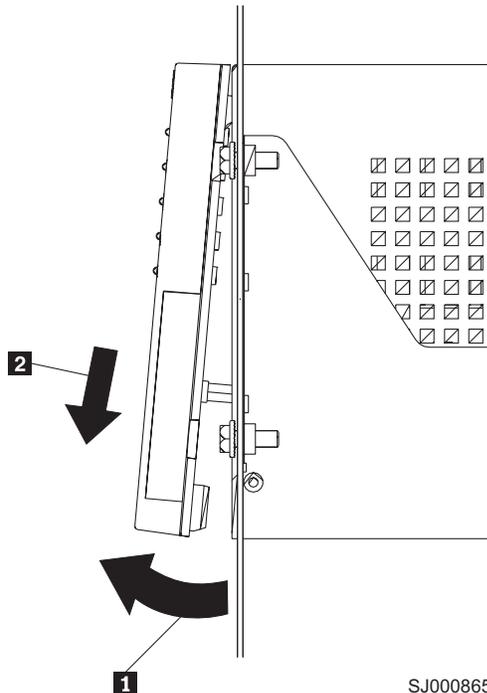
Figure 9. Removing the controller-unit bezel (machine types 3552 and 1742)

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 E, "Storage subsystem and controller information record," on page 137).

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 10.

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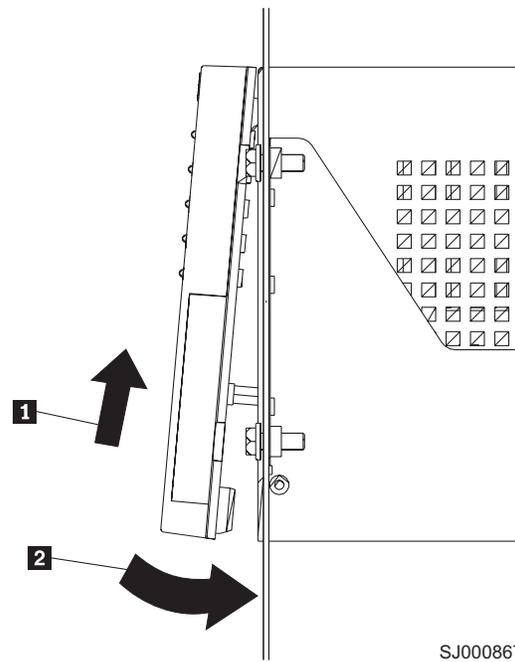
Figure 10. Replacing the controller-unit bezel (machine types 3552 and 1742)

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

Step 4: Assigning IP addresses to hosts and controllers

If you plan to manage your storage subsystem using the 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 E, "Storage subsystem and controller information record," on page 137). Then, go to "Step 5: Setting up the DHCP or BOOTP-compatible server" on page 40.

Note: If you want to assign static IP addresses for the controllers, refer to Retain Tip #H171389 *Unable to setup networking without DHCP/BOOTP* at the IBM support Web site at:

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 47.

For FAStT storage controllers with firmware versions 05.4x.xx.xx or higher, you can establish the out-of-band management connection to the FAStT Storage Server 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 E, "Storage subsystem and controller information record," on page 137). Then, go to "Step 6 (Windows): Verifying the TCP/IP protocol and setting up the host or DNS table" on page 47.

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, Windows Server 2003, and Novell NetWare, 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 9.1.

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 41.

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 of "Creating a scope and setting up a DHCP server."

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 E, "Storage subsystem and controller information record," on page 137). 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.

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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 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 47.

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" on page 43.

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" on page 43.

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 E, "Storage subsystem and controller information record," on page 137. 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 47.

Setting up a Novell NetWare DHCP server

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, refer either to the Novell Documentation CD or to the
   following Web site:

   www.novell.com/documentation/

Setting up a UNIX BOOTP server

To use a UNIX BOOTP server, you must set up a BOOTP table. Table 17 and the
information record (Appendix E, "Storage subsystem and controller information
record," on page 137) provide the necessary information.

Table 17. 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)

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 137)	host name (`Denver_a`)
IP address	IP address of the controller (see Table 27 on page 137)	dot notation (`ip=192.168.128.101`)
Ethernet address	The Ethernet address of the controller hardware (see Table 27 on page 137)	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 4 on page 15 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:

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 4 on page 15:

```
# 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
```

6. To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data.

Windows Server 2003

Perform the following steps for Windows Server 2003:

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 4 on page 15.

```
# 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
```

6. To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data.

Step 6 (NetWare): 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.

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
```

2. To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data.

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 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.

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.

2. To manage storage subsystems through a firewall, configure the firewall to open port 2463 to TCP data.

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 61.
- If you have existing storage systems, see "Installation types" on page 18 and "Managing coexisting storage subsystems" on page 24.
- To ensure proper installation, make sure that you have completed all preparation tasks described in Chapter 2, "Preparing for installation," on page 33.

Important: 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.

New installation process

You can install the Storage Manager 9.1 software components on host computers (only) or on both host computers and management stations. If you are running an earlier version of Storage Manager software, you may need to uninstall it before you are able to install Storage Manager Version 9.1 software components.

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 following storage management software on a management station:

- SMclient

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
2. RDAC
3. SMagent
4. SMutil

To begin the installation on your management station, see "Storage Manager 9.1 Client."

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 FAStT Storage Server. IBM FAStT 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.

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.

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-1.ibm.com/servers/storage/support/fastt/index.html

Storage Manager 9.1 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 FAStT Storage Manager Version 9.1 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

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 54. 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 56. Otherwise, go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

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 FAStT 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 56. Otherwise, go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

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 FAStT 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." Otherwise, go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

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 FAStT Storage Manager Version 9.1 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

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" on page 57.

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 56. 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 9.1 Agent."
   - If you are managing your storage subsystems using the direct-management method, go to "Storage Manager 9.1 Utility" on page 59.

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 56. 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 9.1 Agent."
   - If you are managing your storage subsystems using the direct-management method, go to "Storage Manager 9.1 Utility" on page 59.

Storage Manager 9.1 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 56.
- 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 FAStT Storage Manager Version 9.1 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

   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 FAStT Storage Manager 9 Agent.
3. If IBM FAStT 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 24 on page 131 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 9.1 Utility" on page 59.

- 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 9.1 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 FAStT Storage Manager 9 Agent.

3. If IBM FAStT 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 24 on page 131 for a possible cause. Otherwise, reinstall IBM FAStT 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 9.1 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 FAStT Storage Manager 9 Agent Properties window opens.

     e. In the Startup Type list, select **Manual**. Click **OK**.

     f. The IBM FAStT Storage Manager 9 Agent Properties window closes.

5. Continue with "Storage Manager 9.1 Utility."

Storage Manager 9.1 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 FAStT Storage Manager Version 9.1 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

   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.exe`
   * `SMdevices.bat`
   * `SMrepassist.exe`

   If it does not, reinstall the SMutil by using the procedure in "Installing SMutil" on page 59. If the problem persists, contact your IBM technical support representative.
3. Go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

Additional information

For additional information about installing and using Storage Manager 9.1 for Windows 2000 and Windows Server 2003 in a standard (noncluster) configuration, see Appendix A, "Windows operating system limitations," on page 123.

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 18 and "Managing coexisting storage subsystems" on page 24.
- 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 33.
- Review Table 23 on page 123 for related information.

Important: Always check for a readme file on any installation media. A readme file contains important information that was not available when this guide was prepared.

Preinstallation considerations

The hardware installation involves installing host adapters and storage subsystems. Before you begin the installation of the 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 12 on page 62 shows typical direct-attached or fibre-channel switch connection configurations. Both configurations offer full redundancy.
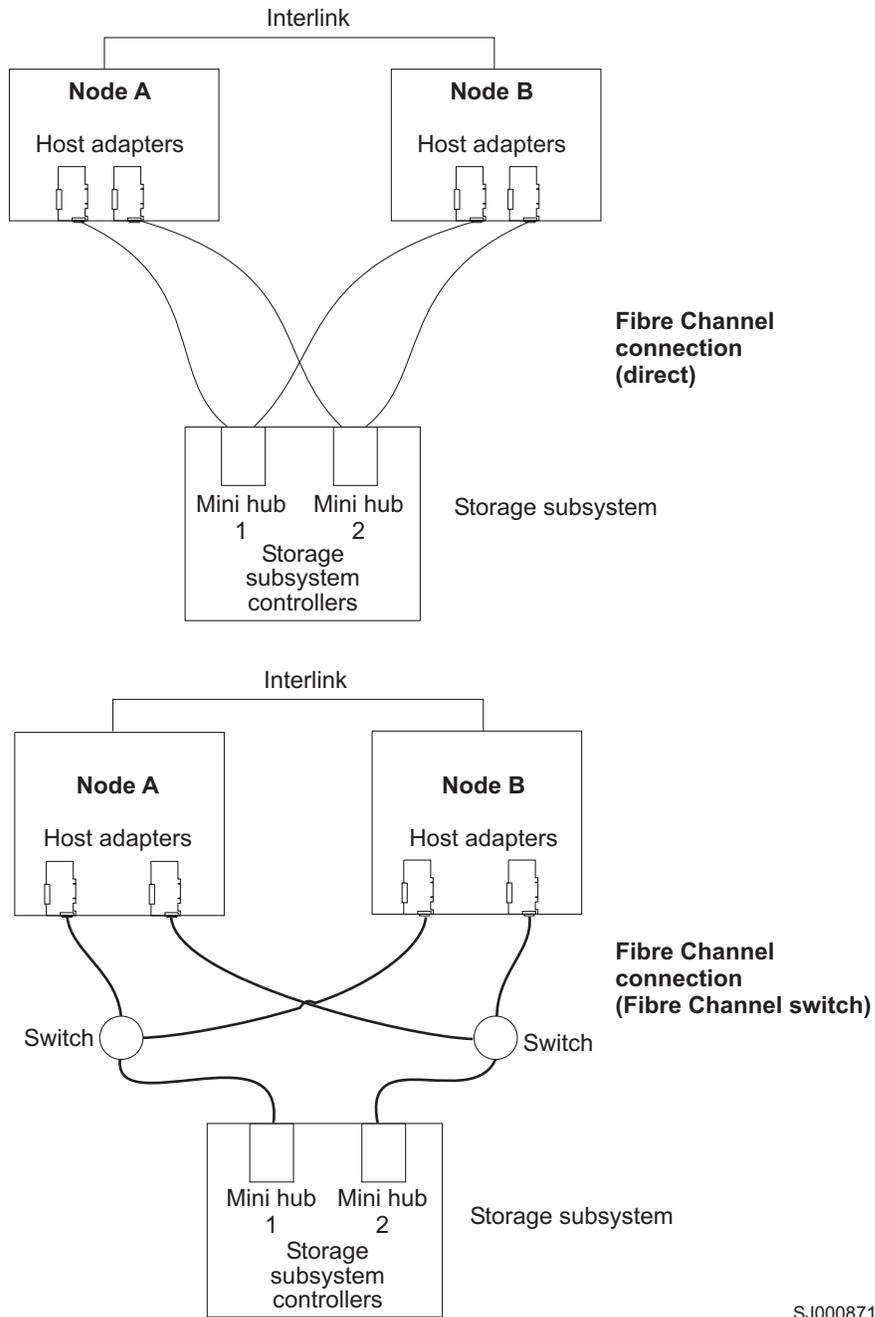
Figure 12. Installing the storage subsystem on a fibre-channel network

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 FAStT Storage Manager Version 9.1 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 65.
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 65 for instructions.
4. Complete the procedures in Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.
5. Run the hot_add utility on node A. See "Using the hot_add utility" on page 116 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 65 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 72 for instructions.
13. Go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

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 65.
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 65 for instructions.
3. Complete the procedures in Chapter 8, "Completing Storage Manager 9.1 installation," on page 97, 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 116 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 72 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 FAStT Storage Server. IBM FAStT 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.

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.

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-1.ibm.com/servers/storage/support/fastt/index.html

Installing the storage management software

This section describes how to install the storage management software on Windows operating systems. Before you begin an installation with existing storage subsystems, refer to your hardware installation documentation for the specific configuration. A specific configuration might be required for your hardware to support the storage management software in a cluster configuration.

You can install the Storage Manager 9.1 software components on cluster nodes only or cluster nodes and management stations.

Management station: A management station is a system that is used to manage the storage subsystem. You can attach it to the storage subsystem in either of the following ways:
* Through a TCP/IP Ethernet connection to the controllers in the storage subsystem
* Through a TCP/IP network connection to a cluster node with the host-agent software installed

You must install the following storage management software on a management station:
* SMclient

Cluster node: The cluster nodes are directly attached to the storage subsystem through a fibre-channel I/O path.

You must install storage management software on each cluster node in the following order:
1. SMclient
2. RDAC

3. SMagent
4. SMutil

See "Installing the SMclient" to begin the installation.

Installing the SMclient

This section provides instructions on how to install SMclient on management stations and cluster nodes that run on Windows operating systems.

Before you install the software, make sure that the following conditions are met:
- The management station or host computer has at least 80 MB of available disk space.
- All programs are closed.

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 FAStT Storage Manager Version 9.1 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

   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; then, 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 procedure:
   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" on page 67.

Verifying the SMclient installation

Perform the following steps to verify that the SMclient software is installed correctly on Windows operating systems:

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 66. If the appropriate software version associated with your operating system still does not display, a failure 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 with step 4.
4. If you are installing SMclient on a host computer, go to "RDAC." Otherwise, go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

Verifying the Event Monitor installation

This section describes how to verify that you installed the Event Monitor correctly on Windows operating systems.

Windows 2000:   To verify that you installed the Event Monitor service correctly on Windows 2000, perform the following steps:

1. Click **Start → Programs → Administrative Tools → Services**. The Services window opens.
2. Verify that the IBM FAStT Storage Manager 9 Event Monitor service displays with the startup type `Automatic` and status `Started`. If it is not, click **Start**. If the service 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." Otherwise, go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

Windows Server 2003:   To verify that you installed the Event Monitor service correctly on Windows Server 2003, perform the following steps:

1. Click **Start → Administrative Tools → Services**. The Services window opens.
2. Verify that the IBM FAStT Storage Manager 9 Event Monitor service displays with the startup type `Automatic` and status `Started`. If it is not, 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, see "RDAC." Otherwise, go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

RDAC

This section describes how to install RDAC on Windows operating systems. You must install RDAC on each cluster node. 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 cluster nodes.
- Each cluster node has at least 2 MB of available disk space.
- You close all programs.

- The appropriate HBA device driver is installed.

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 FAStT Storage Manager Version 9.1 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 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

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

The following section describes how to verify that you installed RDAC correctly on Windows operating systems.

Windows 2000: To verify that you installed RDAC correctly on Windows 2000, 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 → 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." If the failure persists, call your IBM technical support representative. Otherwise, proceed to step 4 on page 69.

4. Perform one of the following procedures:
   - If you are managing the storage subsystems using the host-agent method, continue with "Storage Manager 9.1 Agent."
   - If you are managing your storage subsystems directly, go to "Storage Manager 9.1 Utility" on page 71.

Windows Server 2003: To verify that you have 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, repeat the procedure in "Installing the RDAC" on page 68. 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 9.1 Agent."
   - If you are managing your storage subsystems using the direct-management method, go to "Storage Manager 9.1 Utility" on page 71.

Storage Manager 9.1 Agent

The following section describes how to install the SMagent software on Windows operating systems. You *must* install the SMagent software if you want to manage the storage subsystem using the host-agent method.

Before you install the software on Windows operating systems, ensure that the following conditions are met:
- You have Administrator privileges on the cluster nodes.
- Each cluster node will have at least 1 MB of available disk space if you install SMclient with the Event Monitoring service.
- The host computer will have at least 40 MB of available disk space if you do not install the SMclient program with the Event Monitoring service.
- You installed RDAC on each cluster node. If you have not done so, refer to "RDAC" on page 67.

Installing SMagent
To install SMagent on Windows operating systems, perform the following steps:
1. Close all programs.
2. Insert the IBM FAStT Storage Manager Version 9.1 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`

Operating System	Folder
Windows Server 2003 (32 bit)	\WS03_32bit\SMAgent
Windows Server 2003 (64 bit)	\WS03_64bit\SMAgent

Click **Open**.

7. Select the displayed .exe file. Then 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

The following section describes how to verify that you installed the SMagent correctly on Windows operating systems.

Windows 2000: To verify that you installed the SMagent correctly on Windows 2000, perform the following steps:

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

2. Scroll through the list of services until you find Storage Manager 9 Agent.

3. Verify that Storage Manager 9 Agent is displayed with the startup type `Automatic` and status `Started`. If 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 24 on page 131 for a possible cause. Otherwise, reinstall SMagent. If the problem persists, contact your IBM technical support representative.

4. Perform one of the following procedures:

   - If you plan to use the host-agent software to manage one or more storage subsystems, go to "Storage Manager 9.1 Utility" on page 71.

   - 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 **Storage Manager 9 Agent**.

     d. Click **Properties → Startup Type → Manual**.

     e. Click **OK**.

5. Continue with "Storage Manager 9.1 Utility" on page 71.

Windows Server 2003: To verify that you installed the SMagent correctly, perform the following steps:

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

2. Scroll through the list of services until you find IBM FAStT Storage Manager 9 Agent.

3. If IBM FAStT Storage Manager 9 Agent does not display with a startup type of `Started`, click **Start**. If the status changes to `Started`, go to 4 on page 71. If not,

see Table 24 on page 131 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, see "Storage Manager 9.1 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. Select **Properties** from the pull-down menu. The IBM FAStT Storage Manager 9 Agent Properties window opens.
     e. In the Startup Type list, select **Manual**. Click **OK**.
     f. The IBM FAStT Storage Manager 9 Agent Properties window closes.
5. Continue with "Storage Manager 9.1 Utility."

Storage Manager 9.1 Utility

This section provides instructions regarding SMutil software installation on cluster nodes that run 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 Storage Manager Version 9.1 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

   Click **Open**.
6. Select the setup.exe file, then 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" on page 72.

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.exe`
   - `SMdevices.bat`
   - `SMrepassist.exe`

   If it does not, reinstall the SMutil using the procedure in "Installing SMutil" on page 59. If the problem persists, contact your IBM technical support representative.

3. Go to "Installing the storage management software in a cluster environment" on page 63.

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.

   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 05.4x.xx.xx, you will not be able to communicate with the controller until you have upgraded to Storage Manager 9.1 software on your management station and cluster nodes. Previously installed versions of Storage Manager will not recognize controllers running version 05.4x.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, 8.0, 8.2x, or 8.4x to Storage Manager 9.1 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 storage management software for Storage Manager Version 7.x, 8.0, 8.2x, or 8.4x see "Uninstalling storage management software components" on page 118.

   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. Install the SMclient on node A. See "Installing the SMclient" on page 66 for instructions.
6. Install the RDAC on node A. See "RDAC" on page 67 for instructions.
7. Install the SMagent on node A. See "Storage Manager 9.1 Agent" on page 69 for instructions.
8. Install the SMutil on node A. See "Storage Manager 9.1 Utility" on page 71 for instructions.
9. Shut down node A.
10. Restart node B.
11. From node B, uninstall the components from the previous version of the storage management software. To uninstall the storage management software for Storage Manager Version 7.x, 8.0, 8.2x, or 8.4x see "Uninstalling storage management software components" on page 118.
12. 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.
13. Install the SMclient on node B. See "Installing the SMclient" on page 66 for instructions.
14. Install the RDAC on node B. See "RDAC" on page 67 for instructions.
15. Install the SMagent on node B. See "Storage Manager 9.1 Agent" on page 69 for instructions.

16. Install the SMutil on node B. See "Storage Manager 9.1 Utility" on page 71 for instructions.

17. Shut down node B.

18. 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.

19. Go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

Windows Server 2003

To perform a scheduled upgrade from Storage Manager Version 7.xx, 8.0, 8.2x, or 8.4x to Storage Manager 9.1 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 118 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 65 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, 8.0, 8.2x, or 8.4x to Storage Manager 9.1 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 the software for Storage Manager Version 7.x, 8.0, 8.2x, or 8.4x see "Uninstalling storage management software components" on page 118.

   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. Install the SMclient on node A. See "Installing the SMclient" on page 66 for instructions.
8. Install the RDAC on node A. See "RDAC" on page 67 for instructions.
9. Install the SMagent on node A. See "Storage Manager 9.1 Agent" on page 69 for instructions.
10. Install the SMutil on node A. See "Storage Manager 9.1 Utility" on page 71 for instructions.
11. Run Cluster Administrator. Then click **File → Resume Node** to resume cluster service in node A.
12. From node B, open Cluster Administrator.
13. Double-click the Active Groups folder in the right pane of the Cluster Administrator window.
14. Select each group listed and move them to node A.
15. Select node B. Then click **File → Pause Node** to pause cluster service in node B.
16. From node B, uninstall the components from the previous version of the software. To uninstall the storage management software for Storage Manager Version 7.x, 8.0, 8.2x, or 8.4x see "Uninstalling storage management software components" on page 118.

17. 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.

18. Install the SMclient on node B. See "Installing the SMclient" on page 66 for instructions.

19. Install the RDAC on node B. See "RDAC" on page 67 for instructions.

20. Install the SMagent on node B. See "Storage Manager 9.1 Agent" on page 69 for instructions.

21. Install the SMutil on node B. See "Storage Manager 9.1 Utility" on page 71 for instructions.

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

23. Go to Chapter 8, "Completing Storage Manager 9.1 installation," on page 97.

Windows Server 2003

To perform a rolling upgrade from Storage Manager Version 7.xx, 8.0, 8.2x, or 8.4x to Storage Manager 9.1 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 118.

   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 65 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 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 118. 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 65.
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 118. 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 65 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 on page 78 through 22 for each of the remaining nodes in a cluster, one cluster node at a time.

Additional information

For additional information about installing and using Storage Manager 9.1 in a Windows cluster server configuration, see Appendix A, "Windows operating system limitations," on page 123.

Chapter 5. Installing Storage Manager software in a standard NetWare configuration

This chapter describes how to install the storage management software in standard (noncluster) and cluster server configurations in the NetWare 6.0 operating system environment.

If you have existing storage systems, read "Installation types" on page 18 and "Storage subsystem management methods" on page 10.

To ensure proper installation, complete all preparation tasks described in "Planning and preparing for NetWare installation" on page 33.

Important: Always check for a readme file on any installation media. A readme file might contain important information that was not available when this document was prepared.

Installation overview

You must install Storage Manager 9.1 software components on both management stations and host computers.

Table 18 shows the installation sequence for Storage Manager software components.

Table 18. Software component installation sequence in a Novell NetWare 6.0 environment

System type	Software installation sequence
Management station	Storage Manager 9.1 Client (SMclient)

Host computer and cluster node	1. Storage Manager 9.1 Client (SMclient)
	
	The Storage Manager 9.1 Client software package also includes the following host software components.
	
	  a. Storage Manager 9.1 Utility (SMutil)
	
	    This required component contains the hot_add and SMdevices utilities.
	
	  b. Storage Manager 9.1 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 9.1.

1. Uninstall Storage Manager 8.4x. See "Uninstalling Storage Management 8.4x software components" on page 82.
2. Install the host bus adapter.

To install the storage management software in a NetWare 6.0 operating system environment, 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

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3. Storage Manager 9.1 Client

   This requirement also includes the optional installation of the following Storage Manager host software packages.

   a. Storage Manager 9.1 Utility (SMutil)

   b. Storage Manager 9.1 Agent (SMagent)

4. NetWare Agent component of IBM FAStT Management Suite Java (FAStT-MSJ)

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 9.1. No reboot is required after removing a Storage Manager software package. Existing storage array mappings and storage partition configurations are retained during software removal ans wilkl 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

   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 9.1 Client

This section provides instructions for installing Storage Manager 9.1 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 9.1 Client 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 9.1 Client (SMclient)

Perform the following steps to install SMclient:

1. Insert the IBM FAStT 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 FAStT 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 9.1 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 FAStT 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 120.

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 FAStT 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 Manager 9.1 installation," on page 97

   If the IBM FAStT Storage Manager Client does not display, a failure has occurred and the installation was unsuccessful. Repeat the steps detailed in "Installing Storage Manager 9.1 Client (SMclient)" on page 83 and "Verifying the Storage Manager 9.1 Client installation." If the failure persists, refer to Storage Manager 9.1 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 33 and "Installing Storage Manager 9.1 Client (SMclient)" on page 83.

   - **Storage management software installation is complete is completed on all systems** — See "Starting the host agent manually" on page 121.

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 FAStT Storage Server. IBM FAStT 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. The current readme file and latest multipath I/O device driver are available at the following Web site:

> **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 FAStT 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.

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

Continue with "Installing IBM FAStT Management Suite Java" on page 86.

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 FAStT 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 FAStT storage servers. The `LSIMPE.CDM` driver is a custom driver module that is packaged with the IBM FAStT 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 FAStT Storage Server.

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-1.ibm.com/servers/storage/support/fastt/index.html

Continue with "Installing the NetWare fibre channel HBA device driver" on page 85.

Installing IBM FAStT Management Suite Java

For information about installing and using this software, see the *IBM FAStT MSJ User's Guide* or online Help.

Additional information

For additional information about installing and using Storage Manager 9.1 in a NetWare configuration, see Appendix B, "NetWare operating system limitations," on page 131.

Chapter 6. Installing Storage Manager software in a Linux configuration

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

If you have existing storage systems, make sure that you have read "Installation types" on page 18 and "Managing coexisting storage subsystems" on page 24.

To ensure proper installation, make sure you have completed all preparation tasks described in Chapter 2, "Preparing for installation," on page 33.

Important: Always check for a readme file on any installation media. This readme file might contain important information made available only after completion of this document.

Installation overview

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

Linux software requirements

Table 19 lists the disk space that is required for installing Storage Manager 9.1 in a Linux environment.

Table 19. Installation requirements for Linux by software package

Package	Disk space requirement
Storage Manager 9.1 Client (SMclient)	50 MB on /opt, 2 MB on /tmp
IBM FAStT Management Suite Java (FAStT MSJ)	50 MB
RDAC	2 MB
Storage Manager 9.1 Agent (SMagent)	2 MB
Storage Manager 9.1 Utility (SMutil)	7 MB on /opt
IBM Host Adapter device driver	1 MB
Storage Manager 9.1 runtime (SMruntime)	70 MB on /opt, 1 MB on /var

Linux operating system requirements

Table 20 describes the minimum operating system and kernel level requirements for each management station or host computer. See the readme file for the latest information regarding supported kernel versions.

Table 20. Management station or host computer by minimum operating system and kernel level

Operating system	Kernel
Red Hat Enterprise Linux Advanced Server 2.1	2.4.9-e.43 or higher
SuSE Linux Enterprise Server Version 8 (SLES 8)	2.4.21-215 or higher
Red Hat Enterprise Linux Advanced Server 3.0	2.4.21-9.0.3.el or higher

Note: Two Linux operating system packages are made available on the product CD and Internet site. These packages are associated with either Intel architecture 32-bit or 64-bit systems. Be certain to access the appropriate package.

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.

When using Linux RDAC as the multipath failover/failback device 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 9.1 Runtime.
3. Install Storage Manager 9.1 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 9.1 Agent (SMagent, optional)
8. Install Storage Manager 9.1 Utility.
9. Uninstall existing IBM FAStT Management Suite Java (use this procedure when installing IBM FAStT-MSJ on an existing host/server).
10. Install IBM FAStT Management Suite Java and QLRemote Agent.

When not using RDAC as the multipath failover/failback device driver, and using the IBM FAStT 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 9.1 Runtime.
3. Install Storage Manager 9.1 Client.
4. Disable and enable the Event Monitor.
5. Install Storage Manager 9.1 Utility.
6. Uninstall existing IBM FAStT Management Suite Java (use this procedure when installing Storage Manager 9.1 on an existing storage subsystem).
7. Install the IBM fibre channel Host Adapter (HA) **failover** version device driver for Linux operating systems (`qla2200.o` or `qla2300.o`).
8. Install IBM FAStT 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 9.1 Runtime.
3. Install Storage Manager 9.1 Client.

In "Uninstalling Storage Manager" on page 89, 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. For the new software package, use the ls command to list the contents of the directory.

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 9.1. The software removal procedures can also be performed using an rpm-compatible, GUI-based package manager.

Perform the following steps to uninstall an earlier version of Storage Manager.

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.

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 21 and press **Enter**.

Table 21. 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 22.

Table 22. 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. For information on uninstalingl Linux RDAC, see the Linux RDAC readme.
3. If you are installing a new version of the software, proceed to "Installing the Storage Manager 9.1 software" on page 90. If you are not installing a new version of the software, you have successfully completed this procedure.

Installing the Storage Manager 9.1 software

Use the procedures in this section to install the applicable Storage Manager 9.1 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 priviledges, 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 */cdrom*. You must uncompressthe 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.

3. Use the following steps to review the End User License Agreement (EULA) and to uncompress the packages to a temporary directory.
   a. At the command prompt, type the following command and press **Enter**:

      ```
      /cdrom/install/SM-tar.bin /tmp
      ```

      The system will display the EULA and the following question.

      ```
      Do you consent to the above terms [y or n]?
      ```
   b. To confirm, type `y` and press **Enter**.

      The system will extract the packages to the temporary location specified and then display the folowing line.

      ```
      Extraction to /tmp complete
      ```
   c. To change the temporary directory, type the following command at the command prompt and press **Enter**.

      ```
      cd /tmp
      ```

Installing Storage Manager 9.1 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 9.1 Client (SMclient)." If the installation was unsuccessful, repeat steps 1 on page 90 and 2 on page 90. If the failure persists, see the Storage Manager 9.1 Release Notes or contact your IBM technical support representative.

Installing the Storage Manager 9.1 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 92.

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 92. If the installation was unsuccessful, repeat steps 1 and 2. If the failure persists, see the Storage Manager 9.1 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.

Important: 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.

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.

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 Monitor process.`

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 RDAC package

This section describes how to install RDAC on the Linux operating system. Installation of this 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 9.1 Release Notes for information on supported levels of HBA drivers.

1. To unpack the Linux RDAC source files from the */tmp* directory, 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 `/tmp/linuxrdac` directory.

2. For detailed procedures on compiling and installing the driver modules, see the `README.txt` file located in the `linuxrdac` directory.

3. If the installation was successful, and no failure was reported, continue with "Installing the Storage Manager 9.1 Utility (SMutil)." If the installation was unsuccessful, repeat steps 1 and 2. If the failure persists, see the Storage Manager 9.1 Release Notes or contact your IBM technical support representative.

Installing the Storage Manager 9.1 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 9.1 Agent (SMagent)" on page 93.

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 9.1 Agent (SMagent)." If the installation was unsuccessful, repeat steps 1 on page 92 and 2. If the failure persists, see the Storage Manager 9.1 Release Notes or contact your IBM technical support representative.

Installing Storage Manager 9.1 Agent (SMagent)

Installation of the Storage Manager 9.1 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." 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." If the installation was unsuccessful, repeat steps 1 and 2. If the failure persists, see the Storage Manager 9.1 Release Notes or contact your IBM technical support representative.

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 IBM FAStT Management Suite Java

If you are installing Storage Manager 9.1 in an environment with existing storage subsystems, you need to uninstall older versions of IBM FAStT Management Suite Java (MSJ) and then install the version of IBM FAStT MSJ that came on the IBM FAStT Storage Manager Version 9.1 CD.

Perform the following steps to uninstall FAStT MSJ:

1. From a system prompt, type the following command:

```
/usr/FAStT_MSJ_Uninstaller
```

2. Press **Tab**; then, press **Enter**.

Installing IBM FAStT Management Suite Java

The IBM FAStT MSJ software includes the FAStT GUI device driver that is required for failover and diagnostic support. You can use the GUI to configure logical drives, storage, and failover.

Note: For additional information, see the online help.

Perform the following steps to install IBM FAStT MSJ:

1. Insert the IBM FAStT Storage Manager Version 9.1 CD into the CD-ROM drive.
2. From the X-windows GUI, open a command window.
3. Type the following command and press **Enter**:

   `cd /mnt/cdrom/FAStT_MSJ/linux`

4. To run the installer for FAStT MSJ, type the following command at a system prompt:

   `sh FAStT`

5. Press **Tab**; then, press **Enter**. The Introduction window opens.
6. Click **Next**.
7. Restart your Linux server.
8. Continue with "Installing the IBM fibre-channel host bus adapter device driver."

For additional configuration information, see the *IBM FAStT MSJ User's Guide*.

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 FAStT Storage Server. IBM FAStT 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. The current readme file and latest multipath I/O device driver are available for download at the following Web site:

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

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 FAStT fibre channel HBA.

Additional information

For additional information about installing and using Storage Manager 9.1 in a Linux configuration, see Appendix C, "Linux operating system limitations," on page 133.

Chapter 7. Installing Storage Manager software in a VMware ESX Server configuration

Install Storage Manager 9.1 on a management workstation separate from that running VMware ESX Server 2.0, preferably on the workstation from which you manage the VMware ESX Server 2.0 . Do not install Storage Manager 9.1 on a server running VMware ESX Server 2.0. Your management station should be using either a Windows or Linux operating system. For instructions associated with your particular platform, see Chapter 3, "Installing Storage Manager software in a standard Windows configuration," on page 53 or Chapter 6, "Installing Storage Manager software in a Linux configuration," on page 87.

Figure 13 shows a sample VMware ESX Server configuration.
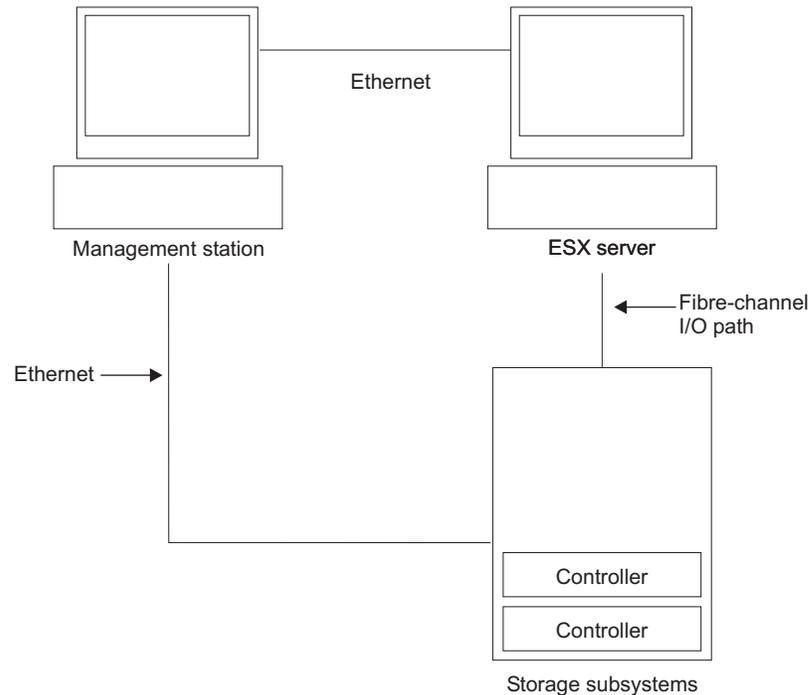
Figure 13. Sample VMware ESX Server configuration

Software requirements

Software requirements for FAStT Storage Manager 9.1 running VMware ESX Server 2.0 are detailed in this section.

Management station

The following software is required for the management station:

1. SM Runtime (Linux only)
2. SMclient

Note: The mapping storage partition host type for VMware is `Linux`.

Host (ESX Server)

The following software is required for the ESX Server:

1. No Storage Manager software
2. VMware-supplied driver for the fibre-channel HBAs
3. QLogic driver failover setup (in VMware ESX Server 2.0)

   Note: For the VMware ESX Server 2.0 Administration Guide and additional related information, see the VMware support Web site at:

   www.vmware.com/support/esx2/

For more information about installing VMware ESX Server 2.0 on an IBM server, see the IBM support Web site at:

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

Hardware requirements

For information about the hardware that is supported with VMware ESX Server 2.0, see the IBM support Web site at:

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

Additional information

For additional information about installing and using Storage Manager 9.1 in a VMware configuration, see Appendix D, "VMware ESX Server operating system limitations," on page 135.

Chapter 8. Completing Storage Manager 9.1 installation

This chapter contains procedures on how to use Enterprise Management and Subsystem Management to complete Storage Manager 9.1 installation tasks for Windows, NetWare, and Linux operating system environments.

Completing the installation

To complete a Storage Manager 9.1 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 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 FAStT 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.

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 FAStT 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 14 on page 98.
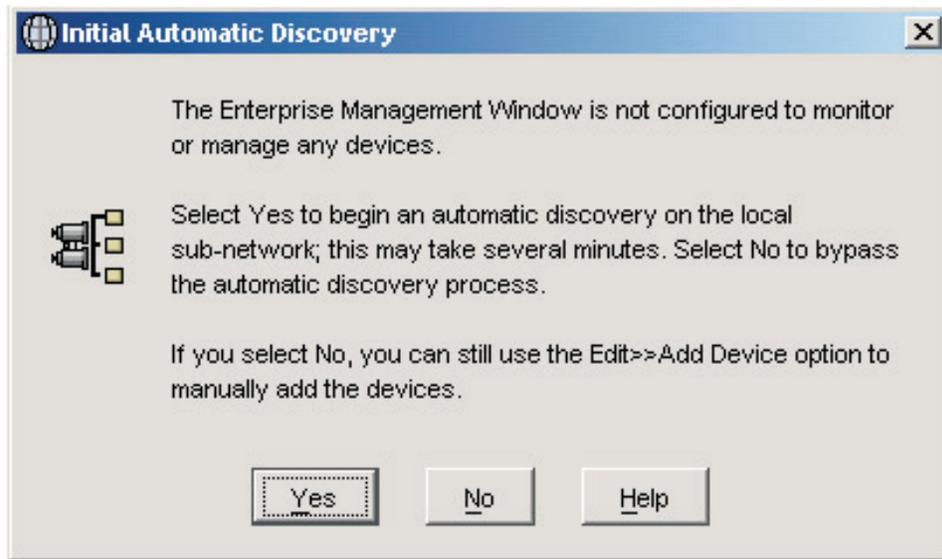
Figure 14. Confirm Initial Automatic Discovery window

> **Note:** The Enterprise Management window can take several minutes to open. No wait cursor (such as an hourglass) displays.

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.
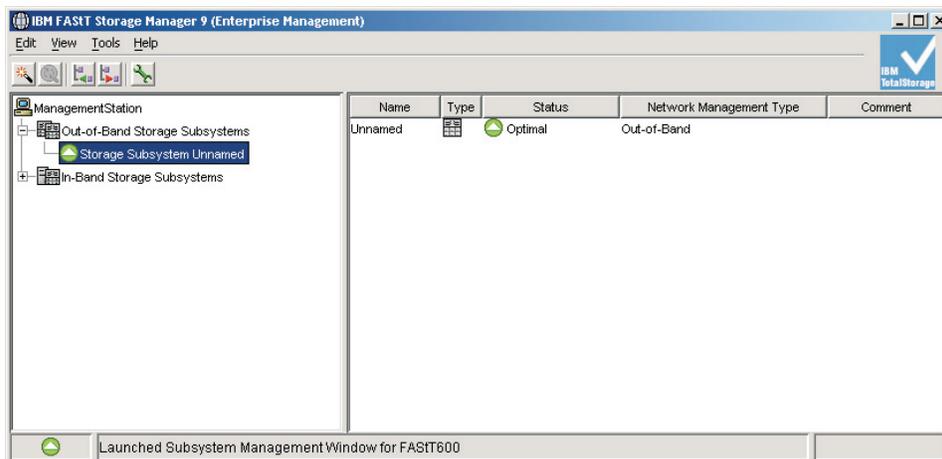
Figure 15. Enterprise Management window

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 33 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 33 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 117.
        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 117. 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.

To set up alert notification to an NMS using SNMP traps, perform the following steps:

1. Insert the IBM FAStT Storage Manager Version 9.1 CD into the CD-ROM drive on an NMS. You need to set up the designated management station only once.
2. Copy the `SM910.MIB` file from the `SM910.mib` 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."

Naming storage subsystems

To name your storage subsystem, perform the following steps:

1. In the Enterprise Management window, select a storage subsystem.
2. Click **Tools → Manage Device**. The Subsystem Management window opens, as shown in Figure 16 on page 101.
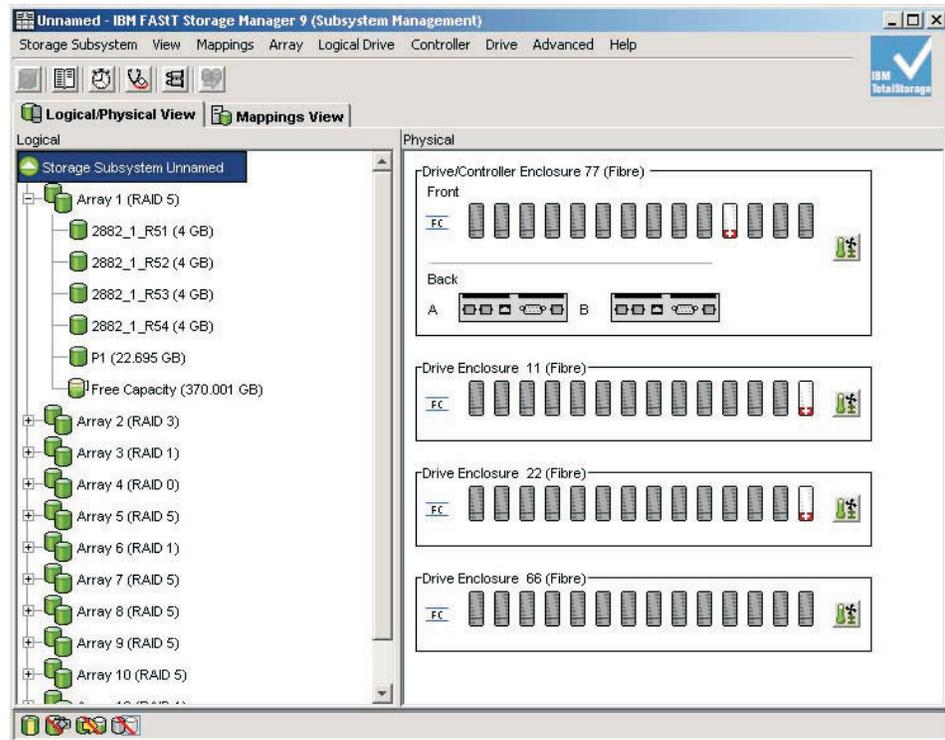
Figure 16. Subsystem Management window

3. Click **Storage Subsystem → Rename**. The Rename Storage Subsystem window opens as shown in Figure 17.
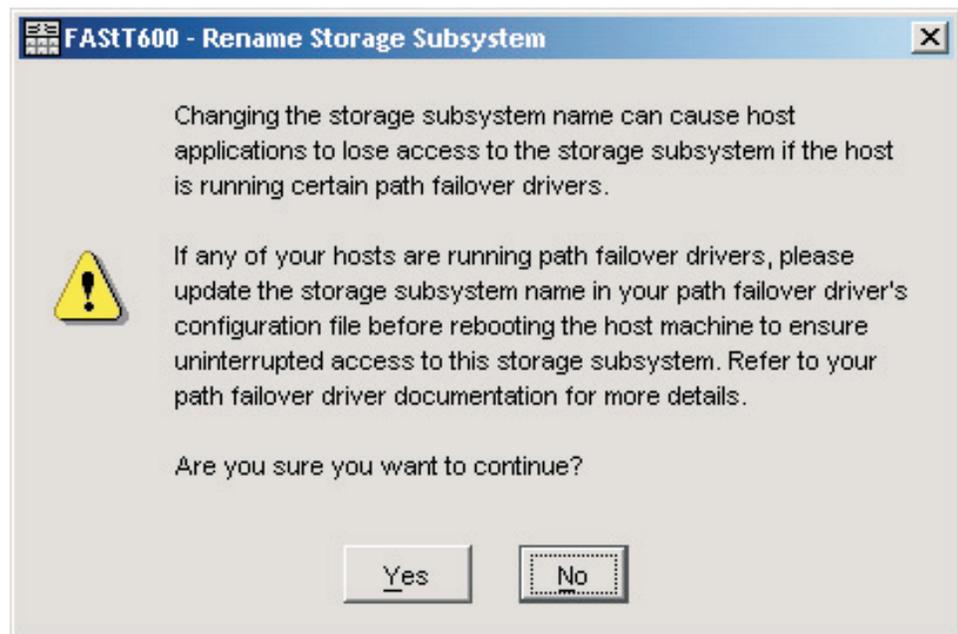
Figure 17.

4. Type the name of the storage subsystem (see Table 27 on page 137). Then click **OK**. Click **Yes** on the warning screen to continue.

5. 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.

6. Proceed to "Downloading controller and NVSRAM ESM firmware."

Downloading controller and NVSRAM ESM firmware

Note: Access the latest versions of FAStT Storage Server controller firmware and NVSRAM and FAStT Storage Expansion Enclosure ESM firmware at the IBM Web site:

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

Important:

1. IBM supports firmware download with I/O, sometimes referred to as "concurrent firmware download". Before proceeding with concurrent firmware download, check the readme file packaged with the firmware code or your particular operating system's FAStT Storage Manager host software for any restrictions to this support .

2. Suspend all I/O activity while downloading firmware and NVSRAM to a FAStT Storage Server with a single controller or you will not have redundant controller connections between the host server and the FAStT Storage Server.

This section provides instructions for downloading FAStT storage server controller firmware and NVSRAM and FAStT Storage Expansion Enclosure ESM firmware. You must download FAStT storage server controller firmware version 06.10.xx.xx before you download FAStT Storage Expansion Enclosure ESM firmware.

If your controller's existing firmware is 06.10.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 FAStT700.

Downloading firmware

To download firmware version 06.10.xx.xx or 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 18 on page 103.

> **Note:** FAStT Storage Server with controller firmware version 06.10.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 06.10.xx.xx or higher. This download feature is not supported in FAStT 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.
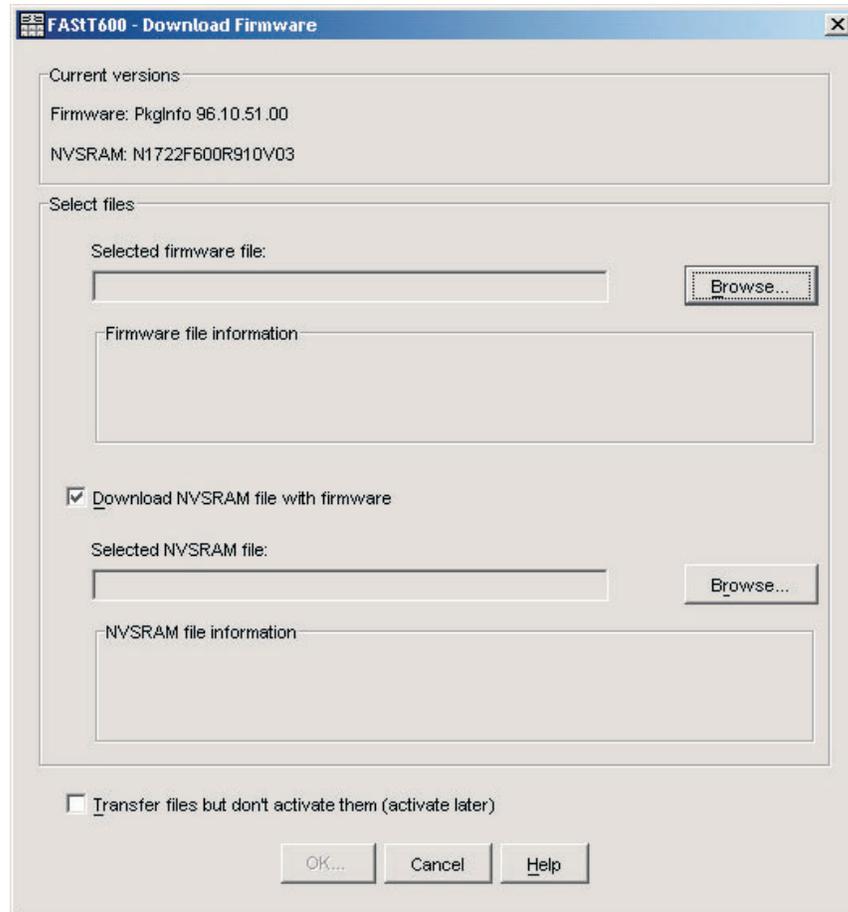
Figure 18. Download Firmware window

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

Perform the following steps to download the ESM firmware:

1. In the FAStT Storage Server 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.

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 server. 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 FAStT Storage Server 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 06.10.xx.xx, you can also select **Advanced → Troubleshooting → Collect All Support Data** as shown in Figure 19 on page 105 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.
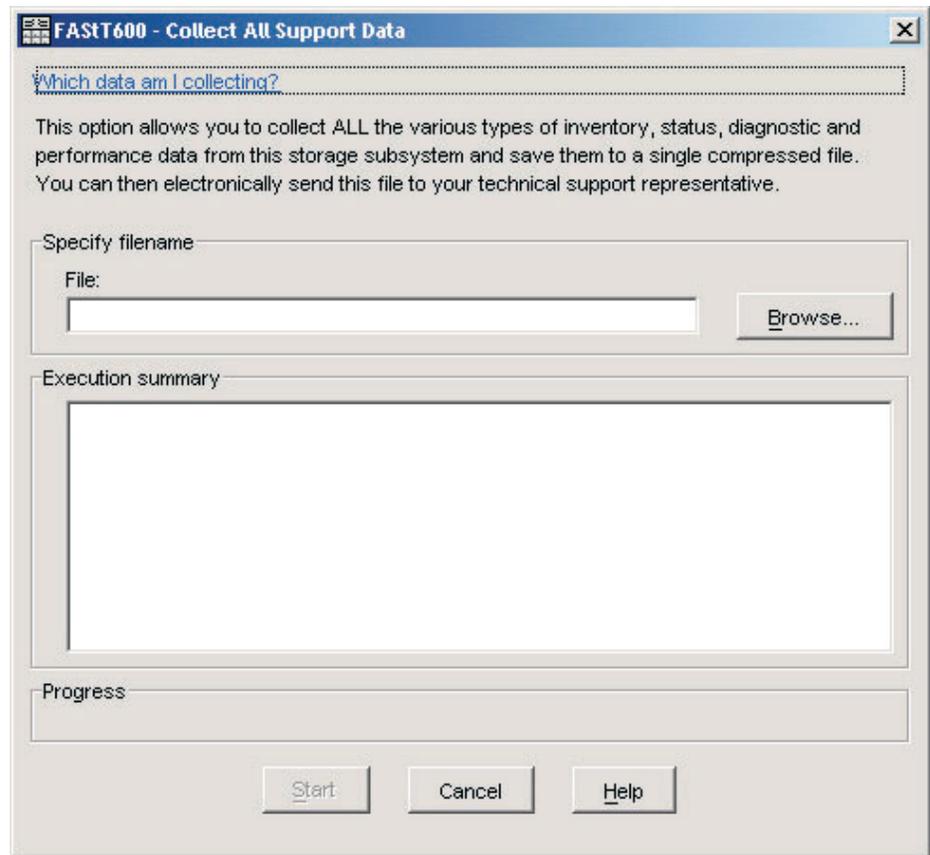
Figure 19. Collect All Support Data window

If you have a storage server with firmware level 04.01.xx.xx or earlier, you must also perform a controller state capture in addition to saving the storage subsystem profile. To use the Capture State Information feature, you must upgrade the controller to firmware level 04.01.02.34 or higher and install the FAStT Storage Manager Field Tool Version 5.21 program. This program is available at the following Web site:

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

To create a storage subsystem profile using the Capture State Information feature, perform the following steps:

1. Click **Tools → Capture State Information**. A State Capture window opens.
2. Click the **Browse** button to specify the file name for the state capture information.
3. Click the **Start** button to start the capture process.
4. Click the **Cancel** button to close the State Capture window when the capturing is completed.

An array is a set of fibre-channel hard drives that are logically grouped together to form a RAID set. 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. For firmware levels 5.4x.xx.xx and higher, 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. 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.

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 108.

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.
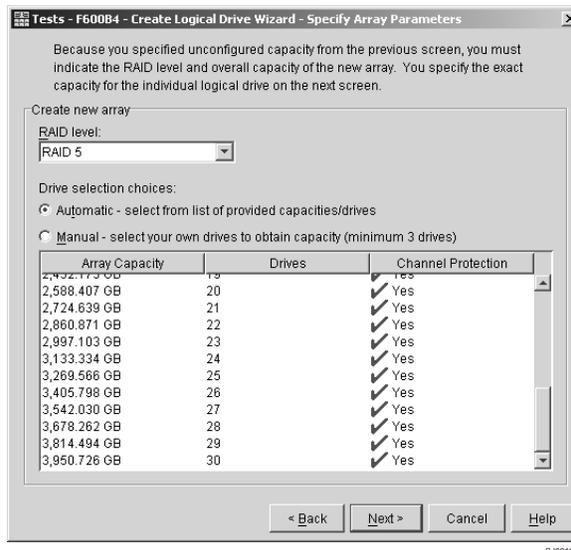
Figure 20. Create Logical Drive window

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 FAStT Storage Server 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 FAStT Storage Server default settings, click **Next** then go to step 6. 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 107.

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 109. 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.

Note: Windows 2000 and Windows Server 2003 share the following host type options:
   - Windows 2000/Server 2003 non-clustered
   - Windows 2000/Server 2003 clustered

   If these host type entries do not display as options in your host type pull-down menu, use either of the following host types instead:
   - Windows 2000 non-clustered
   - Windows 2000 clustered

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" on page 110.

Host type options

The following host type options are available for specification.

1. Windows
   - Windows NT Non-clustered (SP5 or higher)
   - Windows NT Clustered (SP5 or higher)
   - 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 2.0

     Linux
   - ESX Server 2.1

     LNXCL

Configuring heterogeneous hosts

The heterogeneous hosts feature enables hosts running different operating systems to access a single storage subsystem. Previous releases of FAStT Storage Manager (versions 7.02 or earlier) required that hosts run the same operating system in order to access a single storage subsystem.

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.

To start the heterogeneous host configuration, perform the following steps:

1. From the Subsystem Management window, click the **Mappings View** tab.
2. Follow the on-screen instructions.
3. Continue with "Performing other storage-subsystem management tasks" on page 111.

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 FAStT600.

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 FAStT Storage Manager 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 FAStT 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
- Downloading ESM firmware or fibre-channel drive firmware

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. Using the storage management software for Windows and NetWare

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 and NetWare operating system environments. Information regarding the Windows operating system follows. See "Using the storage management software for NetWare" on page 119 for analogous information about the NetWare operating system environment.

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 116 or "Using the SMdevices utility" on page 116.

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.

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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 FAStT 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 116 or "Using the SMdevices utility" on page 116.

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 FAStT 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 8 Agent**.
3. Click **Restart**. The IBM FAStT Storage Manager 8 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 8 Agent**.
3. Click **Restart**. The IBM FAStT Storage Manager 8 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 , it will be necessary for you to remove the current software before installing Storage Manager 9.1. No reboot is required after removing a Storage Manager software package. Existing storage array mappings and storage partition configurations are retained during software removal ans 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. 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.

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 FAStT 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**.

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" and "Using the SMdevices utility."

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 9.1 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 9.1 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 9.1 software components

Use the following procedure to uninstall one or more of the components of Storage Manager 9.1.

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 FAStT Storage Manager host software for NetWare.

11. Are you installing a new version of the software?

    Yes. See Chapter 5, "Installing Storage Manager software in a standard NetWare configuration," on page 81.

    No. You have completed this procedure.

Appendix A. 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.

Important: Always check for a readme file on any installation media. This readme file might contain important information that was not available when this document was prepared.

Limitations of Windows operating systems

Table 23 explains limitations that apply when you use the IBM FAStT Storage Manager Version 9.1 with Windows 2000 and Windows Server 2003.

Table 23. Windows operating system limitations and workarounds

Limitation	Workaround
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.	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.	Contact an IBM technical support representative.
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.
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.

Table 23. Windows operating system limitations and workarounds (continued)

Limitation	Workaround
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 FAStT EXP700 Storage Expansion Unit to a FAStT200, you must set the drive speed to 1 Gbps.	None.

Table 23. 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 higher. 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 128.
	
	• 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 128.
	
	  – Define the access logical drive for the host and restart SMagent. See "SMagent workaround for defining additional access LUN mapping" on page 128.
	
	• 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 128.
	
	  – 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 129.

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 FAStT 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 FAStT Storage Manager 9.1 application in a higher display mode.

Table 23. Windows operating system limitations and workarounds (continued)

Limitation	Workaround
The system might display the FAStT 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 FAStT Storage Server 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 FAStT storage subsystems have two ports per controller – one per minihub slot.
	  – FAStT900, Machine Type 1742
	  – FAStT700, Machine Type 1742
	  – FAStT500, Machine Type 3552
	• The FAStT600 (IBM machine type 1722) has two ports per controller.
	• The FAStT200 (IBM machine type 3542) has only one port per controller.

It is possible to circumvent IBM FAStT Storage Server 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 FAStT Storage Server 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 FAStT 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 FAStT 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 FAStT Storage Manager client has run the command. If it has not, reissue the command.
You must always uninstall IBM FAStT 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 23. Windows operating system limitations and workarounds (continued)

Limitation	Workaround
When you upgrade the FAStT 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 FAStT 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`, `1742`, `3552` or `3542`, depending on the machine type of the FAStT Storage Server from which Windows 2000 had mapped the original LUNs. Under these circumstances, the Windows 2000 server will lose connectivity to the LUNs in the FAStT Storage Subsystem whose controller firmware you updated. This problem will not occur when you upgrade the FAStT 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 FAStT Storage Subsystem controller firmware and NVSRAM, you must perform one of the following procedures reconnect FAStT Storage Servers 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 FAStT Storage Subsystem.

Table 23. 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 33 to manage the subsystem directly.

3. Open the Storage Manager 9.1 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 FAStT Storage Manager 9.1 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 FAStT Storage Manager 9.1 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.

Appendix B. NetWare operating system limitations

This appendix contains information about how to operate the storage management software in a NetWare environment.

Important: Always check for a readme file on any installation media. This readme file might contain important information that was not available when this document was prepared.

Table 24 lists the limitations that apply when you use the IBM FAStT Storage Manager Version 9.1 with Novell NetWare.

Table 24. Novell NetWare limitations and workarounds

Limitation	Workaround
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 FAStT using the direct (out-of-band) method of management. See "Stopping the host-agent software" on page 121 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.
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.	Call for service.
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.

Table 24. Novell NetWare limitations and workarounds (continued)

Limitation	Workaround
When performing a redundancy check (parity scan) from the storage management application, machine type 3542 can take several minutes longer than machine type 3526 and 3552 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 FAStT EXP700 Storage Expansion Unit with at least one logical drive is properly attached to the IBM FAStT700 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 FAStT Storage Manager software.
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 FAStT 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 FAStT 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 FAStT 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 FAStT Storage Manager client has run the command. If it has not, reissue the command.

Appendix C. Linux operating system limitations

This appendix contains information that is specific to operating the storage management software in a Linux environment.

Important: Always check for a readme file on any installation media. This readme file contains information that was not available when this document was prepared.

Table 25 lists the limitations that apply when you use the IBM FAStT Storage Manager Version 9.1 with Linux.

Table 25. Linux limitations and workarounds

Limitations	Workaround
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.	Contact an IBM technical support representative for assistance.
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.
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 9.1 application in a higher display mode.
When you perform a redundancy check (parity scan) from the storage management application, machine type 3542 can take several minutes longer than machine type 1742 and 3552 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.

Table 25. Linux limitations and workarounds (continued)

Limitations	Workaround
When you connect an IBM TotalStorage FAStT 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 FAStT 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 FAStT 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 FAStT Storage Manager client has run the command. If it has not, re-issue the command.

Appendix D. VMware ESX Server operating system limitations

This appendix contains information about how to operate the storage management software in a VMware ESX Server environment.

Important: Always check for a readme file on any installation media. This readme file might contain important information that was not available when this document was prepared.

Table 26 lists the limitations that apply when you use IBM FAStT Storage Manager Version 9.1 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.
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 volumes cannot be successfully created and assigned to a guest operating system.	Although a guest operating system can scan for new disk volumes dynamically, the guest operating system must be powered off before new logical volumes can be created within VMware ESX Server and assigned to that guest.
When you issue a Subsystem Management command from the IBM FAStT 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 FAStT 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 FAStT Storage Manager client has run the command. If it has not, reissue the command.

Appendix E. 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 16 on page 37.

Table 27. Storage subsystem and controller information record

Storage subsystem name (page 36)	Management method (page 10)	Controllers-Ethernet and IP addresses, and host name (pages 36 and 39)		Host-IP address and host name (page 39)

Appendix F. Additional FAStT documentation

The following tables present an overview of the FAStT900, FAStT700, and FAStT600 Fibre Channel Storage Server product libraries, as well as other related documents. Each table lists documents that are included in the libraries and what common tasks they address. Click on active links in the tables to access those documents currently available on the Internet. You can access documentation for the other FAStT products at the following Web site:

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

FAStT900 Fibre Channel Storage Server library

Table 28 associates each document in the FAStT900 Fibre Channel Storage Server library with its related common user tasks.

Table 28. TotalStorage FAStT900 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 FAStT900 Installation and Support Guide, GC26-7530	✔	✔		✔		
IBM TotalStorage FAStT900 Fibre Channel Cabling Instructions, 24P8135	✔	✔				
IBM TotalStorage FAStT900 Storage Server User's Guide, GC26-7534				✔	✔	✔
IBM TotalStorage FAStT FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7532		✔			✔	
IBM FAStT FC2-133 Host Bus Adapter Installation and User's Guide, 48P9823		✔			✔	
IBM TotalStorage FAStT900 Rack Mounting Instructions, 19K0900	✔	✔				

Table 28. TotalStorage FAStT900 Fibre Channel Storage Server document titles by user tasks (continued)

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM Fibre Channel Planning and Integration: User's Guide and Service Information, SC23-4329	✔	✔			✔	✔
IBM FAStT Management Suite Java User's Guide, 32P0081					✔	✔
IBM TotalStorage FAStT Fibre Channel Hardware Maintenance Manual,GC26-7640						✔
IBM TotalStorage FAStT Fibre Channel Problem Determination Guide, GC26-7642						✔

FAStT700 Fibre Channel Storage Server library

Table 29 associates each document in the FAStT700 Fibre Channel Storage Server library with its related common user tasks.

Table 29. TotalStorage FAStT700 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 FAStT700 Installation, User's and Maintenence Guide, GC26-7647	✔	✔		✔	✔	✔
IBM FAStT700 Fibre Channel Cabling Instructions, 32P0343	✔	✔				
IBM FAStT FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7532		✔			✔	
IBM TotalStorage FAStT FC2-133 Host Bus Adapter Installation and User's Guide, 48P9823		✔			✔	
IBM FAStT Management Suite Java User's Guide, 32P0081					✔	✔
IBM TotalStorage FAStT Fibre Channel Hardware Maintenance Manual,GC26-7640						✔
IBM TotalStorage FAStT Fibre Channel Problem Determination Guide, GC26-7642						✔

FAStT600 Fibre Channel Storage Server library

Table 30 associates each document in the FAStT600 Fibre Channel Storage Server library with its related common user tasks.

Table 30. TotalStorage FAStT600 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage FAStT600 Fibre Channel Storage Server Installation and User's Guide, GC26-7531	✔	✔		✔		
IBM TotalStorage FAStT Fibre Channel Hardware Maintenance Manual,GC26-7640						✔
IBM TotalStorage FAStT Fibre Channel Problem Determination Guide, GC26-7642						✔
IBM TotalStorage FAStT FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7532		✔			✔	
IBM TotalStorage FAStT600 Rack Mounting Instructions, 24P8125	✔	✔				
IBM TotalStorage FAStT600 Fibre Channel Cabling Instructions, 24P8126	✔	✔				

FAStT100 Fibre Channel Storage Server library

Table 31 associates each document in the FAStT100 Fibre Channel Storage Server library with its related common user tasks.

Table 31. TotalStorage FAStT100 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 FAStT100 Installation, User's and Maintenance Guide, GC26-7641	✔	✔		✔	✔	✔
*IBM TotalStorage FAStT Fibre Channel Hardware Maintenance Manual,*GC26-7640						✔
IBM TotalStorage FAStT Fibre Channel Problem Determination Guide, GC26-7642						✔
IBM TotalStorage FAStT100 Cabling Guide, 24P8973		✔				

FAStT-related documents

Table 32 associates each of the following documents related to FAStT operations with its related common user tasks.

Table 32. TotalStorage FAStT related document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM Safety Information, P48P9741					✔	
IBM TotalStorage FAStT Quick Start Guide,, GC26-7662	✔	✔				
IBM TotalStorage FAStT EXP100 Storage Expansion Unit Release Notes, GC26–7619	✔	✔				
IBM TotalStorage FAStT EXP100 Storage Expansion Unit Installation and Users Guide, GC26–7601	✔	✔		✔	✔	✔
Fibre Channel Solutions - IBM FAStT EXP500 Installation and User's Guide, 59p5637	✔	✔		✔	✔	✔
IBM TotalStorage FAStT Hard Drive and Storage Expansion Enclosure Installation and Migration Guide, GC26–7663	✔	✔				
IBM Netfinity® Fibre Channel Cabling Instructions, 19K0906		✔				
IBM Fibre Channel SAN Configuration Setup Guide, 25P2509	✔		✔	✔	✔	

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Important notes

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

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

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

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

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

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

Glossary

This glossary provides definitions for the terminology and abbreviations used in IBM TotalStorage FAStT 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 set of fibre-channel hard drives that are logically grouped together to form a redundant array of independent disks (RAID) set.

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

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

ATA.   See *AT-attached*.

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

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

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

AWT. See *Abstract Windowing Toolkit*.

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

BIOS. See *basic input/output system*.

BOOTP. See *bootstrap protocol*.

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

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

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

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

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

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

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

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

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

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

CRU. See *customer replaceable unit*.

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

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

dac. See *disk array controller*.

dar. See *disk array router*.

DASD. See *direct access storage device*.

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 services monitor (ESM) canister. A component in a drive 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 services monitor canister*.

EXP. See *expansion unit*.

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

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

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*.

FAStT MSJ. See *FAStT Management Suite Java*.

FAStT Management Suite Java (FAStT MSJ). A diagnostic and configuration utility that can be used on Linux, Microsoft Windows, and Novell NetWare host systems. In Linux, it is also used with the QLRemote agent to define preferred and non-preferred paths for logical drives.

FC. See *fibre channel*.

FC-AL. See *arbitrated loop*.

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

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

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

Fibre Channel Protocol (FCP) for small computer system interface (SCSI). A high-level fibre-channel mapping layer (FC-4) that uses lower-level fibre-channel (FC-PH) services to transmit SCSI commands, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

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

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

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

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

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

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

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

GUI. See *graphical user interface.*

HBA. See *host bus adapter*.

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

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

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

host computer. See *host*.

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

host port. Ports that physically reside on the host adapters and are automatically discovered by the FAStT 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*.

isolated group.   A collection of isolated devices not connected to the storage area network (SAN) but discovered by the SANavigator tool. The isolated group displays with a gray background near the bottom of the Physical and Data Path maps.

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

JRE.   See *Java Runtime Environment*.

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

LAN.   See *local area network*.

LBA.   See *logical block 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 groups are discovered by the SANavigator tool and displayed with a gray background on the Physical and Data Path maps.

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

LPAR.   See *logical partition*.

LUN.   See *logical unit number*.

MAC.   See *medium access control*.

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

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

MCA.   See *micro channel architecture*.

media scan.   A media scan is a background process that runs on all logical drives in the storage subsystem for which it has been enabled, providing error detection on the drive media. The media scan process scans all logical drive data to verify that it can be accessed, and optionally scans the logical drive data also.

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

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

MIB.   See *management information base*.

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

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

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*.

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*.

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 that appears as a single volume to the server and are fault tolerant through mirroring or parity checking.

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 FAStT 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 FAStT 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 FAStT Storage Manager client software, which is a Java-based graphical user interface (GUI) that is used to configure, manage, and troubleshoot storage servers and expansion units in a FAStT 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 FAStT 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 time-out. The maximum amount of time the SANavigator tool will wait for a device to respond to a request. The specified time applies to one retry only.

SNMP trap 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 FAStT Storage Manager host software (SMClient) to uniquely identify each managed storage server. The FAStT 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 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 FAStT 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.

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

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.

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

worldwide name (WWN). A unique identifier for a switch on local and global networks.

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. 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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W

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