

IBM TotalStorage FAStT Storage Manager Version 8.4



# Installation and Support Guide for AIX, HP-UX, and Solaris



IBM TotalStorage FAStT Storage Manager Version 8.4



# Installation and Support Guide for AIX, HP-UX, and Solaris

**Note:**

Before using this information and the product it supports, read the information in "Notices" on page 119.

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## About this document

This document provides information about how to set up, install, configure, and work with the IBM® TotalStorage® Fibre Array Storage Technology (FAStT) Storage Manager Version 8.4 in AIX®, HP-UX, and Solaris.

Throughout this document, the terms *storage management software* and *Storage Manager 8.4* refer to the IBM TotalStorage FAStT Storage Manager Version 8.4. Individual components of the storage management software are identified by name.

**Note:** Throughout this document, Storage Manager version 8.4 refers to software levels 8.40 or higher.

Use this document to:

- Determine the hardware and software that is required to install the Storage Manager 8.4 software into your subsystem network
- Install the Storage Manager 8.4 software
- Upgrade the controller's nonvolatile storage random access memory (NVSRAM) and firmware
- Identify management features that are unique to your specific installation

**Note:** This document does not cover hardware installation or integration. For information about these topics, see the FAStT Installation and Support Guide that is appropriate for your FAStT Fibre Channel Storage Server. See Appendix F, "Additional FAStT documentation," on page 113 for a list of these documents.

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## Who should read this document

This document is intended for system administrators and storage administrators who are responsible for installing software.

Readers should have knowledge of the following concepts:

- Redundant array of independent disks (RAID)
- Small computer system interface (SCSI)
- Fibre channel technology

Readers should also have working knowledge of the applicable operating systems that are used with Storage Manager 8.4.

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## FAStT installation process overview

Figure 1 on page xii gives an overview of the FAStT hardware and the FAStT Storage Manager software installation process. Lined arrows in the flow chart indicate consecutive steps in the hardware and software installation process. Labeled arrows indicate which current documents provide detailed information about

those steps.

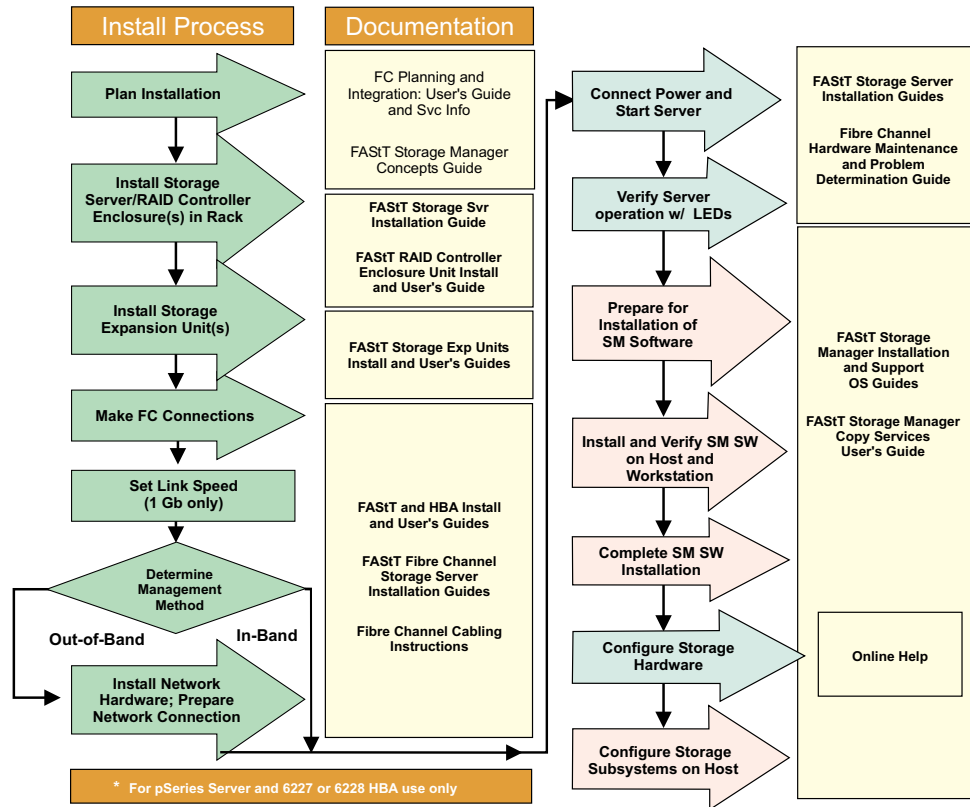


Figure 1. Installation process flow by current publications

## FASTt documentation

The following table presents an overview of the FASTt Storage Manager product library. The table lists documents included in the library 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/](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/fastt/)

## FAStT Storage Manager Version 8.4 library

Table 1 associates each document in the FAStT Storage Manager library with its related common user tasks.

Table 1. TotalStorage FAStT Storage Manager Version 8.4 titles by user tasks

Title	User Tasks					
	Planning	Hardware Installation	Software Installation	Configuration	Operation and Administration	Diagnosis and Maintenance
IBM TotalStorage FAStT Storage Manager 8.4 Library Guide and Common Index, GC26-7600	✓	✓	✓	✓	✓	✓
IBM TotalStorage FAStT Storage Manager 8.4 Installation and Support Guide for Intel-based Operating System Environments, GC26-7589	✓		✓	✓		
IBM TotalStorage FAStT Storage Manager 8.4 Installation and Support Guide for AIX®, UNIX, and Solaris, GC26-7593	✓		✓	✓		
IBM TotalStorage FAStT Storage Manager Copy Services User's Guide, GC26-7561	✓		✓	✓	✓	
IBM FAStT Storage Manager Script Commands (see product CD)				✓		
IBM TotalStorage FAStT Storage Manager Concepts Guide, GC26-7560	✓	✓	✓	✓	✓	✓

## Storage Manager 8.4 online help

Storage Manager 8.4 provides online help for the Enterprise Management and Subsystem Management windows. These help systems contain information about working with the management domain and about managing storage subsystems.

You can access the help systems from the Enterprise Management and Subsystem Management windows in Storage Manager 8.4. Click **Help** on the toolbar or press F1.

**Note:** The online help systems contain operating information that is common to all operating environments. For operating-system-specific information, see the following chapters and appendices of this document.

#### **AIX**

- Chapter 2, “Installing storage management station software on AIX systems,” on page 17
- Appendix A, “AIX system requirements,” on page 101

#### **HP-UX**

- Chapter 3, “Installing storage management station software on HP-UX systems,” on page 47
- Appendix B, “HP-UX system requirements,” on page 103

#### **Solaris**

- Chapter 4, “Installing storage management station software on Solaris systems,” on page 63
- Appendix C, “Solaris system requirements,” on page 105

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## **Web sites**

The most up-to-date information about FAS*T* Fibre Channel Storage Servers and FAS*T* Storage Manager 8.4, including documentation and the most recent software, firmware, and NVSRAM downloads, can be found at the following Web sites.

#### **FAS*T* Fibre Channel Storage Servers**

Find the latest information about all of the IBM FAS*T* Fibre Channel Storage Servers at:

[www.storage.ibm.com/hardsoft/disk/fastt/](http://www.storage.ibm.com/hardsoft/disk/fastt/)

#### **IBM TotalStorage products**

Find information about all IBM TotalStorage products at:

[www.storage.ibm.com/](http://www.storage.ibm.com/)

#### **TotalStorage FAS*T* interoperability matrix**

Find the latest information about operating system and HBA support, clustering support, storage area network (SAN) fabric support, and Storage Manager feature support at:

[www.storage.ibm.com/disk/fastt/supserver.htm/](http://www.storage.ibm.com/disk/fastt/supserver.htm/)

#### **Storage Manager 8.4 readme files**

Find the latest readme files for FAS*T* Storage Manager 8.4 at:

[www.ibm.com/pc/qtechinfo/MIGR-50177.html](http://www.ibm.com/pc/qtechinfo/MIGR-50177.html)

#### **Fix delivery center for AIX**

Find the latest AIX downloads at:

[techsupport.services.ibm.com/server/aix.fdc](http://techsupport.services.ibm.com/server/aix.fdc)

#### **FAS*T* technical support**

Find FAS*T* downloads, hints and tips, documentation, parts information, HBA and fibre channel support at:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk/](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk/)



**Premium feature activation**

Enable a premium feature on a FASiT600 or FASiT900 by using the online tool at:

[www.storage.ibm.com/pfeatures.html/](http://www.storage.ibm.com/pfeatures.html/)

**IBM publications center**

Order IBM publications at:

[www.ibm.com/shop/publications/order/](http://www.ibm.com/shop/publications/order/)

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## How to send your comments

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

- E-mail

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[starpubs@us.ibm.com](mailto:starpubs@us.ibm.com)

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

- Mail or fax

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

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



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## Chapter 1. Introduction

This document provides system administrators with information about how to install, configure, and work with Storage Manager 8.4 in AIX, HP-UX, and Solaris environments.

Before you install Storage Manager 8.4, consult the following documentation:

### readme files

Read these first.

For the most recent readme files, see the following Web site:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FASTT Storage Server.

When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FASTT Storage Manager for the appropriate operating system.

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

### **IBM FASTT Storage Manager Concepts Guide**

Use this reference document to become familiar with the terminology and the features of the Storage Manager 8.4 software. This document is available on the Storage Manager 8.4 installation CD.

---

## Overview of Storage Manager 8.4

The IBM TotalStorage FASTT Storage Manager Version 8.4 is a set of client and host tools that enable you to manage IBM FASTT600, FASTT700, and FASTT900 Fibre Channel Storage Server subsystems from a storage management station.

### The storage management station

The *storage management station* is the system that is responsible for managing all, or a portion of, a storage network. It communicates with the network management agents that reside in the managed nodes using a network management protocol, such as Simple Network Management Protocol (SNMP).

Storage management commands are sent to the storage subsystem controllers, where the controller firmware validates and runs the commands, and then returns status and configuration information to the client software.

A storage management station can be either of the following configurations:

- A remote system, connected to an Ethernet network, that is used to manage one or more storage subsystems
- A host that is connected to the storage subsystem with a fibre-channel input/output (I/O) path which is also used to manage the attached storage subsystems

**Note:** Even though you can install the storage management software on a host, the host still uses the Transmission Control Protocol/Internet Protocol (TCP/IP) to

communicate with the host-agent. The host-agent communicates with the controller over the fibre-channel connection through the *access volume*.

## Storage Manager 8.4 online help

After you have completed all the installation and configuration procedures that are provided in this document, refer to the following online help systems. The online help contains information that is common to all operating system environments.

You can access the help systems from the Enterprise Management and Subsystem Management windows in Storage Manager 8.4 by clicking **Help** on the toolbar or pressing F1.

### Enterprise Management Help window

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

### Subsystem Management Help window

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

## Storage Manager 8.4 new features

The following features have been added to FASTT Storage Manager:

- Support for the VolumeCopy premium feature
- Support for up to 256 logical unit numbers (LUNS) per storage partition (depending on the operating system)
- Support for VERITAS Volume Manager 3.5 with Dynamic Multipathing (DMP) on Solaris hosts
- Support for increased command queue depth

In addition, the FASTT600 Fibre Channel Storage Server now supports the following:

- FASTT600 Turbo option
- Up to seven FASTT EXP700 expansion units
- 1 Gb switches and host bus adapters (HBAs)
- FlashCopy™ premium feature
- MC/Service Guard

**Note:** With the FASTT600 Turbo option, the FASTT600 Fibre Channel Storage Server supports VolumeCopy. For more information about the FASTT600 Turbo option, see the *IBM TotalStorage FASTT600 Fibre Channel Storage Server Installation and User's Guide*.

## Storage Manager 8 premium features

FASTT Storage Manager 8.4 supports the following premium features, which are available for purchase separately from IBM or an IBM Business Partner.

### Premium Copy Services features

This document lists the premium Copy Services features that are supported by Storage Manager 8.4, but does not describe them in detail. For detailed Copy Services concepts and procedures, see the following documents, which are included on the Storage Manager 8.4 installation CD-ROM.

- *IBM TotalStorage FASTT Storage Manager Copy Services User's Guide*
- *IBM TotalStorage FASTT Storage Manager Concepts Guide*

**FlashCopy** FlashCopy supports the creation and management of FlashCopy logical drives, which are logical equivalents of complete physical copies. FlashCopy logical drives are created more quickly than physical copies, and they require less disk space.

FlashCopy is host addressable, so you can perform backups using FlashCopy while the base logical drive is online and user-accessible. When the backup completes, you can delete the FlashCopy logical drive or save it for reuse.

**VolumeCopy** VolumeCopy is used with FlashCopy to copy data from one logical drive to a target logical drive in a single storage subsystem. For example, you can use VolumeCopy for any of the following purposes:

- To copy data from arrays that use smaller capacity drives to arrays that use larger capacity drives
- To back up data
- To restore FlashCopy logical drive data to the base logical drive

**Note:** You must have FlashCopy enabled in order to use VolumeCopy. VolumeCopy can be purchased as part of a package with FlashCopy, or it can be purchased at a later time as an enhancement to FlashCopy.

#### Remote Mirror Option

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

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

#### FAStT600

The FAStT600 Fibre Channel Storage Server does not support the Remote Mirror Option or VolumeCopy.

**Note:** With the FAStT600 Turbo option, the FAStT600 Fibre Channel Storage Server supports VolumeCopy. For more information about the FAStT600 Turbo option, see the *IBM TotalStorage FAStT600 Fibre Channel Storage Server Installation and User's Guide*.

### Storage Partitioning premium features

FAStT Storage Manager 8.4 supports storage partitioning premium features for each FAStT storage server. Table 2 indicates whether the storage partition feature is enabled by default, and shows the maximum number of storage partitions that you can define for each server.

Table 2. Storage partitioning premium feature

FAStT Storage Server	Storage partitioning enabled by default	Maximum number of storage partitions	Storage partition premium feature purchase options
FAStT900	Yes (16 partitions standard)	64	16 - 64
FAStT700	Yes	16	16

Table 2. Storage partitioning premium feature (continued)

FAStT Storage Server	Storage partitioning enabled by default	Maximum number of storage partitions	Storage partition premium feature purchase options
FAStT600	No	8	4, 8, 4 - 8
FAStT600 with Turbo option	Yes (8 partitions standard)	64	8 - 16, 8 - 64, 16 - 64

### Enabling your premium features

To enable premium features on a FAStT600, FAStT700 or FAStT900 Fibre Channel Storage Server, use the premium feature activation tool that is located at the following Web site:

[www.storage.ibm.com/pfeatures.html/](http://www.storage.ibm.com/pfeatures.html/)

If a premium feature becomes disabled, you can access the Web site or CD-ROM to re-enable the feature. For any additional assistance, contact your IBM technical-support representative.

## FAStT600 restrictions

The following restrictions that apply to the FAStT600 Fibre Channel Storage Server:

- Supports FAStT EXP700 expansion units only (maximum of two)
- Supports only one drive side arbitrated loop
- Supports only 42 drives
- Supports a maximum of eight storage partitions

---

## Overview of Storage Manager 8.4 software packages

Storage Manager 8.4 contains the following client software packages:

**SMruntime** Storage Manager 8 Java™ compiler

**SMclient** Storage Manager 8 client package

Storage Manager 8.4 contains the following host software packages:

**SMagent** Storage Manager 8 agent package

**SMutil** Storage Manager 8 utility package

**RDAC** Storage Manager 8 multipath device drivers

**Note:** In addition to this document, see the *IBM FAStT Storage Manager Concepts Guide* for more information about Storage Manager 8.4 software.

### SMruntime software package

The Storage Manager 8.4 runtime software, SMruntime, is a Java compiler for the Storage Manager 8.4 client software, SMclient. SMruntime must be installed before SMclient is installed.

### SMclient software package

The Storage Manager 8.4 client software, SMclient, is a Java-based graphical user interface (GUI).

SMclient enables you to configure, manage, and troubleshoot IBM FAStT600, FAStT700 and FAStT900 Fibre Channel Storage Servers and EXP700 expansion units in a storage subsystem through a host system or through a storage management station.

Specifically, SMclient enables you to perform the following tasks:

- Configure disk arrays and logical volumes
- Assign names to arrays and volume groups
- Assign logical volumes to storage partitions
- Replace and rebuild failed disk drives
- Expand the size of arrays
- Expand the size of logical volumes
- Change RAID-type arrays
- Configure and add additional host partitions with the premium partitioning feature
- Monitor the status of FAStT storage servers
- Perform troubleshooting and maintenance tasks, such as download firmware to controllers and upgrade NVSRAM
- View the major events log (MEL)
- Expand the storage capacity using the EXP700 1 Gb or 2 Gb fibre-channel enclosure
- Assign redundant RAID controllers

The SMclient contains two main components:

#### **Enterprise Management**

This component enables you to add, remove, and monitor storage subsystems in the management domain.

#### **Subsystem Management**

This component enables you to manage the components of an individual storage subsystem.

## **SMagent software package**

The Storage Manager 8.4 software agent package, SMagent, contains optional host-agent software, which you can use on HP-UX and Solaris host systems to manage storage subsystems through the host fibre-channel connection.

SMagent takes requests from a storage management station that is connected to the host through a network connection, and passes the requests to the storage subsystem controllers through the fibre-channel I/O path.

For more information about managing storage subsystems through SMagent, see “Host-agent (in-band) management method” on page 7.

## **SMutil software package**

You can use the Storage Manager 8.4 utility, SMutil, to register and map new logical drives to the operating system.

Install SMutil on all HP-UX and Solaris host systems that are attached to a storage subsystem. The host computers are attached to the storage subsystem through the fibre channel.

## Failover driver

AIX and Solaris host systems require one of the following failover drivers for fibre-channel path redundancy:

<b>AIX</b>	Redundant Disk Array Controller (RDAC)
<b>Solaris</b>	RDAC, or VERITAS Volume Manager with Dynamic Multipathing (DMP)

If a FAStT storage server has two controllers, and the operating system does not support multipath I/O, then you can use the RDAC. The RDAC monitors I/O paths; if a component failure occurs in one of the fibre-channel paths, the RDAC reroutes all I/O to another path.

**Note:** The AIX RDAC driver files are not included on the Storage Manager 8.4 installation CD. You must follow the instructions in “Installing RDAC on AIX hosts” on page 24 to download them from the appropriate Web site.

## Software installation sequence

Install the Storage Manager 8.4 software packages in the sequences shown in Table 3.

Table 3. Installation sequences of Storage Manager 8.4 software packages by host type

Step	AIX	HP-UX	Solaris
1	SMruntime (see “Installing SMruntime” on page 20)	SMruntime (see “Installing the client software” on page 48)	SMruntime (see “Installing SMruntime” on page 65)
2	SMclient (see “Installing SMclient” on page 20)	SMclient (see “Installing the client software” on page 48)	SMclient (on Solaris 8 and 9 only; see “Installing SMclient” on page 66; supports Solaris 7, 8 and 9)
3	RDAC (see “Installing RDAC on AIX hosts” on page 24)	SMagent (see “Installing the SMagent (optional)” on page 50)	SMagent (see “Installing SMagent (optional)” on page 67)
4		SMutil (see “Installing SMutil (required)” on page 51)	SMutil (see “Installing the host software” on page 67)
5			RDAC or DMP (see “Installing the host software” on page 67 or “Installing DMP on Solaris hosts” on page 82)

---

## Storage subsystem management methods

The storage management software provides the following two methods for managing storage subsystems:

### Host-agent (in-band) management method

Using this method, you manage the storage subsystems through the fibre-channel I/O path to the host.



### Direct (out-of-band) management method

Using this method, you manage the storage subsystems directly over the network through the Ethernet connection to each controller.

The management methods are described in the next sections.

## 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 be processed by the host or passed to the storage management station through the network connection. Figure 2 shows the host-agent (in-band) management method.

### Restrictions:

- You cannot use the in-band management method on AIX systems.
- If both fibre channel connections to the controllers are lost, the SMclient cannot be accessed for problem determination.

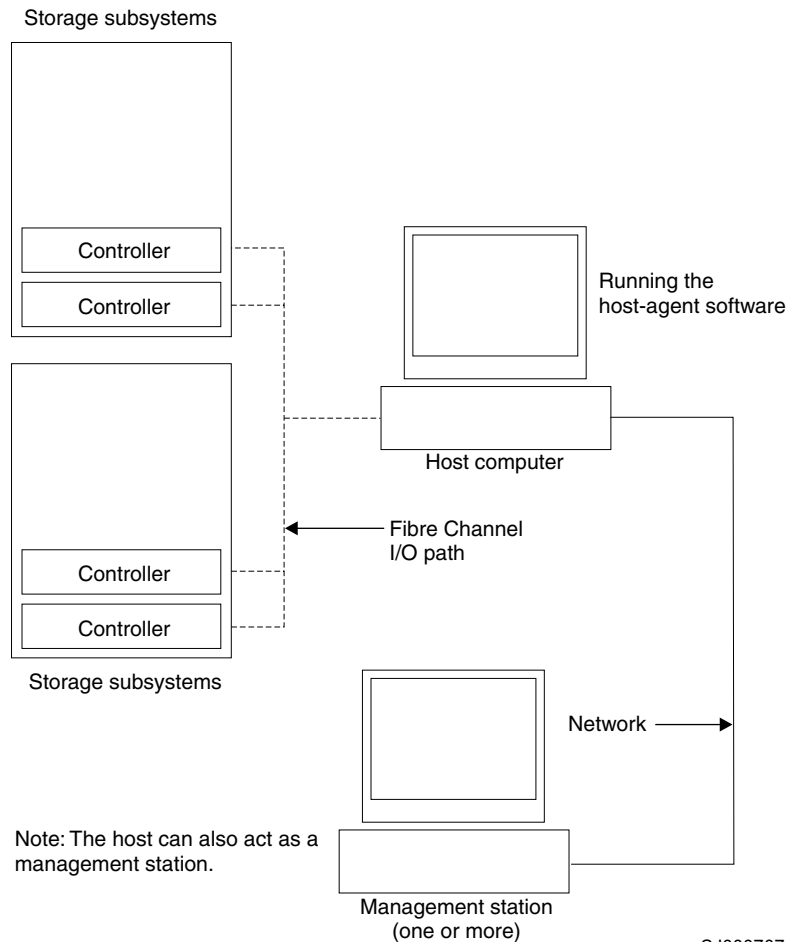


Figure 2. Host-agent (in-band) managed storage subsystems

### Host-agent (in-band) management method advantages

Using the host-agent (in-band) management method provides the following advantages:

- You do not need to run Ethernet cables to the controllers.
- You do not need a Dynamic Host Configuration Protocol (DHCP) bootstrap protocol (BOOTP) server to connect the storage subsystems to the network.
- You do not need to configure the controller network (described in Chapter 2, “Installing storage management station software on AIX systems,” on page 17, Chapter 3, “Installing storage management station software on HP-UX systems,” on page 47, or Chapter 4, “Installing storage management station software on Solaris systems,” on page 63).
- When adding devices, you need to specify a host name or Internet Protocol (IP) address for the host only, not for the individual controllers in a storage subsystem. Storage subsystems that are attached to the host are automatically discovered.

### **Host-agent (in-band) management method disadvantages**

Using the host-agent (in-band) management method has the following disadvantages:

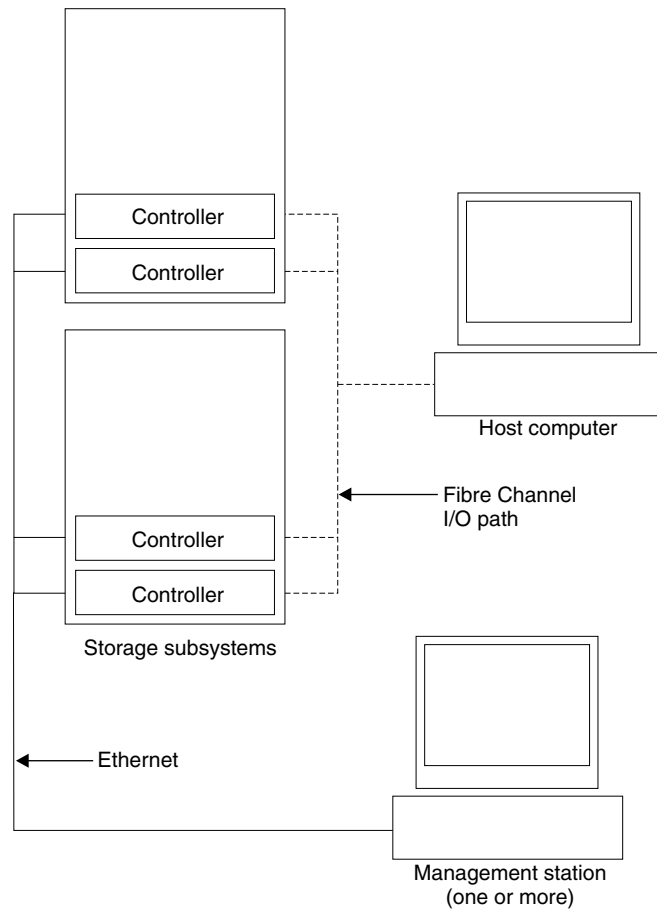
- If both fibre channel connections to the controllers are lost, the SMclient cannot be accessed for problem determination.
- Unlike direct (out-of-band) management, in which the fibre channel connections are dedicated for I/O, host-agent (in-band) management uses the fibre channel for both I/O and status reporting. Therefore, host-agent management uses more bandwidth on the fibre channel than direct management, and this can have an impact on performance.
- You are limited to configuring one less LUN than the maximum number allowed by the operating system and host adapter that you are using.
- The host-agent requires a special logical drive, called an *access volume*, to communicate with the controllers in the storage subsystem.

**Important:** The access volume uses one of the LUNs. If your host already has the maximum number of LUNs configured, either use the direct-management method or give up a LUN for use as the access volume. For information about your specific configuration, see the appropriate chapter in this document for your operating system environment.

## **Direct (out-of-band) management method**

When you use the direct (out-of-band) management method, you manage storage subsystems directly over the network through the 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 and attach a cable to the Ethernet ports on each of the storage subsystem controllers. Figure 3 on page 9 shows the direct (out-of-band) management method.



SJ000708

Figure 3. Direct (out-of-band) managed storage subsystems

If you use the direct (out-of-band) management method, see “Setting up IP addresses for FAStT storage controllers” on page 14.

### Direct (out-of-band) management method advantages

Using the direct (out-of-band) management method provides the following advantages:

- Unlike host-agent (in-band) management, which uses the fibre channel connections for both I/O and status reporting, direct (out-of-band) management dedicates the fibre channel for I/O only. Therefore, direct management can result in higher performance than host-agent management.
- Because status reporting is conducted over Ethernet connections, the SMclient can be accessed for problem determination if both fibre channel connections to the controllers are lost.
- The Ethernet connections to the controllers enable a storage management station running SMclient to manage storage subsystems that are connected to a host running one of the following operating systems:
  - AIX
  - HP-UX
  - Linux
  - Microsoft® Windows NT®, Windows® 2000, or Windows Server 2003
  - Solaris
  - Any other operating systems that are supported by Storage Manager 8.4

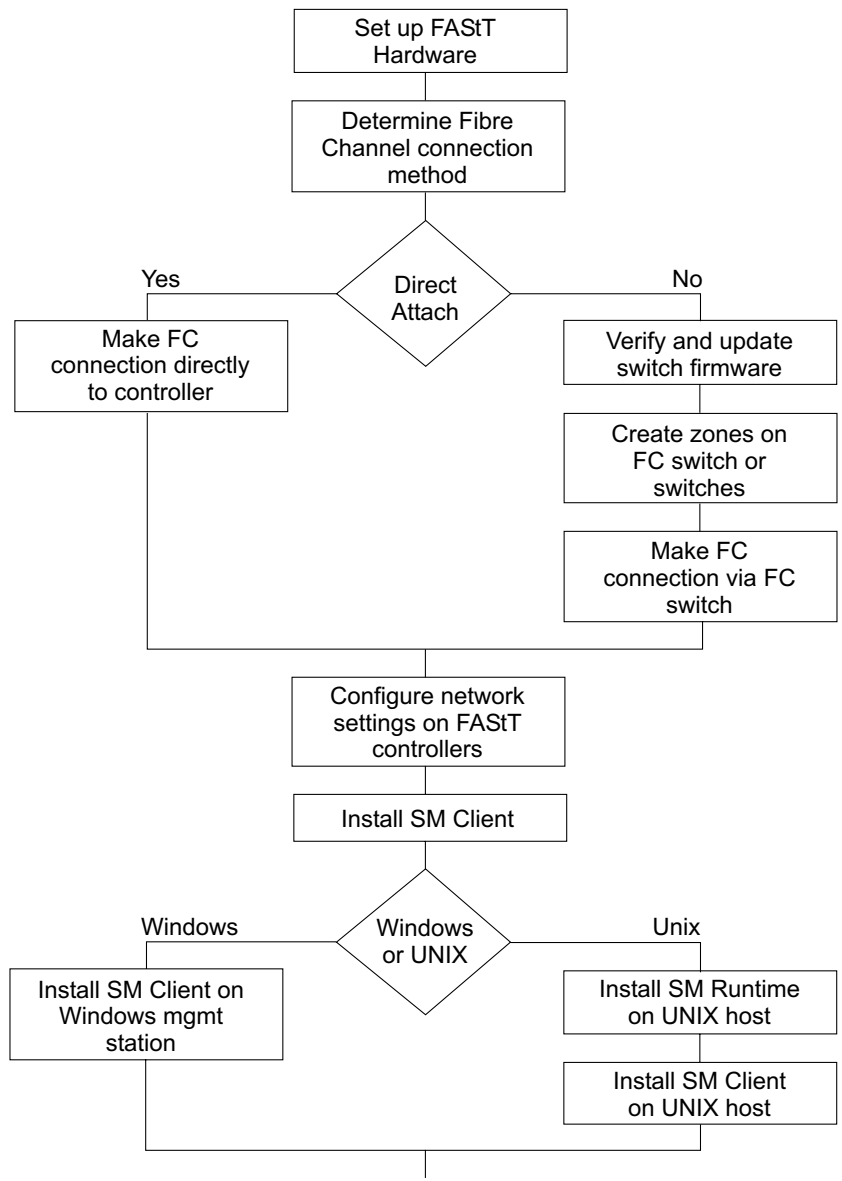
### **Direct (out-of-band) management method disadvantages**

Using the direct (out-of-band) management method has the following disadvantages:

- It requires two Ethernet cables to connect both storage subsystem controllers to the network.
- When you configure IP addresses for new devices, you must either assign a static IP address or host name for each controller, or place the devices on a network with a DHCP or BOOTP server.
- Other network preparation tasks might be required. For more information, see the system installation guide for your network server.

### **Installation process diagram**

Figure 4 on page 11, Figure 5 on page 12, and Figure 6 on page 13 provide an overview of the installation process for out-of-band management.



(Continued on Flowchart 2)

SJ002000

Figure 4. Installation process (part 1)

(Continued from Flowchart 1)

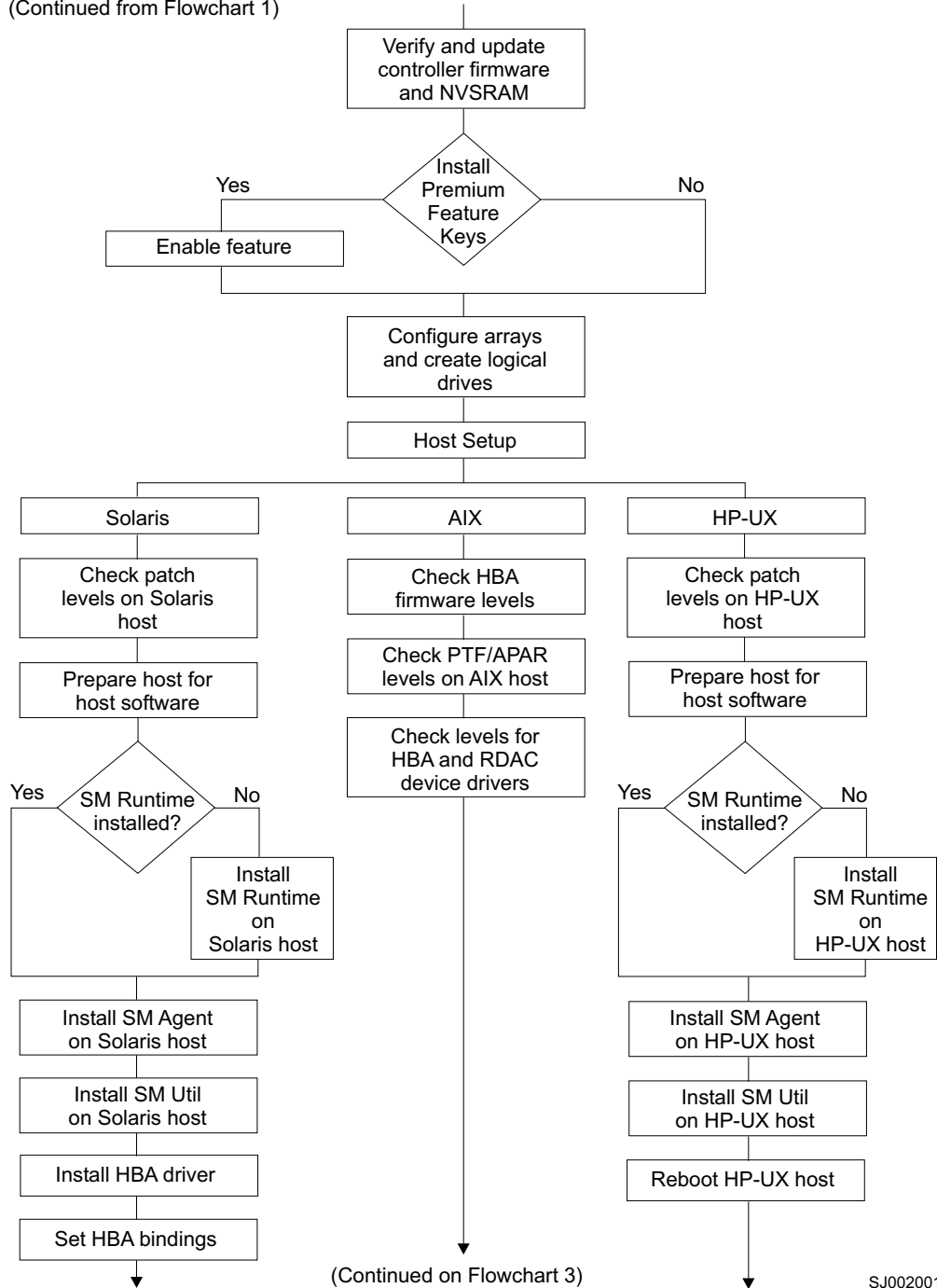
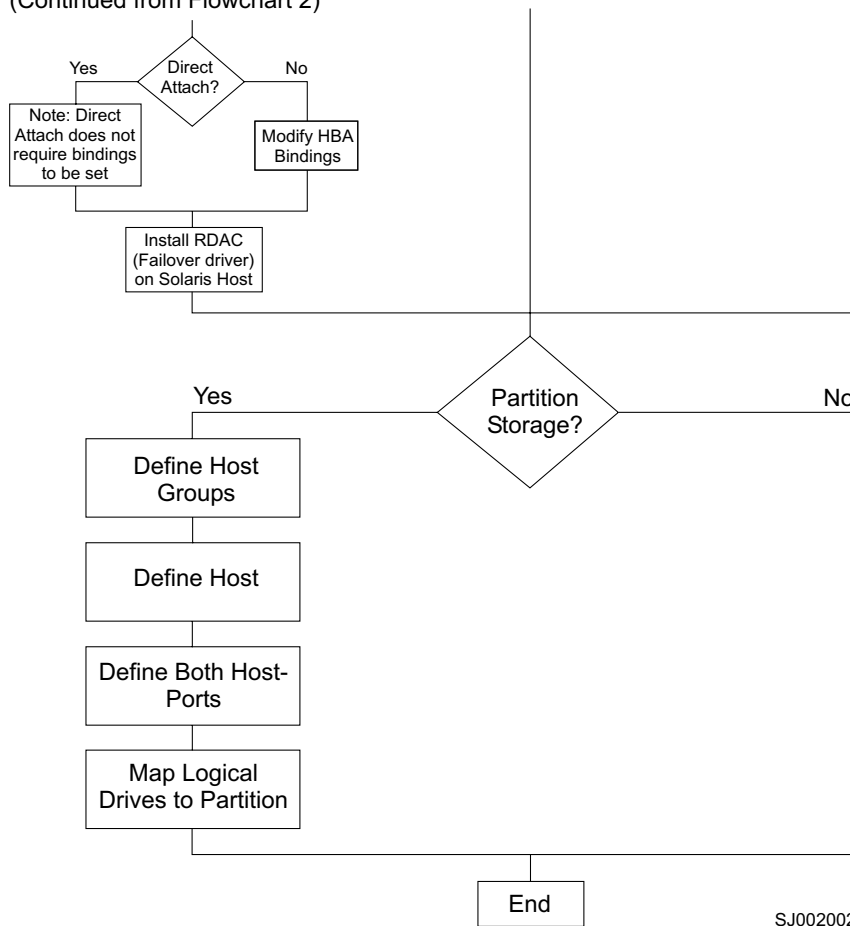


Figure 5. Installation process (part 2)

SJ002001

(Continued from Flowchart 2)



SJ002002

Figure 6. Installation process (part 3)

## Operating system requirements

Storage Manager 8.4 supports the following IBM FAStT Fibre Channel Storage Servers in the following environments.

Operating systems	FAStT FC Storage Servers	Where to find more information
IBM AIX versions: 4.3.3 5.1 5.2	FAStT600, FAStT700, FAStT900	Appendix A, "AIX system requirements," on page 101
HP-UX versions: 11.0 (32 bit or 64 bit) 11.11 11i	FAStT600, FAStT700, FAStT900	Appendix B, "HP-UX system requirements," on page 103
Sun Solaris versions: 7 8 9	FAStT600, FAStT700, FAStT900	Appendix C, "Solaris system requirements," on page 105

---

## Setting up IP addresses for FAS*St* storage controllers

To use the out-of-band management method without setting up a DHCP BOOTP server, you must assign IP addresses to the FAS*St* controllers using command-line interface (CLI) commands through serial cables that are connected to a terminal emulator.

**Before you begin:** Contact your network administrator to obtain the IP address and associated host name for each controller in every storage subsystem on the network, and make a note of those values for reference.

- Ensure that you have the following addresses:
  - An IP address for each controller
  - A submask address
- Download the latest version of HyperTerminal Private Edition (6.3 or higher) from the following Web site:  
[www.hilgraeve.com](http://www.hilgraeve.com)

Complete the following steps to set up the FAS*St* controller IP addresses by using serial ports:

1. Stop all I/O to the FAS*St* controllers.
2. Connect a null modem serial cable from one of the controllers to a system with a terminal emulator available.
3. Open the HyperTerminal and from the menu bar, click **File** → **Properties** → **Configure**. Choose the following settings:

**Bits/second** 57600

**Data bits** 8

**Parity** None

**Stop Bit** 1

**Flow Control** None

4. Connect to the FAS*St* storage server and send a break signal (Ctrl+Break for most emulators).
5. Repeat this step until the following message is displayed:

Press the space bar for baud rate within 5 seconds.

6. Press the space bar to ensure the correct baud rate setting.
7. Send another break signal; the following message is displayed:

Press within 5 seconds: ESC for SHELL, BREAK for baud rate.

8. Press Escape to access the shell of the controller.
9. Type the following password: `infiniti`.
10. Type `netCfgShow` to show the current network configuration.

**Note:** The default following IP address settings are set by manufacturing:

- Controller A = 192.168.10.101
- Controller B = 192.168.10.102
- IP address mask = 255.255.255.0

11. Type `netCfgSet` to change the network configuration information.



**Note:** Press Enter to advance to the next field. Type the new IP address in the **My IP Address** field.

12. Assign an IP address to the controller.
13. Type netCfgShow to verify the new network settings.
14. Disconnect from the first controller and connect to the second controller.
15. Repeat step 1 on page 14 through step 14 to assign the second IP address to the second controller.
16. Turn the controller unit off and on to restart the FAStT storage server.



---

## Chapter 2. Installing storage management station software on AIX systems

This chapter provides the following information for AIX operating systems:

- “Hardware and firmware requirements”
- “AIX restrictions” on page 18
- “Removing previous versions of Storage Manager” on page 19
- “Installing the client software” on page 19
- “Configuring storage subsystems on AIX hosts” on page 20
- “Creating direct and SAN-attached configurations” on page 23
- “Installing RDAC on AIX hosts” on page 24
- “AIX configuration information” on page 25
- “Using fast I/O failure for fibre-channel devices” on page 40
- “Using dynamic tracking of fibre-channel devices” on page 41
- “Using dynamic capacity expansion and dynamic volume expansion” on page 42
- “Resolving disk array errors” on page 43
- “Redistributing volumes in case of failure” on page 45

**Attention:** For cluster configurations, complete all applicable configuration procedures for each storage subsystem *before* installing the Storage Manager 8.4 software on a second host or cluster server.

---

### Hardware and firmware requirements

Table 4 lists the FAS*t*T storage servers that are supported with Storage Manager 8.4.

*Table 4. FAS*t*T storage servers that are supported on AIX systems*

Product Name	Model	Product release and firmware version
IBM TotalStorage FAS <i>t</i> T900 Fibre Channel Storage Server	1742-90U	Appware 5.40.03.00 NVSRAM N1742F900R840V00
IBM TotalStorage FAS <i>t</i> T700 Fibre Channel Storage Server	1742-1RU	Appware 5.40.03.00 NVSRAM N1742F700R840V00
IBM TotalStorage FAS <i>t</i> T600 Fibre Channel Storage Server	1722-60U, 1722-60X	Snapware 5.40.03.02 NVSRAM N1722F600R840V02

Table 5 lists the supported versions of hardware to use with Storage Manager 8.4.

*Table 5. Supported versions of hardware for AIX systems*

Product Name	Model	Product release and firmware version
IBM TotalStorage FAS <i>t</i> T700 EXP700 Storage Expansion Unit	1740-1RU	ESM 9324
IBM TotalStorage FAS <i>t</i> T500 EXP500 Storage Expansion Unit	3560-1RU	ESM 9166
IBM HA Emulex LP7000	FC 6227	S1F3.22A1
IBM HA Emulex LP9000	FC 6228	C1D3.82A1
IBM HA Emulex LP9802-F2	FC 6239	H1D1.00X5

Table 5. Supported versions of hardware for AIX systems (continued)

Product Name	Model	Product release and firmware version
Brocade switch	2109-S08 2109-S16	2.6.0j
Brocade switch	2109-F16	3.0.2.9
Brocade switch	2109-M12, 2109-F32	4.0.2b
Brocade switch	2109-F08	3.0.2.K
McData switch	2032-064, 2032-140	4.01.00
McData switch	2031-016	4.01.00
McData switch	2031-216, 2031-224	4.01.00
InRange switch	2042-001	4.1.06
Cisco switch	2062-D01, 2062-D07, 2062-T07	1.1

**Note:** Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. To ensure that you have the latest versions of the firmware and the NVSRAM, read the readme file that is shipped with the product. You can also find the latest readme file at the following Web site:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FAStT Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FAStT Storage Manager for AIX.

---

## AIX restrictions

The following restrictions apply to FAStT600, FAStT700, and FAStT900 storage servers:

- F-RAID Manager is not supported.
- The maximum number of partitions per AIX host, per FAStT storage server, is two.
- Each AIX host can support one to four HBAs and up to two FAStT storage partitions, each requiring two HBA connections per FAStT storage server. Additional HBAs can be added to support additional FAStT storage servers.
- Direct-attach configurations are restricted to single-initiator configurations only. Only one connection to each FAStT minihub is allowed.

**Note:** FAStT600 storage servers do not have minihubs.

- Single HBA configurations are allowed, but each single HBA configuration requires that both controllers in the FAStT be connected to the HBA, either through a switch or daisy-chain (direct-attach only). If they are connected through a switch, both controllers must be within the same SAN zone as the HBA.

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

- Single-switch configurations are allowed, but each HBA and FASSt controller combination must be in a separate SAN zone.
- All volumes that are configured for AIX must be mapped to an AIX host group. Connecting and configuring to volumes in the default host group is not allowed. See “Setting up an AIX host group” on page 22.
- Other storage devices, such as tape devices or other disk storage, must be connected through separate HBAs and SAN zones.
- Booting up from a FASSt device is supported only on AIX 5.1 and 5.2.
- When you boot from a FASSt device, both paths to the FASSt storage server must be up and operational.
- Path failover is not supported during the AIX boot process. Once the AIX host has started, failover operates normally.

---

## Removing previous versions of Storage Manager

If you are upgrading from Storage Manager 8.xx, you do not have to remove the previous version. Installing Storage Manager 8.4 overwrites previous 8.xx versions.

If you are upgrading from Storage Manager 7.xx, complete the following steps to remove it before you install Storage Manager 8.4:

1. List all the Storage Manager software that is installed on the current AIX system, using the following command.

```
lslpp -L | grep SM
```

2. Remove the Storage Manager software, using the following command.

```
installp -u SM_component_name
```

where *SM\_component\_name* is the name of a Storage Manager package component that you want to remove.

It might take several minutes for the task to complete. The system might be unresponsive during this time.

3. Repeat step 2 to remove each Storage Manager software package.

After you have completed these steps, you have finished removing the previous version of Storage Manager. You can now install Storage Manager 8.4 software.

---

## Installing the client software

Use the procedures in this section to install the client software on an AIX storage management station.

Install the software in the following order:

1. SMruntime
2. SMclient

**Note:** The SMclient is dependent on SMruntime, which is a Java compiler for the SMclient and must be installed first.

## Prerequisites

Before installing the software, ensure that the following conditions are met:

- The AIX host on which you are installing SMruntime meets the minimum hardware and software requirements described in “Hardware and firmware requirements” on page 17 and “Software requirements” on page 101.
- The correct file sets are present on the system.

**Note:** If the file sets are not present, follow the instructions in “Installing RDAC on AIX hosts” on page 24 to download them from the appropriate Web site.

- For a list of AIX 4.3.3 file sets, see Table 15 on page 101.
- For a list of AIX 5.1 file sets, see Table 16 on page 101.
- For a list of AIX 5.2 file sets, see Table 17 on page 102.

## Installing SMruntime

Adjust these instructions as required for your specific installation. No restart is required during the installation process.

1. Install SMruntime by typing the following command:

```
# installp -a -d /complete path name
/SMruntime.aix-08.40.65.00.bff SMruntime.aix.rte
```

2. Verify that the installation was successful by typing the following command:

```
# ls1pp -ah SMruntime.aix.rte
```

The verification process returns a table that describes the software installation, including the install package file name, version number, action and action status. If the verification process returns an error, contact your service representative.

## Installing SMclient

In the following procedure, the installation CD is mounted at /dev/cdrom. Adjust these instructions as required for your specific installation. No restart is required during the client installation process.

1. Install SMclient by typing the following command:

```
# installp -a -d /complete path name/
SMclient.aix-08.40.65.00.bff SMclient.aix.rte
```

2. Verify that the installation was successful by typing the following command:

```
# ls1pp -ah SMclient.aix.rte
```

The verification process returns a table that describes the software installation, including the install package file name, version number, action and action status. If the verification process returns an error, contact your support representative.

---

## Configuring storage subsystems on AIX hosts

If you have purchased a Storage Partitioning premium feature, ensure that the premium feature is enabled. For more information, see “Enabling your premium features” on page 4.

Complete the following procedures to configure Storage Manager 8.4 for an AIX system. This can be done from the SMclient running on either an AIX or a non-AIX system.

## Adding storage subsystems to SMClient

Perform the following steps to add storage subsystems to SMclient:

1. To set up the storage subsystem for AIX and the AIX SMclient, the subsystem must be physically configured for direct management through the Ethernet connections on each controller. Install SMclient before configuring the subsystem.

**Note:** See “Setting up IP addresses for FASTT storage controllers” on page 14 for information about assigning IP addresses to the controllers.

2. After the disk subsystem is configured on the network, start the SMclient on the host server by typing the following command:

```
# /usr/SMclient/SMclient
```

3. Complete the following steps to specify the IP addresses of the controllers:
  - a. In the Enterprise Management window, click **Edit** → **Add Device**.
  - b. In the Add Device window, type the IP address of the first controller in the storage subsystem and click **Add**.
  - c. Type the IP address of the second controller and click **Add**, and then click **Close**.

The storage subsystem is shown as a direct network attachment. Double-click **Storage Subsystem** to open the Subsystem Management window.

## Upgrading FASTT firmware and NVSRAM

**Before you begin:** Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. To ensure that you have the latest versions of the firmware and the NVSRAM, read the readme file that is shipped with the product. You can also find the latest readme file at the following Web site:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FASTT Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FASTT Storage Manager for AIX.

If you do not have the latest versions of the firmware and NVSRAM, click the **Back** button on your browser to return to the previous Web page. You can download the correct versions by clicking the appropriate link that is listed in the IBM FASTT Controller Firmware matrix.

Complete the following steps to upgrade the controller firmware:

1. Ensure that all I/O to the controllers has been stopped.
2. Download the correct version of the firmware from the Web site. Place the file in a designated directory on the host system.
3. In the Subsystem Management window, click **Storage Subsystem** → **Download** → **Firmware**.
4. Type or select the full path name of the firmware file.

5. Click **OK** to update both controllers.
6. Click **Yes** to start the download. A new window opens.
7. Close the Subsystem Management window and then reopen it to complete the firmware update.
8. Verify that the firmware was successfully installed.

Complete the following steps to upgrade the NVSRAM:

1. Ensure that all I/O to the controllers has been stopped.
2. Download the correct version of NVSRAM from the Web site. Place the file in a designated directory on the host system.
3. In the Subsystem Management window, click **Storage Subsystem** → **Download** → **NVSRAM**.
4. Type or select the full path name of the NVSRAM directory.
5. Double-click the NVSRAM filename or click **OK** to select the correct file.
6. Click **Yes** to start the download.
7. Verify that the NVSRAM was successfully installed.

## Setting up an AIX host group

Perform the following steps to set up an AIX host group.

**Note:** Create the AIX host group at the storage subsystem level. Do not create host groups at the default group level.

In a cluster partition, perform logical drive mappings on the host group level so that all the hosts can see the same storage. In a normal partition, perform logical drive mappings on the host level.

1. Click the **Mappings View** tab on the Subsystem Management window.
2. In the Mappings window, create a new host group by clicking **Mappings** → **Define** → **Host Group**.
3. Type the name of the new host group (for example, AIX). Click **Add**, and then click **Close**.
4. Highlight the new host group and click **Mappings** → **Define** → **Host**.
5. Define the new host. Type the name of the AIX host to which the storage subsystem is attached.
  - a. Click **Add**, and then click **Close**.
  - b. Highlight the host that you just added and right-click **Define New Host Port**.
  - c. Select the desired host port for the first HBA, and then change the host type to **AIX** and click **Add**.

**Note:** Failure to change the host type from the default to AIX will cause undesired results.

- d. If you are configuring additional HBAs to this partition, choose the host port for the next HBA and click **Add**, and then click **Close**.

After you set up an AIX host group, perform the following steps to verify that the host ports match the AIX host:

1. Type the following command:

```
lsdev -Cc adapter | grep fcs
```

A list that contains all the HBAs that are in the system is displayed, as shown in



the following example:

```
# lsdev -Cc adapter |grep fcs
fcs0   Available 20-58   FC Adapter
fcs1   Available 30-70   FC Adapter
fcs2   Available 40-60   FC Adapter
fcs3   Available 90-58   FC Adapter
fcs4   Available B0-70   FC Adapter
fcs5   Available C0-60   FC Adapter
```

2. Identify the fcs number of the HBA that is connected to the FASTt.
3. Type the following command:

```
lscfg -vl fcs# |grep Network
```

where *fcs#* is the fcs number of the HBA that is connected to the FASTt. The network address number of the HBA is displayed, as in the following example:

```
# lscfg -vl fcs0|grep Network
Network Address.....10000000C925514C
```

- Note:** A network address is also known as a worldwide port name (WWPN).
4. Verify that the network address number matches the host port number that displays in host partition table of the FASTt SMclient.
  5. Repeat this procedure to verify the second host port.

## Mapping LUNs to a FASTt storage partition

Complete the following steps to map LUNs to a storage partition:

1. Select the Mappings View of the Subsystem Management window.
2. In the topology tree, right-click the host partition on which you want to map LUNs, and select **Define Additional Mappings**. The Define Additional Mappings window opens.
3. In the Define Additional Mappings window, select the following options, and then click **Add**:
  - Host group or host
  - Logical unit number (LUN)
  - The logical drive you want to map

Repeat these steps for each LUN that you want to map to the partition.

---

## Creating direct and SAN-attached configurations

Storage Manager 8.4 supports IBM FASTt Fibre Channel Storage Servers in direct-attached AIX configurations or in a SAN environment through switches in AIX configurations.

### Creating a direct-attached configuration

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

- One or two AIX servers can be connected to the FASTt storage servers.

- Two-server FAStT700 or FAStT900 configurations require four host-side minihubs, each with exactly one fibre-channel connection from each HBA to a minihub.

**Note:** FAStT600 storage servers do not have minihubs.

- There are two or four HBAs per FAStT storage server. Each pair must be configured to one FAStT partition.
- No external hubs are being used.

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

1. Connect the HBAs to each controller or mini-hub port of the FAStT storage server.
2. Configure and verify the configuration.

## Creating a SAN-attached configuration

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

- Multiple fibre-channel HBAs within the same server cannot “see” the same FAStT controller port.
- The IBM fibre-channel HBAs are isolated from each other if they are connected to the same switch that is connected to the same FAStT controller port.
- Each fibre-channel HBA and controller port must be in its own fabric zone, if they are connecting through a single fibre-channel switch, such as 2109-F16.

See the documentation that is provided by the switch manufacturer for more information about zoning. Multiple FAStT devices can be configured to the same set of fibre-channel HBAs through a fibre-channel switch.

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

1. Connect the HBAs to the switch or switches.
2. Connect the FAStT storage subsystems to the switch or switches.
3. Set the required zones on the fibre-channel switch or switches, if applicable.

**Note:** For information about zoning and enabling zones, see the documentation that is provided by the switch manufacturer.

4. Configure and verify the configuration.

---

## Installing RDAC on AIX hosts

After you install the client software and configure your storage subsystems, use these instructions to install the appropriate Storage Manager 8.4 RDAC device driver.

All AIX hosts in your storage subsystem must have the RDAC multipath driver installed. This section describes how to check the current RDAC driver program driver version level, update the RDAC device driver, and verify that the RDAC update is complete.

## Prerequisites

This section lists the prerequisites for installing the RDAC driver version levels on an AIX system and describes how to verify the current RDAC drive driver version level.

## Prerequisites for installing RDAC

See Table 15 on page 101, Table 16 on page 101, or Table 17 on page 102 for a list of required driver version level filesets.

## Verifying RDAC software

Use the **lslpp** command to verify that the correct driver versions are installed:

```
# lslpp -ah filename
```

Where *filename* is one of the required file sets listed in Table 15 on page 101, Table 16 on page 101, or Table 17 on page 102.

For example:

```
# lslpp -ah devices.fcp.disk.array.rte
```

## Installing the RDAC driver

Complete the following steps to update the RDAC driver version (devices.fcp.disk.array.rte) on an AIX system. Repeat these steps for all AIX systems that are connected to the storage subsystem.

**Before you begin:** Check the fileset versions that are listed in Appendix A, “AIX system requirements,” on page 101 or in the readme file, to find out whether your AIX systems have the most recent RDAC filesets. You only need to perform this installation on AIX systems that do not have the most recent RDAC filesets.

1. Download the most recent filesets from the following Web site:

[techsupport.services.ibm.com/server/aix.fdc/](http://techsupport.services.ibm.com/server/aix.fdc/)

2. Verify that the correct version of the software was successfully installed by typing the following command:

```
# lslpp -ah devices.fcp.disk.array.rte
```

The verification process returns a table that describes the software installation, including the installation package fileset name, version number, action, and action status. If the verification process returns an error, contact your customer service representative. If it does not return an error, then you are finished installing the updated RDAC driver on this AIX system.

3. Configure the devices for the software changes to take effect by typing the following command:

```
# cfgmgr -v
```

---

## AIX configuration information

This section contains the following AIX configuration information:

- Viewing and setting attributes of the RDAC driver for AIX
- Viewing Object Data Manager (ODM) attributes in AIX
- Changing ODM attribute settings in AIX
- Verifying the installation and configuration of AIX hosts
- Identifying the controller ID numbers
- Identifying device names and bus numbers

- Identifying logical drives by operating system device names
- Identifying FlashCopy volume types

## Viewing and setting attributes of the RDAC driver for AIX

The RDAC driver must be installed on all AIX hosts that will be attached to a FAStT storage subsystem. The RDAC driver creates the following devices that represent the FAStT storage subsystem configuration:

- dar** The disk array router represents the entire array, including the current and the deferred paths to all LUNs (hdisks on AIX).
- dac** The disk array controller devices represent a controller within the storage subsystem. There are two dacs in the storage subsystem.
- hdisk** These devices represent individual LUNs on the array.

When these devices are configured, the Object Data Manager (ODM) is updated with default parameters. In most cases and for most configurations, the default parameters are satisfactory. However, there are some parameters that can be modified for maximum performance and availability. See “hdisk attribute settings” on page 32.

See “Viewing Object Data Manager attributes in AIX” on page 30 for information about using the **lsattr** command to view attribute settings on an AIX system.

### Definitions of attribute settings

Some attributes for dars, dacs, and hdisks are for information purposes only, showing how the FAStT is configured or its current state. You can modify other attributes with SMIT or with the AIX **chdev -p** command. Attributes with True in the Changeable column can be modified from their default settings. False means that they are for informational or state purposes only.

**Note:** Some attributes with False in the Changeable column can be modified using the SMclient.

Another method of determining attributes that can be modified is with the **lsattr -el** command. Attributes with True in the last column of the output can be modified. See the examples in Table 6, Table 7 on page 28, and Table 8 on page 29. Display the default with the **lsattr -dl** command.

Table 6. Attributes for dar devices

Attribute	Definition	Changeable (T/F)	Possible value
<i>act_controller</i>	List of controllers in the active state at the time of configuration.	False	Set at configuration time by the RDAC software.
<i>all_controller</i>	List of controllers that comprise this array; usually there are two dac devices.	False	Set at configuration time by the RDAC software.
<i>held_in_reset</i>	Name of the controller that was in the held-in-reset state at the time of configuration, or <b>none</b> if no controllers were in that state.	True	Set at configuration time by the RDAC software. Should not be changed.

Table 6. Attributes for dar devices (continued)

Attribute	Definition	Changeable (T/F)	Possible value
<i>load_balancing</i>	Indicator that shows whether load balancing is enabled ( <b>yes</b> ) or disabled ( <b>no</b> ); see the definition of the <i>balance_freq</i> attribute for more information.	True	Yes or No. See restrictions on use.
<i>autorecovery</i>	Indicator that shows whether the device returns the array to dual-active mode when it detects proper operation of both paths and controllers ( <b>yes</b> ) or not ( <b>no</b> ).	True	Yes or No. See restrictions on use.
<i>lun_bitmap</i>	Bitmap that shows which controller owns which LUN at the time of configuration.	True	While changeable, this should not be changed. LUN ownership should be controlled by the Storage Manager.
<i>hlthchk_freq</i>	Number that specifies how often health checks are performed, in seconds.	True	1 - 9999. Should not be changed
<i>aen_freq</i>	Number that specifies how often polled AEN checks are performed, in seconds.	True	1 - 9999. Should not be changed
<i>balance_freq</i>	If <i>load_balancing</i> is enabled, number that specifies how often the system performs load-balancing on the array, in seconds.	True	1 - 9999 - should not be changed
<i>fast_write_ok</i>	Indicator that shows whether fast-write write-caching is available for this system ( <b>yes</b> ) or not ( <b>no</b> ).	False	Yes or No. State of FAST configuration.
<i>cache_size</i>	Cache size for both controllers, in megabytes; <b>0</b> if the sizes do not match.	False	512 or 1024. Set by FAST.
<i>switch_retries</i>	Number that specifies how many times to retry failed switches, in integers.	True	0 - 255. Should not be changed.

Table 7. Attributes for dac devices

Attribute	Definition	Changeable (T/F)	Possible value
<i>passive_control</i>	Indicator that shows whether this controller was in passive state at the time of configuration ( <b>yes</b> ) or not ( <b>no</b> ).	False	Yes or No. State of FAStT configuration.
<i>alt_held_reset</i>	Indicator that shows whether the alternate controller was in the held-in-reset state at the time of configuration ( <b>yes</b> ) or not ( <b>no</b> ).	False	Yes or No. State of FAStT configuration.
<i>controller_SN</i>	Serial number of this controller.	False	Set by FAStT.
<i>ctrl_type</i>	Type of array this controller belongs to. A value of value of <b>1722</b> indicates FAStT600; a value of <b>1742</b> indicates FAStT700; a value of <b>1742-900</b> indicates FAStT900.	False	1742, 1722, 1742-900. Set by FAStT.
<i>cache_size</i>	Cache size of this controller, in megabytes.	False	512, 1024. Set by FAStT.
<i>scsi_id</i>	SCSI identifier of this controller.	False	Set by SAN, reported by AIX.
<i>lun_id</i>	Logical unit number of this controller.	False	Set by FAStT.
<i>utm_lun_id</i>	Logical unit number of this controller, or <b>none</b> if UTM (access volumes) is not enabled.	False	0 - 31. Set by FAStT Storage Manager.
<i>location</i>	User-defined location label for this controller; the system does not use this value.	True	Set by FAStT Storage Manager.
<i>ww_name</i>	fibre-channel worldwide name of this controller.	False	Set by FAStT.
<i>GLM_type</i>	GLM type used for this controller.	False	High or Low. Set by FAStT.

Table 8. Attributes for hdisk devices

Attribute	Definition	Changeable (T/F)	Possible value
<i>pvid</i>	AIX physical volume identifier, or <b>none</b> if not set.	False	Set by AIX.
<i>q_type</i>	Queueing type for this device; must be set to <b>simple</b> .	False	Set by AIX. Must be "simple".
<i>queue_depth</i>	Number that specifies the depth of the queue based on system configuration; reduce this number if the array is returning a BUSY status on a consistent basis.	True	1 - 64
<i>reserve_lock</i>	Indicator that shows whether the fcparray issues a SCSI Remove command every time a device is opened or when a Test Unit Ready sequence is issued by the driver ( <b>yes</b> ) or not ( <b>no</b> ).	True	Yes or No.
<i>write_cache</i>	Indicator that shows whether write-caching is enabled on this device ( <b>yes</b> ) or not ( <b>no</b> ); see the definition of the <i>cache_method</i> attribute for more information.	False	Yes or No.
<i>size</i>	Size of this volume.	False	Set by FAStT.
<i>raid_level</i>	Number that specifies the RAID level of this device.	False	0, 1, 3, 5. Set by FAStT Storage Manager.
<i>rw_timeout</i>	Number that specifies the read/write timeout value for each read/write command to this array, in seconds; usually set to 30.	True	30 - 180. Should not be changed from default.
<i>reassign_to</i>	Number that specifies the timeout value for FC reassign operations, in seconds; usually set to 120.	True	0 - 1000. Should not be changed from default.
<i>scsi_id</i>	SCSI identifier at the time of configuration.	False	Set by SAN, reported by AIX.

Table 8. Attributes for hdisk devices (continued)

Attribute	Definition	Changeable (T/F)	Possible value
<i>lun_id</i>	Logical unit number of this device.	False	0 - 31. Set by FAS <i>St</i> T Storage Manager.
<i>cache_method</i>	<p>If <i>write_cache</i> is enabled, the write-caching method of this array; set to one of the following:</p> <ul style="list-style-type: none"> <li>• <b>default.</b> Default mode; the word "default" is not seen if <i>write_cache</i> is set to yes.</li> <li>• <b>fast_write.</b> Fast-write (battery-backed, mirrored write-cache) mode.</li> <li>• <b>fw_unavail.</b> Fast-write mode was specified but could not be enabled; write-caching is not in use.</li> <li>• <b>fast_load.</b> Fast-load (non-battery-backed, non-mirrored write-cache) mode.</li> <li>• <b>fl_unavail.</b> Fast-load mode was specified but could not be enabled.</li> </ul>	False	Default, <i>fast_write</i> , <i>fast_load</i> , <i>fw_unavail</i> , <i>fl_unavail</i> .
<i>prefetch_mult</i>	Number of blocks to be prefetched into read cache for each block read.	False	0 - 100.
<i>ieee_volname</i>	IEEE unique volume name identifier for this volume.	False	Set by FAS <i>St</i> T.

## Viewing Object Data Manager attributes in AIX

To view the Object Data Manager (ODM) attributes for *dars*, *dacs*, and *hdisks*, use the **lsattr** command. The following examples demonstrate how to use the **lsattr -EI** command, which shows the attributes that are currently set on the system. To view the default settings, use the **-DI** flag instead of **-EI**.

This example shows the attribute settings for a disk array router (*dar0*).





## hdisk attribute settings

This section lists the attribute settings that you should use for hdisk devices and shows how to set them using the **chdev -l** command. To make the attribute changes permanent in the Customized Devices object class, use the **-P** option.

**Disabling FASTT cache mirroring:** Cache mirroring is enabled on the FASTT storage server by default. However, you might want to disable this function in certain environments where high performance is a critical factor (such as streaming media applications).

For most applications, cache mirroring should remain enabled.

**Attention:** You must be careful when you disable cache mirroring, particularly when the write cache function is enabled.

- If a controller failure or a power down occurs, data that is in the write cache (but not written to the physical disk media) might be lost. This can result in corrupted files, file systems, or databases.
- On AIX 5.1 and 5.2, cache mirroring is *not* automatically re-enabled the next time the system is restarted or when **cfgmgr** is run.

In the SMclient, complete the following steps to disable cache mirroring.

**Before you begin:** If write cache is enabled, make backups of all data before disabling cache mirroring.

1. In the Subsystem Management window, right-click the volume on which you want to disable cache mirroring, and select **Change** → **Cache Settings**.
2. In the Change Cache Settings window, clear the *Enable write caching with mirroring* checkbox.
3. Click **OK**.

### Notes:

1. When a LUN is opened that is running with write cache enabled and cache mirroring disabled, an FCP array warning message displays. The warning displays again every 24 hours until cache mirroring is enabled again. See FCP\_ARRAY\_ERR25, which is described in “Resolving disk array errors” on page 43.
2. If you are running AIX 4.3.3, do not disable cache mirroring while cache write is enabled. If this condition exists, the RDAC software automatically re-enables it the next time the system is restarted, or when **cfgmgr** is run.

**Restrictions for the load\_balancing attribute:** The *load\_balancing* attribute should only be set to **yes** in single-host configurations.

**Setting the queue depth for hdisk devices:** Setting the *queue\_depth* attribute to the appropriate value is important for system performance. For large FASTT configurations with many volumes and hosts attached, this is a critical setting for high availability. If you set this attribute incorrectly, it could result in the loss of file systems and system panics.

Use the following formula to determine the maximum queue depth for your system:

$$1024 / (\text{number-of-hosts} * \text{LUNs-per-host} )$$

For example, a system with four hosts, each with 32 LUNs (the maximum number of LUNs per AIX host), would have a maximum queue depth of 8:

1024 / ( 4 \* 32 ) = 8

In this case, you would set the `queue_depth` attribute for `hdiskX` as follows:

```
# chdev -l hdiskX -a queue_depth=8 -P
```

**Attention:** If you do not set the queue depth to the proper level, you might experience loss of file systems and system panics.

## Verifying the installation and configuration of AIX hosts

After you have completed the procedures that are outlined in the previous sections, and before you mount your file systems and install your applications, use the following information to verify that all of your FASTT device names and paths are correct and that AIX recognizes your dars, dacs, and hdisks.

### Initial device identification

After the FASTT storage subsystem has been set up, volumes have been assigned to the host, and the RDAC driver has been installed, type the following command to probe for the new devices.

```
# cfgmgr -v
```

Next, use the **lsdev -Cc disk** command to see if the RDAC software recognizes the FASTT volumes as shown in the following list:

- Each FASTT600 volume is recognized as a “1722 (600) Disk Array Device”.
- Each FASTT700 volume is recognized as a “1742 (700) Disk Array Device”.
- Each FASTT900 volume is recognized as a “1742-900 Disk Array Device”.

The following example shows the results of the command for a set of FASTT900 LUNs.

```
# lsdev -Cc disk
hdisk0 Available 10-88-00-8,0 16 Bit LVD SCSI Disk Drive
hdisk32 Available 31-08-01 1742-900 Disk Array Device
hdisk33 Available 91-08-01 1742-900 Disk Array Device
hdisk34 Available 31-08-01 1742-900 Disk Array Device
hdisk35 Available 91-08-01 1742-900 Disk Array Device
```

## Identifying the controller ID numbers

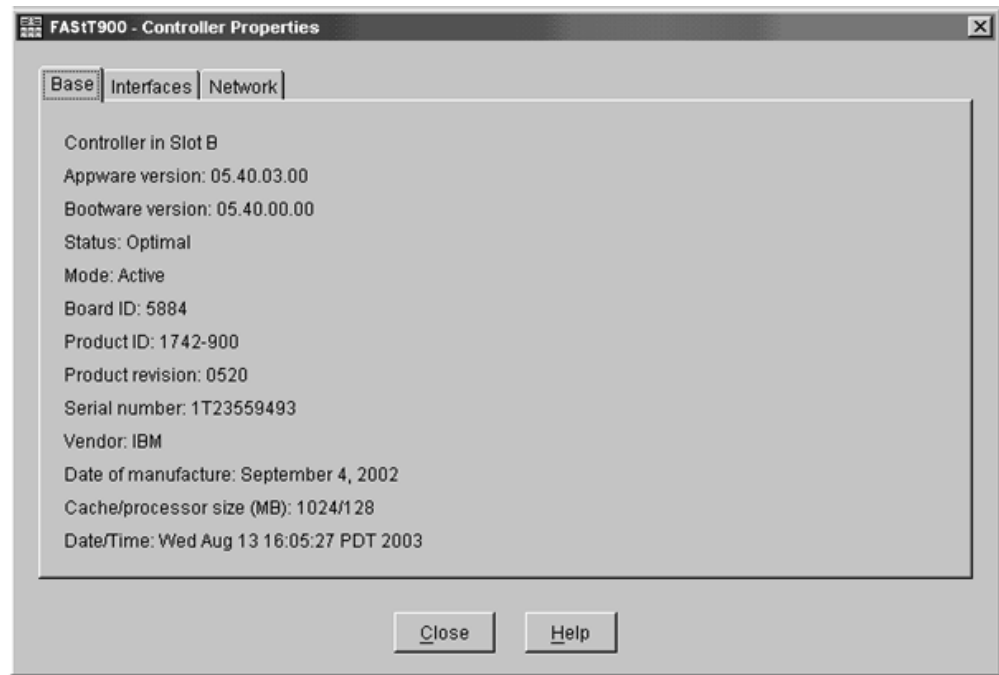
One of the attributes listed by the **lsattr -EI** command is the controller serial number (`controller_SN`) of that dac.

Perform the following step to display the FASTT Controller Properties window:

In the Logical/Physical view of the Subsystem Management window, right-click a controller and select **Properties**. The Controller Properties window opens.

Figure 7 on page 34 shows the Controller Properties window of the controller in slot A. This controller has a serial number of 1T23559493 and is represented by dac1.

```
# lsattr -El dac1
GLM_type          low          GLM type          False
alt_held_reset    no          Alternate held in reset  False
cache_size        1024        Cache Size in MBytes  False
controller_SN    1T23559493  Controller serial number  False
ctrl_type         1742-0900   Controller Type      False
location          Location Label      True
lun_id            0x0         Logical Unit Number   False
node_name         0x200400a0b80f434d  FC Node Name         False
passive_control   no          Passive controller    False
scsi_id           0x11a00    SCSI ID              False
utm_lun_id        none        Logical Unit Number   False
ww_name           0x200500a0b80f434e  World Wide Name      False
```



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Figure 7. Controller Properties window

## Identifying device names and bus numbers

After the operating system device names are found, those names must be correlated to the preferred and failover paths of the FAST device, and then from each path to its associated logical drive. As mentioned earlier in this chapter, the RDAC software uses `dars`, `dacs`, and `hdisks` to represent the FAST storage subsystem. `dars` represent the disk array routers; `dacs` represent the disk array controllers, and `hdisks` represent the logical drives, or FAST volumes.

AIX provides the following commands to help you determine the FAST configuration, and to get information about device names and bus numbers:

### lsdev

Displays devices and their characteristics. The `lsdev` command shows the state of the devices at startup time, or the last time that the `cfgmgr -v` command was run.

### lsattr

Displays device attributes and possible values. Attributes are only updated at startup time, or the last time that the **cfgmgr -v** command was run.

### fget\_config

Displays controllers and hdisks that are associated with a specified FAST (dar).

The **fget\_config** command shows the current state and volume (hdisk) ownership.

There are several ways to correlate a system's configuration and monitor the state of FAST storage subsystems. The use of commands in validating configurations is illustrated in Figure 8.

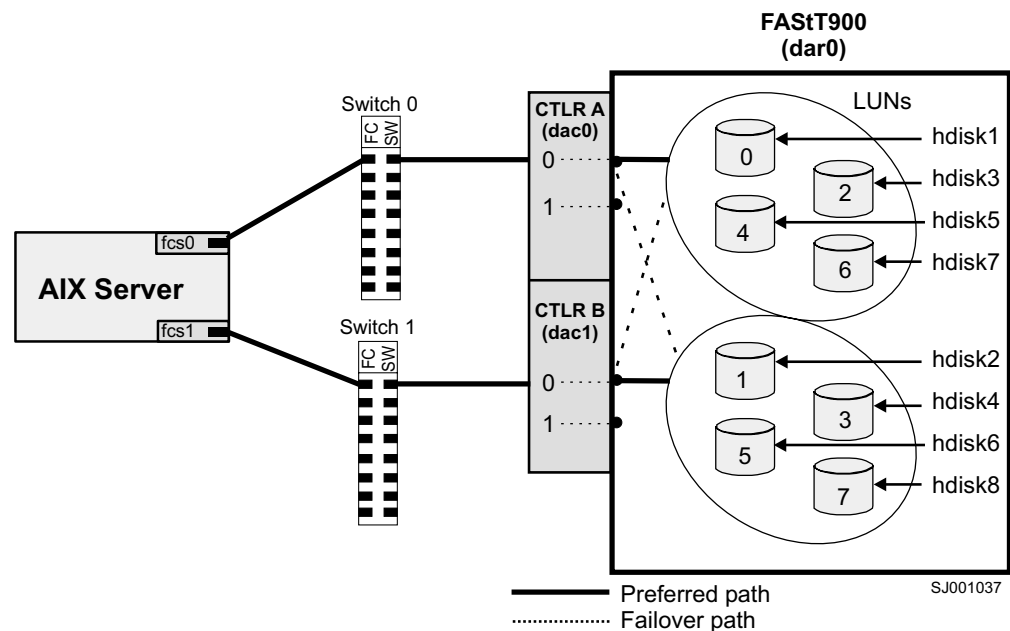


Figure 8. Use of commands applied to validating system configuration

### Using the lsdev command

The following example uses the **lsdev** command to show the status of the dar, which represents a FAST storage subsystem. This example shows dar as a machine type 1742, which is a FAST700. It is in the Available state, which is the state at the time when the device was last configured by AIX.

```
# lsdev -C |grep dar0
dar0      Available          1742      (700) Disk Array Router
```

The following example uses the **lsdev** command to show the status of two dacs, which represent the FAST storage subsystem controllers. As in the previous example, this shows a FAST700 in an Available state. The third column shows the location code. In this example, each dac has its own location or *path*, which are represented by the values 11-08-01 and 14-08-01. Each AIX system has its own set of location codes that describe the internal path of that device, including bus and host-adapter locations. See the service manual for your system type to identify device locations.

```
# lsdev -C |grep dac
dac0      Available 11-08-01    1742    (700) Disk Array Controller
dac1      Available 14-08-01    1742    (700) Disk Array Controller
```

The following example uses the **lsdev** command to show the status and location codes of eight FAStT700 hdisks. Notice that the location codes of the odd hdisks (1, 3, 5, 7) correspond to the same location code of dac0 in the previous example, and that the even hdisks (2, 4, 6, 8) correspond to the same location code of dac1. This means that the preferred paths for I/O for hdisk1, hdisk3, hdisk5, and hdisk7 is through dac0. The failover path would be through dac1. Conversely, the preferred path for the even-numbered hdisks would be through dac1, and failover path through dac0.

```
# lsdev -Cc |grep hdisk
hdisk0    Available 40-60-00-4,0 16 Bit LVD SCSI Disk Drive
hdisk1    Available 11-08-01    1742    (700) Disk Array Device
hdisk2    Available 14-08-01    1742    (700) Disk Array Device
hdisk3    Available 11-08-01    1742    (700) Disk Array Device
hdisk4    Available 14-08-01    1742    (700) Disk Array Device
hdisk5    Available 11-08-01    1742    (700) Disk Array Device
hdisk6    Available 14-08-01    1742    (700) Disk Array Device
hdisk7    Available 11-08-01    1742    (700) Disk Array Device
hdisk8    Available 14-08-01    1742    (700) Disk Array Device
```

You can determine the full preferred path from hdisk to fibre-channel fabric by searching for the first two numbers of the location code using the **grep** command, as shown in the following example.

```
# lsdev -C|grep 11-08
fcs0      Available 11-08            FC Adapter
fscsi0    Available 11-08-01        FC SCSI I/O Controller Protocol Device
dac0      Available 11-08-01        1742    (700) Disk Array Controller
hdisk1    Available 11-08-01        1742    (700) Disk Array Device
hdisk3    Available 11-08-01        1742    (700) Disk Array Device
hdisk5    Available 11-08-01        1742    (700) Disk Array Device
hdisk7    Available 11-08-01        1742    (700) Disk Array Device
hdisk8    Available 11-08-01        1742    (700) Disk Array Device
```

### Using the **fget\_config** command

The **fget\_config** command displays the state of each controller in a FAStT array, and the current path that is being used for I/O for each hdisk. The following example shows that both controllers (dac0 and dac1) are in the Active state. This is normal when the FAStT storage subsystem is configured correctly. Other possible states could be:

#### **NONE**

The controller is not defined or is offline.

#### **RESET**

The controller is in the reset state.

```
# fget_config -l dar0
dac0 ACTIVE dac1 ACTIVE
dac0-hdisk1
dac1-hdisk2
dac0-hdisk3
dac1-hdisk4
dac0-hdisk5
dac1-hdisk6
dac0-hdisk7
dac1-hdisk8
```

## Using the lsattr command

You can also use the **lsattr** command to find out which controller owns a particular hdisk. The following example shows portions of the outputs from several **lsattr** commands.

```
# lsattr -El dac0
GLM_type          low          GLM type          False
alt_held_reset    no           Alternate held in reset False
cache_size        1024        Cache Size in MBytes False
controller_SN     1T23559428  Controller serial number False
ctrl_type         1742-0900   Controller Type    False
location          location     Location Label    True
lun_id            0x0         Logical Unit Number False
node_name         0x200400a0b80f434d FC Node Name      False
passive_control   no           Passive controller False
scsi_id          0x11100    SCSI ID           False
utm_lun_id        none        Logical Unit Number False
ww_name           0x200400a0b80f434e World Wide Name   False

# lsattr -El dac1
GLM_type          low          GLM type          False
alt_held_reset    no           Alternate held in reset False
cache_size        1024        Cache Size in MBytes False
controller_SN     1T23559493  Controller serial number False
ctrl_type         1742-0900   Controller Type    False
location          location     Location Label    True
lun_id            0x0         Logical Unit Number False
node_name         0x200400a0b80f434d FC Node Name      False
passive_control   no           Passive controller False
scsi_id          0x11a00    SCSI ID           False
utm_lun_id        none        Logical Unit Number False
ww_name           0x200500a0b80f434e World Wide Name   False

# lsattr -El hdisk1
----- Parts removed:
scsi_id          0x11100    SCSI ID           False
size              4096        Size in Mbytes    False
write_cache       yes         Write Caching enabled False
```

In the example, hdisk1 belongs to the controller represented by dac0. The hdisk has the same SCSI ID as the controller (dac) that owns it.

## Identifying logical drives by operating system device names

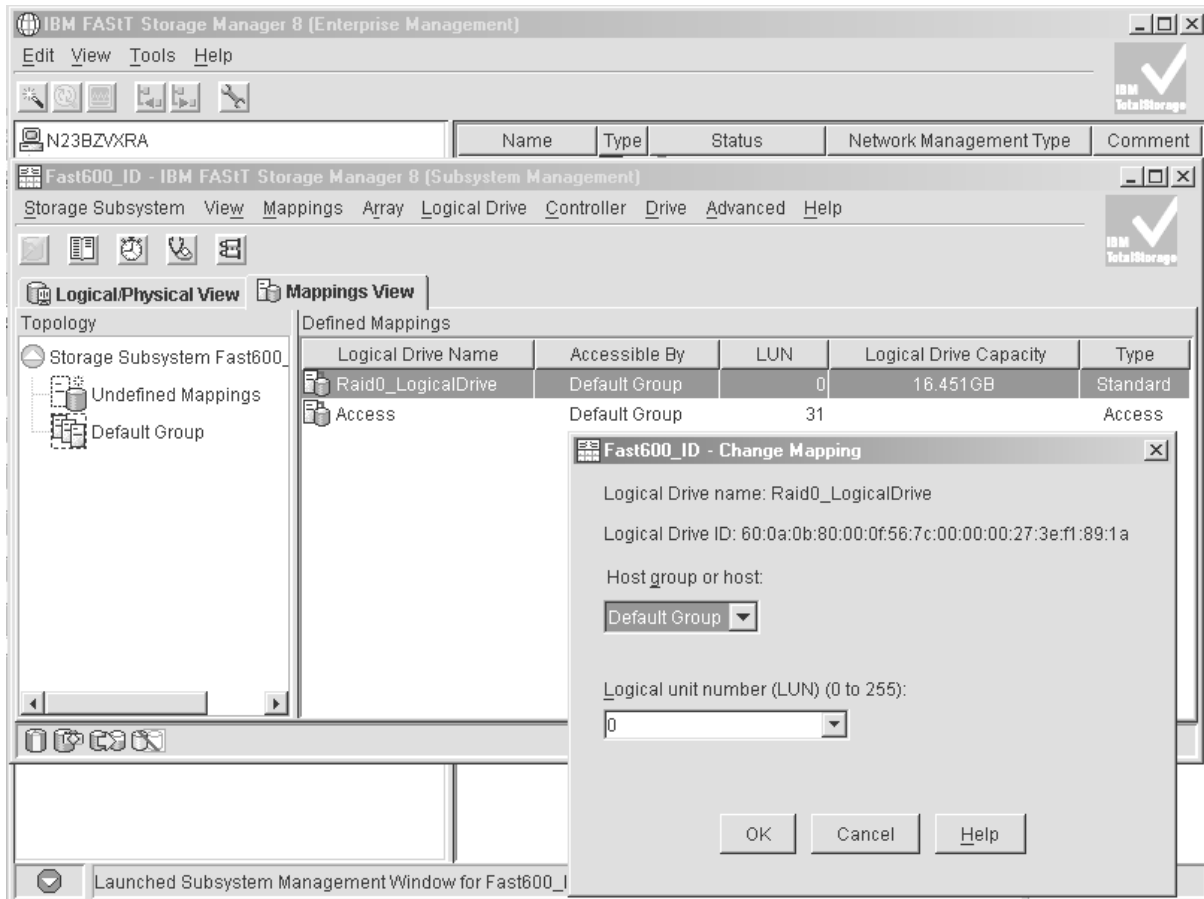
The **lsattr** command provides detailed information about a volume, including information that allows you to map the system device name to the logical volume on the FAsT storage subsystem.

For example, if you run the **lsattr** command on the LUN named `hdisk4`, it provides the following information: it is a 6 GB LUN of type RAID, with a LUN ID of 2, and an IEEE volume name of `600A0B80000C1E63000000033BB39927` (see the following example). You can make a quick identification by locating the LUN ID on the far right side of the **Mappings View** tab.

```
# lsattr -El hdisk4
pvid          none                Physical volume identifier      False
q_type        simple              Queuing Type                   False
queue_depth   30                   Queue Depth                    True
reserve_lock  yes                  RESERVE device on open        True
write_cache   yes                  Write Caching enabled          True
size         6062                Size in Mbytes                 False
raid_level  0                   RAID Level                     False
rw_timeout    30                   Read/Write Timeout value       True
reassign_to   120                  Reassign Timeout value         True
scsi_id       0x11000              SCSI ID                        False
lun_id      0x0002000000000000 Logical Unit Number            False
cache_method  fast_write           Write Caching method           True
prefetch_mult 0                     Multiple of blocks to prefetch on read True
ieee_volname 600A0B80000C1E63000000033BB39927 IEEE Unique volume name       False
```

You can make a more exact correlation using the distinctive *ieee\_volname* attribute. The value of this attribute on the AIX host is the same as the Unique Logical Drive Identifier on the FAS*St*T storage subsystem. The **ieee\_volname** and Unique Logical Drive Identifier can be found in the Change Mappings window, which is shown in Figure 9 on page 39. (Click the **Mappings view** tab. Select **Logical Drive Name**. Right click and select **Change Mappings**.)





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Figure 9. Change Mappings window

Another way to identify the system disk name based on the logical volume name is by using the Logical Drive Property window. Open this window by clicking the Storage Management window and right-clicking **Logical Drive Name** → **Properties**. Look for the **World-wide name**, **Capacity**, and **RAID level** properties.

The following example shows a portion of the output of the **lsattr** command for **hdisk20**. The **ieee\_volname** and **lun\_id** attributes have the same values as the **World-wide name** and **Subsystem ID (SSID)** properties that are displayed in the Logical Drive Property window, respectively.

```
# lsattr -El hdisk20
write_cache yes Write Caching enabled True
size 9216 Size in Mbytes False
raid_level 5 RAID Level False
scsi_id 0x210513 SCSI ID False
lun_id 0x0012000000000000 Logical Unit Number False
cache_method fast_write Write Caching method True
prefetch_mult 0 Multiple of blocks to prefetch on read True
ieee_volname 600A0B80000C1E63000000163BB39B7C IEEE Unique volume name False
```

## Identifying FlashCopy volume types

Perform the following steps to identify FlashCopy volume types:

1. Run the following command to list available volumes:

```
# lsdev -Cc disk
```

A list of available volumes appears, as shown in the following example:

```
[root@el1m17c171] / # lsdev -Cc disk |pg
hdisk0 Available 40-60-00-4,0 16 Bit LVD SCSI Disk Drive
hdisk1 Available 40-60-00-8,0 16 Bit LVD SCSI Disk Drive
hdisk2 Available 11-08-01 1742-900 (900) Disk Array Device
hdisk3 Available 11-08-01 1742-900 (900) Disk Array Device
hdisk4 Available 11-08-01 1742-900 (900) Disk Array Snapshot
```

The FlashCopy array is identified by the term **Disk Array Snapshot**.

2. Run the following command to display the state of each controller in a FASTT array:

```
# fget_config -Av
```

A list appears, as shown in the following example:

```
[root@el1m17c171] / # fget_config -Av
---dar0---
User array name = 'FASTT System 1'
dac0 ACTIVE dac1 ACTIVE
dac0-hdisk2 Raid-0-0B
dac1-hdisk3 Raid-0-1B
dac1-hdisk4 Raid-3-0A-1 Snapshot Volume
```

The FlashCopy volume is identified by the term **Snapshot Volume**.

For more information about the **lsdev** and **fget\_config** commands, see “Identifying device names and bus numbers” on page 34.

---

## Using fast I/O failure for fibre-channel devices

I/O failover occurs when a fibre-channel adapter driver detects a link failure on the fabric between the switch and the FASTT storage server. You can change the failover characteristics by setting the fscsi device attribute **fc\_err\_recov** to one of the following settings.

**fast\_fail** Enables fast I/O failure.

If the fibre-channel adapter driver detects a link loss between the switch and the FASTT, it waits a few seconds to allow the fabric to stabilize. If **fast\_fail** is specified, the adapter then begins failing all I/O at the adapter driver if it detects that the device is not on the fabric. Any new I/O or future retries of the failed I/O are failed immediately.

Fast I/O failure can be useful in multipath configurations. It can decrease the I/O fail times due to link loss between the storage device and the switch, and can allow faster failover to alternate paths.

**delayed\_fail** Default setting.

If **delayed\_fail** is specified, I/O failure proceeds as normal; retries are not immediately failed, and failover takes longer than it does if **fast\_fail** is specified.

In single-path configurations, especially configurations with a single path to a paging device, the **delayed\_fail** setting should be used.

**Example:** You can enable fast I/O failure by setting this attribute, as shown in the following example. Be sure to stop all I/O and put the fscsi device into a Defined state before you set the attribute.

```
chdev -l fscsi0 -a fc_err_recov=fast_fail
```

**Notes:**

1. The **fast\_fail** attribute only affects failover that occurs between the switch and the FASTT storage server. It does not affect failover that occurs between the host and the switch.
2. Set the **fast\_fail** attribute on each HBA that is configured to the FASTT storage server.
3. You can use fast I/O failure only in a SAN environment. You cannot use it in a direct-attach environment.

---

## Using dynamic tracking of fibre-channel devices

AIX supports dynamic tracking of fibre-channel devices, which allows the dynamic movement of a fibre-channel path between the fabric switch and the FASTT subsystem by suspending I/O for 15 seconds while the move occurs.

You can enable or disable dynamic tracking by setting the fscsi device attribute **dyntrk** to one of the following settings:

**yes** Enables dynamic tracking.

If dynamic tracking is enabled, the fibre-channel adapter detects when the fibre-channel node port ID of a device changes. It reroutes the traffic that is destined for that device to the new WWPN while the devices are still online.

For example, you can move a cable from one switch port to another while the devices are still online, and no failover occurs if you complete the move within 15 seconds. After 15 seconds, failover occurs.

**Note:** The ports must be in the same zone on the same switch.

**no** Default setting.

If dynamic tracking is not enabled, you must take the devices offline before you move a cable from one port to another. Otherwise, failover occurs.

**Example:** You can enable dynamic tracking by setting this attribute, as shown in the following example. Be sure to stop all I/O and put the fscsi device into a Defined state before you set the attribute.

```
chdev -l fscsi0 -a dyntrk=yes
```

**Notes:**

1. Set the **dyntrk** attribute on each HBA that is configured to the FASTT storage server.
2. You can use dynamic tracking only in a SAN environment. You cannot use it in a direct-attach environment.

---

## Using dynamic capacity expansion and dynamic volume expansion

Dynamic Volume Expansion (DVE) is dynamic on the FAS*t*T, but it requires manual intervention for AIX to recognize the new volume capacity. This section explains how to use DVE with AIX.

DVE is only supported on AIX 5.2.

**Before you begin:** Ensure that there is available free capacity within the array. You can check free capacity availability using the SMclient, in the Logical/Physical view. If there is not enough free capacity, and extra drives are available, perform a Dynamic Capacity Expansion (DCE) operation before you perform the DVE operation. A DCE operation increases the capacity of the array by adding physical disks.

### Performing a dynamic capacity expansion operation

Complete the following steps to perform a DCE:

1. From the Logical/Physical view of the SMclient, right-click **Array** → **Add Free Capacity (Drives)**.
2. From the Logical/Physical view of the SMclient, right-click **Logical Drive** → **Increase Capacity**.
3. Type the amount that you want to increase the logical volume.

You will see an hourglass on every logical drive within the array. You must wait for the process to complete before you can begin any AIX intervention.

**Note:** If the FAS*t*T is busy, the process might take several hours to complete.

After you have ensured that there is sufficient free capacity within the array, you can perform DVE.

**Note:** You must either reboot the system or run the **cfgmgr** command before you can view the additional capacity using the ODM attribute.

### Performing a dynamic volume expansion operation

Complete the following steps to perform a DVE on the AIX host. See the man page for the **chvg** command for more information about expanding Logical Volume Manager (LVM) volumes.

1. Unmount the filesystems from the LVM volume group that has been expanded, using the following command:

```
umount mount_point
```

where *mount\_point* is the name of the filesystem that is being unmounted.

2. Change the volume group using the following command:

```
chvg -g volume_group_name
```

where the *volume\_group\_name* is the name of the associated LVM volume group.

**Note:** If you see a warning that the volume group cannot be imported to AIX 5.1 or lower, ignore the warning. It is an error.

3. Mount the file systems.

**Notes:**

1. You might have to run the **varyoffvg** command, and then the **varyonvg** command, on the volume group for LVM to see the size change on the disk. However, the new capacity is available for use by the operating system.
2. You cannot resize while the volume group is activated in classic or enhanced concurrent mode.
3. Resizing of the root volume group is not supported.

---

## Resolving disk array errors

This section shows a list of possible disk array errors that could be reported in the AIX error log. You can view the AIX error log by running the **errpt -a** command.

You can also check your Storage Manager Major Event log (MEL) to find out whether there is any correlation between the host, SAN, and FASTT storage subsystem.

You might need to validate your configuration or replace defective hardware to correct the situation.

- **FCP\_ARRAY\_ERR1 ARRAY OPERATION ERROR**  
A permanent hardware error involving the disk array media.
- **FCP\_ARRAY\_ERR2 ARRAY OPERATION ERROR**  
A permanent hardware error.
- **FCP\_ARRAY\_ERR3 ARRAY OPERATION ERROR**  
A permanent error detected by the array adapter.
- **FCP\_ARRAY\_ERR4 ARRAY OPERATION ERROR**  
A temporary error within the array, communications, adapter, and so on.
- **FCP\_ARRAY\_ERR5 UNDETERMINED ERROR**  
An undetermined error has occurred.
- **FCP\_ARRAY\_ERR6 SUBSYSTEM COMPONENT FAILURE**  
A degradation condition has occurred other than a disk drive.
- **FCP\_ARRAY\_ERR7 CONTROLLER HEALTH CHECK FAILURE**  
A health check on the passive controller has failed.
- **FCP\_ARRAY\_ERR8 ARRAY CONTROLLER SWITCH**  
One array controller has become unavailable, so I/O has moved to the other controller.
- **FCP\_ARRAY\_ERR9 ARRAY CONTROLLER SWITCH FAILURE**  
An array controller switch has failed.
- **FCP\_ARRAY\_ERR10 ARRAY CONFIGURATION CHANGED**  
A logical unit has been moved from one controller to the other (most likely by the action of an alternate host).
- **FCP\_ARRAY\_ERR11 IMPROPER DRIVE TYPE FOR DUAL ACTIVE MODE**  
This error should not be possible on the 2102 array, and exists for history reasons only. FCP\_ARRAY\_ERR11 might be reused for a different error in the future.
- **FCP\_ARRAY\_ERR12 POLLED AEN FAILURE**  
An automatic error notification has failed.
- **FCP\_ARRAY\_ERR13 ARRAY INTER-CONTROLLER COMMUNICATION FAILURE**

The controllers are unable to communicate with each other. This could result from one of the controllers being rebooted while the error log was being generated. However, it could be a much more serious error that indicates a problem with the fibre-channel connections.

- **FCP\_ARRAY\_ERR14** *ARRAY DRIVE FAILURE*  
A serious or unrecoverable error has been detected on a physical disk within the FAStT subsystem. A system engineer might be able to obtain the exact cause from an analysis of the sense data.
- **FCP\_ARRAY\_ERR15** *CACHE BATTERY LOW/DATA LOSS POSSIBLE*  
If a controller card is replaced, it is likely that the cache batteries will be flat. It can take two days for the cache batteries to be fully recharged. During this time errors are logged in the error log. Do not replace the controller.
- **FCP\_ARRAY\_ERR16** *CACHE BATTERY CHARGE BELOW 87.5%*  
If a controller card is replaced, it is likely that the cache batteries will be flat. It can take two days for the cache batteries to be fully recharged. During this time errors are logged in the error log. Do not replace the controller.
- **FCP\_ARRAY\_ERR17** *WORLDWIDE NAME CHANGED*  
A controller has changed worldwide names (most likely either it was replaced without placing it in the reset state first, or the cabling was changed so that a different controller with the same SCSI ID is on the loop).
- **FCP\_ARRAY\_ERR18** *RESERVATION CONFLICT*  
An operation failed because the disk array volume (LUN) is reserved by another host.
- **FCP\_ARRAY\_ERR19** *SNAPSHOT VOLUME'S REPOSITORY FULL*  
The repository capacity limit has been reached. To resolve this error you can increase the repository capacity.
- **FCP\_ARRAY\_ERR20** *SNAPSHOT OPERATION STOPPED BY ADMIN*  
The FlashCopy (snapshot) operation has been disabled or stopped. To resolve this error you can recreate the FlashCopy.
- **FCP\_ARRAY\_ERR21** *SNAPSHOT REPOSITORY METADATA ERROR*  
There was a problem with the FlashCopy (snapshot) repository's metadata during the FlashCopy operation. To resolve this error you can recreate the FlashCopy.
- **FCP\_ARRAY\_ERR22** *REMOTE VOL MIRRORING: ILLEGAL I/O ORIGIN*  
The primary volume received I/O from a remote array, or the secondary volume received I/O from other than the primary volume. To resolve this error you can try the operation again.
- **FCP\_ARRAY\_ERR23** *SNAPSHOT OPERATION NOT ALLOWED*  
The repository capacity limit has been reached, so the FlashCopy (snapshot) operation has failed. To resolve this error you can delete or recreate the FlashCopy.
- **FCP\_ARRAY\_ERR24** *SNAPSHOT VOLUME'S REPOSITORY FULL*  
The repository capacity limit has been reached. To resolve this error you can delete or recreate the FlashCopy (snapshot).
- **FCP\_ARRAY\_ERR25** *CACHED DATA WILL BE LOST IF CONTROLLER FAILS*  
This message is a warning that a disk array volume (LUN) is running with write cache enabled and cache mirroring disabled. The warning displays when the LUN is opened, and it displays again every 24 hours until cache mirroring is enabled again.

If a controller failure or a power down occurs while the LUN is running in this mode, data that is in the write cache (but not written to the physical disk media) might be lost. This can result in corrupted files, file systems, or databases.

---

## Redistributing volumes in case of failure

If a failure occurs that initiates a controller failover, complete the following steps to redistribute logical drives to their preferred paths:

1. Repair or replace any faulty components. For more information, see the *IBM TotalStorage FAS*St*T Installation and Support Guide* for the appropriate IBM FAS*St*T Fibre Channel Storage Server.
2. Redistribute volumes to their preferred paths by clicking **Subsystem Management** → **Storage Subsystem** → **Redistribute Logical Drive**.
3. Run the **fget\_config** command to verify the active paths, as shown in this example:

```
# fget_config -l dar0
dac0 ACTIVE dac1 ACTIVE
dac0-hdisk1
dac0-hdisk2
dac0-hdisk3
dac1-hdisk4
dac1-hdisk5
dac1-hdisk6
dac1-hdisk7
dac0-hdisk8
```





---

## Chapter 3. Installing storage management station software on HP-UX systems

This chapter provides the following information for HP-UX operating systems:

- “Hardware and firmware requirements”
- “Installing the client software” on page 48
- “Installing the host software” on page 50
- “Configuring storage subsystems on HP-UX hosts” on page 52
- “Creating direct-attached and SAN-attached configurations” on page 55
- “Enabling multipath I/O with PV-links” on page 56
- “Redistributing volumes in case of failure” on page 61

**Attention:** For cluster configurations, complete all applicable configuration procedures for each storage subsystem *before* installing the Storage Manager 8.4 software on a second host or cluster server.

---

### Hardware and firmware requirements

For system-level hardware requirements, software requirements, and patch levels, see Appendix B, “HP-UX system requirements,” on page 103.

**Attention:** Be sure to install the following patches on your HP-UX operating system:

- **HP-UX 11.0:** PHKL\_27003, version 1.0
- **HP-UX 11.i:** PHKL\_26519, version 1.0

Table 9 lists the FAS*St* storage servers that are supported with Storage Manager 8.4.

*Table 9. FAS*St* storage servers that are supported on HP-UX systems*

Product Name	Model	Product release and firmware version
IBM TotalStorage FAS <i>St</i> T900 Fibre Channel Storage Server	1742-90U	Appware 5.40.03.00 NVSRAM N1742F900R840V00
IBM TotalStorage FAS <i>St</i> T700 Fibre Channel Storage Server	1742-1RU	Appware 5.40.03.00 NVSRAM N1742F700R840V00
IBM TotalStorage FAS <i>St</i> T600 Fibre Channel Storage Server	1722-60U, 1722-60X	Snapware 5.40.03.02 NVSRAM N1722F600R840V02

Table 10 lists the supported versions of hardware to use with Storage Manager 8.4.

*Table 10. Supported versions of hardware for HP-UX systems*

Product Name	Model	Product release and firmware version
IBM TotalStorage FAS <i>St</i> T700 EXP700 Storage Expansion Unit	1740-1RU	ESM 9324
IBM TotalStorage FAS <i>St</i> T500 EXP500 Storage Expansion Unit	3560-1RU	ESM 9166
HP FC Adapter	A5158A	B.11.00.06
HP FC Adapter 2Gb	A6795A	B.11.00.01

Table 10. Supported versions of hardware for HP-UX systems (continued)

Product Name	Model	Product release and firmware version
Brocade switch	2109-S08 2109-S16	2.6.0j
Brocade switch	2109-F16	3.0.2.9
Brocade switch	2109-M12, 2109-F32	4.0.2b
Brocade switch	2109-F08	3.0.2.K
McData switch	2032-064, 2032-140	4.01.00
McData switch	2031-016	4.01.00
McData switch	2031-216, 2031-224	4.01.00
InRange switch	2042-001	4.1.06
Cisco switch	2062-D01, 2062-D07, 2062-T07	1.1

**Note:** Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. To ensure that you have the latest versions of the firmware and the NVSRAM, read the readme file that is shipped with the product. You can also find the latest readme file at the following Web site:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FAStT Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FAStT Storage Manager for HP-UX.

## Installing the client software

Use the procedures in this section to install the client software on an HP-UX storage management station or on an HP-UX host acting as a storage management station. Install the software in the following order:

1. SMruntime
2. SMclient

**Note:** SMclient is dependent on SMruntime, which is a Java compiler for the SMclient and must be installed first. If you do not install SMruntime you will receive errors during the software install analysis phase.

## Prerequisites

Before installing the client software, ensure that the following conditions are met:

- This is the HP 9000-series server that you identified as the storage management station.
- This machine meets the minimum hardware and software requirements described in Appendix B, "HP-UX system requirements," on page 103.
- Neither SMruntime nor SMclient is installed on the host and you are ready to install them on this machine.

## Installing SMruntime

In the following procedure, the installation CD is mounted at /cdrom. Adjust these instructions as required for your specific installation. No restart is required during the SMruntime installation process.

1. Insert the HP-UX installation CD in the CD-ROM drive.
2. Start the installation process by typing the following command:

```
# mount -o cdfcase -F cdfs /device_pathname /cdrom
# swinstall -s /cdrom/HP-UX/HPruntime_0804500
```

The Software Selection window opens and displays this message:

```
SMruntime
```

3. Select **SMruntime**.
4. Click **Actions** → **Mark for installation**.
5. Click **Actions** → **Install (Analysis)**.
6. Click **OK** when the analysis is finished.
7. In the confirmation window, click **Yes** to start the installation.
8. When the application is finished, click **Done** in the Installation window and close the application.

**Note:** You must exit the **swinstall** command before running the **swverify** command to verify the installation.

9. Verify that the installation was successful by typing the following command:

```
# swverify -v SMruntime
```

If no failure is reported, go to step 10. If a failure is reported, follow the instructions in the /var/adm/sw/swagent.log file.

10. You have completed the SMruntime installation of this HP-UX storage management station.

## Installing the SMclient

In the following procedure, the installation CD is mounted at /cdrom. Adjust these instructions as required for your specific installation. No restart is required during the SMclient installation process.

1. Start the installation process by typing the following command:

```
# swinstall -s /cdrom/HP-UX/SMclient-HP-081G500
```

The Software Selection window opens and displays the following message:

```
SMclient
```

2. Select **SMclient**.
3. Click **Actions** → **Mark for installation**.
4. Click **Actions** → **Install (Analysis)**
5. Click **OK** when the analysis is finished.
6. In the Confirmation window, click **Yes** to start the installation.

7. When the application is finished, click **Done** in the Installation window and close the application.

**Note:** You must exit the **swinstall** command before running the **swverify** command to verify installation.

8. Verify that the installation was successful by typing the following command:

```
# swverify -v SMclient
```

If no failure is reported, go to step 9. If a failure is reported, follow the instructions in the `/var/adm/sw/swutil.log` file.

9. You have completed the SMclient installation of this HP-UX storage management station.

**Note:** To ensure redundancy in a cluster environment, you must install SMclient on at least one additional storage management station or cluster server.

---

## Installing the host software

Use the procedures in this section to install the host software on an HP-UX storage management station or on an HP-UX host acting as a storage management station. Install the software in the following order:

1. SMagent (optional — for in-band management only)
2. SMutil (required)

**Note:** SMagent and SMutil are dependent on SMruntime, which is a Java compiler for the storage manager software and must be installed first. If you do not install SMruntime you will receive errors during the software install analysis phase.

## Prerequisites

Before installing the host software, ensure that the following conditions are met:

- This is the HP 9000-series server that you identified as the storage management station.
- This machine meets the minimum hardware and software requirements described in Appendix B, “HP-UX system requirements,” on page 103.
- SMruntime has been installed.

## Installing the SMagent (optional)

SMagent is required for in-band management only. It is not required for out-of-band management.

In the following procedure, the installation CD is mounted at `/cdrom`. Adjust these instructions as required for your specific installation. No restart is required during the SMagent installation process.

1. Start the installation process by typing the following command:

```
# swinstall -s /cdrom/HP-UX/SMagent-HP-08204500
```

The Software Selection window opens and displays this message:

```
SMagent
```

2. Select **SMagent**.
3. From the toolbar, click **Actions** → **Mark for installation**.
4. Click **Actions** → **Install (analysis)**.
5. Click **OK** when the analysis is finished.
6. In the Confirmation window, click **Yes** to start the installation.
7. When the installation is finished, click **Done** in the Installation window and close the application.

**Note:** You must exit the **swinstall** command before running the **swverify** command to verify the installation.

8. Verify that the installation was successful by typing the following command:

```
# swverify -v SMagent
```

If no failure is reported, go to step 9. If a failure is reported, follow the instructions in the `/var/adm/sw/swagent.log` file.

9. You have completed SMagent installation on this HP-UX storage management station.

## Installing SMutil (required)

In the following procedure, the installation CD is mounted at `/cdrom`. Adjust these instructions as required for your specific installation. No restart is required during the SMutil installation process.

1. Start the installation process by typing the following command:

```
# swinstall -s /cdrom/HP-UX/SMutil_08204500
```

The Software Selection window opens and displays this message:

```
SMutil
```

2. Select **SMutils**.
3. Click **Actions** → **Mark for Installation**.
4. Click **Actions** → **Install (Analysis)**.
5. Click **OK** when the analysis is finished.
6. In the Confirmation window, click **Yes** to start the installation.
7. When the application is finished, click **Done** in the Installation window and close the application.

**Note:** You must exit the **swinstall** command before running the **swverify** command to verify the installation.

8. Verify that the installation was successful by typing the following command:

```
# swverify -v SMutil
```

If no failure is reported, go to step 9. If a failure is reported, follow the instructions in the `/var/adm/sw/swutil.log` file.

9. You have completed the SMutil installation of this HP-UX storage management station.

---

## Configuring storage subsystems on HP-UX hosts

After you install the Storage Manager 8.4 software you need to configure the subsystem. System configuration includes configuring logical drives and creating storage arrays through the Subsystem Management window of the SMclient application.

See “Configuring storage subsystems” on page 95 for additional information about storage configuration.

**Before you begin:** Read the following information:

- All FASTt storage servers have an access volume set to LUN 31.

**Note:** Do not delete the access LUN or the access volume.

- AVT/ADT is enabled by default; leave it in that state for HP-UX hosts.
- Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. To ensure that you have the latest versions of the firmware and the NVSRAM, read the readme file that is shipped with the product. You can also find the latest readme file at the following Web site:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FASTt Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FASTt Storage Manager for HP-UX.

**Note:** If you do not have the latest versions of firmware and NVSRAM, download them and complete the procedure described in “Upgrading FASTt firmware and NVSRAM” on page 53. If the version numbers are current, you can skip that procedure.

- If you have purchased a Storage Partitioning premium feature, ensure that the feature is enabled. See “Enabling your premium features” on page 4 for more information.

Complete the following procedures to configure Storage Manager 8.4 for an HP-UX system.

## Adding storage subsystems to SMclient

Complete the following steps to add storage subsystems to SMclient:

1. To set up the storage subsystem for HP-UX, the subsystem must be physically configured, at least initially, for direct management through the Ethernet connections on each controller as well as through the fibre-channel connection. Install the Storage Manager 8.4 software (SMruntime, SMclient, SMagent, and SMutil) before configuring the subsystem.
2. After the disk subsystem is configured on the network, type the following command to run SMclient on either the host server, if it is on the same network as the storage subsystem, or on another machine in the network that has the Storage Manager 8.4 software installed:

```
# SMclient
```

3. Complete the following steps to specify the IP addresses of the controllers:

- a. In the Enterprise Management window, click **Edit** → **Add Device**.
- b. In the Add Device window, type the IP address of the first controller in the storage subsystem and click **Add**.
- c. Type the IP address of the second controller and click **Add**, and then click **Close**.

**Note:** Failure to add both controllers results in a partially-managed system.

4. In the Subsystem Management window, click **Storage Subsystem** → **Profile** and review the summary portion of the output.

## Upgrading FAST firmware and NVSRAM

**Before you begin:** Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. To ensure that you have the latest versions of the firmware and the NVSRAM, read the readme file that is shipped with the product. You can also find the latest readme file at the following Web site:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FAST Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FAST Storage Manager for HP-UX.

If you do not have the latest versions of the firmware and NVSRAM, click the **Back** button on your browser to return to the previous Web page. You can download the correct versions by clicking the appropriate link that is listed in the IBM FAST Controller Firmware matrix.

Complete the following steps to upgrade the NVSRAM:

1. Rescan the storage subsystem, and then click **Manage the Device** to return to the Subsystem Management window.
2. Click **Storage Subsystem** → **Download** → **NVSRAM**.
3. In the NVSRAM window, go to the directory where the latest NVSRAM file resides.
4. Type or select the full path name of the NVSRAM file, and then click **Update** → **OK**.

If required, the host restart process starts after the storage subsystem has been turned off.

Complete the following steps to upgrade the firmware:

1. Click **Storage Subsystem** → **Download** → **Firmware**.
2. Go to the directory where the firmware resides.
3. Type or select the full path name of the firmware file, and then click **Update** → **OK**.

The firmware is downloaded to the controllers. When the download is finished, the storage subsystem becomes unresponsive and you are returned to the Enterprise Management window.

Type the following command to restart the host:

```
# reboot
```

## Setting up an HP-UX host group

Complete the following steps to create an HP-UX host group.

### Notes:

1. Create the HP-UX host group at the storage subsystem level. Do not create host groups at the default group level.
2. In a cluster partition, perform logical drive mappings on the host group level so that all the hosts can see the same storage. In a normal partition, perform logical drive mappings on the host level.

Before you create an HP-UX host group, identify the worldwide port name for each of your HBAs. Look for the worldwide port name for the HBA and write down the number for future reference. Use the following command to find your HBAs listed in the dev directory as td0, td1, and so on, where X in the following example represents the td number.

```
#cd /dev/td
#tdutil /dev/tdX
```

1. Click the **Mappings View** tab on the Subsystem Management window.
2. In the Mappings window, create a new host group by clicking **Mappings** → **Define** → **Host Group**.
3. Type the name of the new host group (for example, HP-UX). Click **Add**, and then click **Close**.
4. Select the new host group and click **Mappings** → **Define** → **Host**.
5. Define the new host. Type the name of the HP-UX host to which the storage subsystem is attached.
  - a. Click **Add**, and then click **Close**.
  - b. Select the host that you just added and right-click **Define New Host Port**.

**Note:** You might be required to restart the host if you cannot see the WWPN for your HBAs. Restarting causes the system to log into the switch. If the restart does not work, manually enter the WWPNs when prompted.

- c. Select the desired host port for the first HBA, and then change the host type to **HP-UX** and click **Add**.

**Note:** Failure to change the host type from the default to HP-UX causes undesired results. Also, if you use two HBAs you must define two host ports. Failure to do so causes undesired results.

- d. Choose the host port for the second HBA and click **Add**, and then click **Close**.

## Mapping LUNs to a FAS*St*T storage partition

Complete the following steps to map LUNs to a storage partition:

1. Select the Mappings View of the Subsystem Management window.
2. In the topology tree, right-click the host partition on which you want to map LUNs, and select **Define Additional Mappings**. The Define Additional Mappings window opens.



3. In the Define Additional Mappings window, select the following options, and then click **Add**:
  - Host group or host
  - Logical unit number (LUN)
  - The logical drive you want to map

Repeat these steps for each LUN that you want to map to the partition.

---

## Creating direct-attached and SAN-attached configurations

Storage Manager 8.4 supports IBM FAStT Fibre Channel Storage Servers in direct-attached HP-UX configurations or in a SAN environment through switches in HP-UX configurations.

### Creating a direct-attached configuration

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

- One or two HP-UX servers can be connected to FAStT storage servers.
- Two server FAStT700 or FAStT900 configurations require four host-side minihubs, each with exactly one fibre-channel connection from each HBA to a minihub.

**Note:** FAStT600 storage servers do not have minihubs.

- There are two or four HBAs (HP A6795A or HP A5158A) per FAStT storage server. Each pair must be configured to one FAStT partition.
- No external hubs are being used.

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

1. Connect the HBAs to each controller or minihub port of the FAStT storage server.
2. Configure and verify the configuration.

### Creating a SAN-attached configuration

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

- Multiple fibre-channel HBAs within the same server cannot “see” the same FAStT controller port.
- The IBM fibre-channel HBAs are isolated from each other if they are connected to the same switch that is connected to the same FAStT controller port.
- Each fibre-channel HBA and controller port must be in its own fabric zone, if they are connecting through a single fibre-channel switch, such as a 2109-F16.

See the documentation that is provided by the switch manufacturer for more information about zoning. Multiple FAStT devices can be configured to the same set of fibre-channel HBAs through a fibre-channel switch.

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

1. Connect the HBAs to the switch or switches.
2. Connect the FAStT storage subsystems to the switch or switches.
3. Set the required zones on the fibre-channel switch or switches, if applicable.

**Note:** For information about zoning and enabling zones, see the documentation that is provided by the switch manufacturer.

4. Configure and verify the configuration.

---

## Enabling multipath I/O with PV-links

If the HP-UX system is attached with two host bus adapters to the FAStT storage server, you can establish redundant access to storage by using physical volume links (PV-links), a feature of the HP-UX operating system. PV-links achieve access redundancy by using devices with both primary and secondary paths to the same device.

### Important:

- There are two methods for establishing redundant access to storage using PV-links:
  - If you have firmware 5.xx.xx.xx installed, use method 1.
  - If you have firmware 4.xx.xx.xx installed, use method 2.
- For both methods, you must have SMutil installed on the host.

## Using PV-links: Method 1

If you have firmware 5.xx.xx.xx installed, use the following procedure to enable multipath I/O by using PV-links:

1. Run the **hot\_add** command from HP-UX at the shell prompt. This command updates any new devices that are created or added. A dump is generated. When the **hot\_add** command runs, each new logical drive that is created in the Subsystem Management window represents a disk device to the operating system.

```
#hot_add
```

2. Run the **SMdevices** command. The system provides a dump similar to the example in Figure 10 on page 57. Notice that every logical drive and logical drive access unit has been assigned a logical unit number (LUN). Each logical drive has two paths. Each RAID controller has one logical drive access. For example, a subsystem that contains two RAID controllers has two logical drive accesses.

```
#SMdevices
```

```

/dev/rds/c166t0d0 [Storage Subsystem FASSt, Logical Drive Accounting, LUN 0,
Logical Drive WWN <600a0b80000f56d0000001e3eaead2b>,
Preferred Path (Controller-B): In Use]
/dev/rds/c166t0d1 [Storage Subsystem FASSt, Logical Drive HR, LUN 1,
Logical Drive WWN <600a0b80000f5d6c000000273eaeae30>,
Alternate Path (Controller-B): Not In Use]
/dev/rds/c166t0d2 [Storage Subsystem FASSt, Logical Drive Finance,
LUN 2, Logical Drive WWN <600a0b80000f5d6c000000253eaeadf8>,
Alternate Path (Controller-B): Not In Use]
/dev/rds/c166t0d3 [Storage Subsystem FASSt, Logical Drive Purchasing,
LUN 3, Logical Drive WWN <600a0b80000f5d6c000000243eaeadbe>,
Alternate Path (Controller-B): Not In Use]
/dev/rds/c166t0d4 [Storage Subsystem FASSt, Logical Drive Development,
LUN 4, Logical Drive WWN <600a0b80000f56d0000001d3eaeacef>,
Preferred Path (Controller-B): In Use]
/dev/rds/c166t3d7 [Storage Subsystem FASSt, Logical Drive Access, LUN 31,
Logical Drive WWN <600a0b80000f56d0000001b0000000>]

/dev/rds/c172t0d0 [Storage Subsystem FASSt, Logical Drive Accounting, LUN 0,
Logical Drive WWN <600a0b80000f56d0000001e3eaead2b>,
Alternate Path (Controller-A): Not In Use]
/dev/rds/c172t0d1 [Storage Subsystem FASSt, logical Drive HR, LUN 1,
Logical Drive WWN <600a0b80000f5d6c000000273eaeae30>,
Preferred Path (Controller-A): In Use]
/dev/rds/c172t0d2 [Storage Subsystem FASSt, Logical Drive Finance, LUN 2,
Logical Drive WWN <600a0b80000f5d6c000000253eaeadf8>,
Preferred Path (Controller-A): In Use]
/dev/rds/c172t0d3 [Storage Subsystem FASSt, Logical Drive Purchasing, LUN 3,
Logical Drive WWN <600a0b80000f5d6c000000243eaeadbe>,
Preferred Path (Controller-A): In Use]
/dev/rds/c172t0d4 [Storage Subsystem FASSt, Logical Drive Development, LUN 4,
Logical Drive WWN <600a0b80000f56d0000001d3eaeacef>,
Alternate Path (Controller-A): Not In Use]
/dev/rds/c172t3d7 [Storage Subsystem FASSt, Logical Drive Access, LUN 31,
Logical Drive WWN <600a0b80000f5d6c000000220000000>]

```

Figure 10. Sample **SMdevices** command output (method 1)

**Note:** If you do not see the logical drives and logical drive accesses after running the **hot\_add** and **SMdevices** commands, restart the HP-UX host by running the **reboot** command.

```
#reboot
```

- Determine the preferred and alternate path for each logical drive by examining the output from the **SMdevices** command, as shown in the example in Figure 10. Notice that each device is listed twice; one instance is the preferred path and one instance is the alternate path.

#### Preferred path

In the sample output that is shown in Figure 10, the preferred path is **/dev/rds/c166t0d0**:

```

/dev/rds/c166t0d0 [Storage Subsystem FASSt, Logical Drive
Accounting, LUN 0, Logical Drive WWN <600a0b80000f56d0000001e3eaead2b>,
Preferred Path (Controller-B): In Use]

```

#### Alternate path

In the sample output that is shown in Figure 10, the alternate path is **/dev/rds/c172t0d0**:

```
/dev/rdisk/c172t0d0 [Storage Subsystem FAStT, Logical Drive Accounting, LUN 0, Logical Drive WNN <600a0b80000f56d00000001e3eaead2b>, Alternate Path (Controller-A): NotIn Use]
```

## Using PV-links: Method 2

If you have firmware 4.xx.xx.xx installed, use the following procedures to enable multipath I/O by using PV-links:

- Determine the preferred and alternate paths
- Create the volumes and volume groups

### Determining preferred and alternate paths

Complete the following steps to determine the preferred and alternate paths.

1. Run the **hot\_add** command from HP-UX at the shell prompt. This command updates any new devices that are created or added. A dump is generated. When the **hot\_add** command runs, each new logical drive that is created in the Subsystem Management window represents a disk device to the operating system.

```
#hot_add
```

2. Run the **SMdevices** command. The system provides a dump similar to the example in Figure 11. Notice that every logical drive and logical drive access unit has been assigned a logical unit number (LUN). Each logical drive has two paths. Each RAID controller has one logical drive access. For example, a subsystem that contains two RAID controllers has two logical drive accesses.

```
#SMdevices
```

```
/dev/rdsk/c166t0d0 [Storage Subsystem FAStT, Logical Drive Accounting, LUN 0, Logical Drive WNN <600a0b80000f56d00000001e3eaead2b>]
/dev/rdsk/c166t0d1 [Storage Subsystem FAStT, Logical Drive HR, LUN 1, Logical Drive WNN <600a0b80000f5d6c000000273eaeae30>]
/dev/rdsk/c166t0d2 [Storage Subsystem FAStT, Logical Drive Finance, LUN 2, Logical Drive WNN <600a0b80000f5d6c000000253eaeadf8>]
/dev/rdsk/c166t0d3 [Storage Subsystem FAStT, Logical Drive Purchasing, LUN 3, Logical Drive WNN <600a0b80000f5d6c000000243eaeadbe>]
/dev/rdsk/c166t0d4 [Storage Subsystem FAStT, Logical Drive Development, LUN 4, Logical Drive WNN <600a0b80000f56d00000001d3eaeacef>]
/dev/rdsk/c166t3d7 [Storage Subsystem FAStT, Logical Drive Access, LUN 31, Logical Drive WNN <600a0b80000f56d00000001b00000000>]

/dev/rdsk/c172t0d0 [Storage Subsystem FAStT, Logical Drive Accounting, LUN 0, Logical Drive WNN <600a0b80000f56d00000001e3eaead2b>]
/dev/rdsk/c172t0d1 [Storage Subsystem FAStT, logical Drive HR, LUN 1, Logical Drive WNN <600a0b80000f5d6c000000273eaeae30>]
/dev/rdsk/c172t0d2 [Storage Subsystem FAStT, Logical Drive Finance, LUN 2, Logical Drive WNN <600a0b80000f5d6c000000253eaeadf8>]
/dev/rdsk/c172t0d3 [Storage Subsystem FAStT, Logical Drive Purchasing, LUN 3, Logical Drive WNN <600a0b80000f5d6c000000243eaeadbe>]
/dev/rdsk/c172t0d4 [Storage Subsystem FAStT, Logical Drive Development, LUN 4, Logical Drive WNN <600a0b80000f56d00000001d3eaeacef>]
/dev/rdsk/c172t3d7 [Storage Subsystem FAStT, Logical Drive Access, LUN 31, Logical Drive WNN <600a0b80000f5d6c0000002200000000>]
```

Figure 11. Sample SMdevices command output (method 2)

**Note:** If you do not see the logical drives and logical drive accesses after running the **hot\_add** and **SMdevices** commands, restart the HP-UX host by running the **reboot** command.

```
#reboot
```

- Determine the preferred and alternate path for each logical drive by examining the output from the **SMdevices** command, as shown in the example in Figure 11 on page 58.

Notice that each device is listed twice; one instance is the preferred path and one instance is the alternate path. Also, notice that each device has a worldwide name (WWN). Part of the WWN of each logical drive is unique for each controller in the FASTT storage server. If you examine the WWNs for the logical drive access in Figure 11 on page 58, you notice that they differ in only five digits, f56d0 and f5d6c.

The devices in Figure 11 on page 58 are viewed through the controllers c166 and c172. To determine the preferred path of a specific logical drive seen by the operating system perform the following steps:

- Find the WWN for each logical drive access. In this case, Logical Drive Access 1 is associated with **c166** and has the WWN of **f56d0**. Logical Drive Access 2 is associated with **c172** and has the WWN of **f5d6c**:

```
/dev/rdisk/c166t3d7 [Storage Subsystem FASTT, Logical Drive Access, LUN 31, Logical Drive WWN <600a0b80000f56d00000001b00000000>]
```

**Logical Drive Access 2** is associated with **c172** and has the WWN of **f5d6c**:

```
/dev/rdisk/c172t3d7 [Storage Subsystem FASTT, Logical Drive Access, LUN 31, Logical Drive WWN <600a0b80000f5d6c0000002200000000>]
```

- Identify the preferred device path name for the attached storage device by matching the logical drive WWN to a logical drive access WWN. In this case, the WWN for **LUN 0** is associated with controller **c166** and **c172**. Therefore, the preferred path for **LUN 0** is **/dev/rdisk/c166t0d0**, which is controller **c166**:

```
/dev/rdisk/c166t0d0 [Storage Subsystem FASTT, Logical Drive Accounting, LUN 0, Logical Drive g<600a0b80000f56d00000001e3eaead2b>]
```

The alternate path is **/dev/rdisk/c172t0d0**, which is controller **c172**:

```
/dev/rdisk/c172t0d0 [Storage Subsystem FASTT, Logical Drive Accounting, LUN 0, Logical Drive WWN <600a0b80000f56d00000001e3eaead2b>]
```

- To keep a record for future reference, enter this path information for LUN 0 into a matrix (similar to the one in Table 11).

Table 11. Sample record of logical drive preferred and alternate paths

LUN	Logical drive name	Preferred path	Alternate path
0	Accounting	/dev/rdisk/c166t0d0	/dev/rdisk/c172t0d0
1	HR	/dev/rdisk/c172t0d1	/dev/rdisk/c166t0d1
2	Finance	dev/rdisk/c172t0d2	/dev/rdisk/c166t0d2
3	Purchasing	/dev/rdisk/c172t0d3	/dev/rdisk/c166t0d3

Table 11. Sample record of logical drive preferred and alternate paths (continued)

LUN	Logical drive name	Preferred path	Alternate path
4	Development	/dev/rdisk/c166t0d4	/dev/rdisk/c172t0d4

- d. Repeat step 3a on page 59 through step 3c on page 59 for each logical drive that is seen by the operating system.

Continue to the next procedure.

## Creating volumes and volume groups

After you have determined the preferred and alternate paths, and have recorded them in a matrix for future reference, perform the following steps to create volumes and volume groups.

**Note:** The steps in this procedure refer to LUN 0 in Table 11 on page 59.

1. Create a physical volume and define the primary paths for the attached storage devices. The primary path will be the preferred path. Type the following command at the shell prompt:

```
#pvcreate /dev/rdisk/c166t0d0
```

The system confirms the creation of the new physical volume.

2. Create volume groups.

**Note:** For more information on how to create volume groups, refer to HP-UX documentation or to man pages.

- a. Make a directory for volume group by typing the following commands. This directory must reside in the /dev directory.

```
#cd /dev  
#mkdir /vg1
```

- b. Create the group special file in the /dev directory for the volume group by typing the following command:

```
#mknod /dev/vg1/group c 64 0x010000
```

- c. Create a volume group and define physical volume names (primary link) for the attached storage device by typing the following command:

```
#vgcreate /dev/vg1/ /dev/dsk/c166t0d0
```

- d. Define the secondary path name (alternate path) for the attached-storage device by typing the following command:

```
#vgextend vg1 /dev/dsk/c172t0d0
```

**Note:** You can also use the **vgextend** command to add additional storage devices to an existing volume group. Add the primary path first, then add the alternate path, as shown in the following example:

- 1) Add the primary path for LUN1.

```
#vgextend vg1 /dev/dsk/c172t0d1
```

2) Add the secondary path for LUN1.

```
#vgextend vg1 /dev/dsk/c166t0d1
```

3. Create logical volumes. For more information, refer to HP-UX documentation.
4. Create file systems for the logical volumes.
5. Repeat step 1 on page 60 through step 4 to create additional volume groups. For more information, refer to HP-UX documentation.
6. Verify the primary (preferred) and secondary (alternate) paths for each device by typing the following command:

```
#vgdisplay -v vgname
```

where *vgname* is the volume group name.

---

## Redistributing volumes in case of failure

Auto Volume Transfer (AVT) is enabled, by default, on HP-UX hosts. If a failure occurs that initiates a controller failover, AVT redirects I/O to the available controller. AVT does not require manual redistribution.

**Important:** If you have a heterogeneous environment, you must redistribute logical volumes manually. Failure to do so will leave the subsystem in a *Needs Attention* state, because hosts that do not support AVT or have AVT disabled will not automatically redirect I/O to the preferred controller. If a failure occurs that initiates a controller failover, perform the following steps to redistribute logical drives to their paths:

1. Repair or replace any faulty components. For more information, see the *IBM TotalStorage FAStT Installation and Support Guide* for the appropriate FAStT Fibre Channel Storage Server.
2. Redistribute volumes to their preferred paths by clicking **Subsystem Management** → **Storage Subsystem** → **Redistribute Logical Drive**.





---

## Chapter 4. Installing storage management station software on Solaris systems

This chapter provides the following information for Solaris operating systems:

- “Hardware and firmware requirements”
- “Installing the client software” on page 65
- “Installing the host software” on page 67
- “Configuring storage subsystems on Solaris hosts” on page 69
- “Creating direct-attached and SAN-attached configurations” on page 70
- “Configuring the host bus adapter cards” on page 71
- “Setting up a Solaris host group” on page 79
- “Mapping LUNs to a FAStT storage partition” on page 79
- “Installing RDAC on Solaris hosts” on page 80
- “Installing DMP on Solaris hosts” on page 82
- “Verifying external storage” on page 93
- “Redistributing volumes in case of failure” on page 93

**Attention:** For cluster configurations, complete all applicable configuration procedures for each storage subsystem *before* installing the Storage Manager 8.4 software on a second host or cluster server.

---

### Hardware and firmware requirements

Table 12 lists the FAStT storage servers that are supported with Storage Manager 8.4.

*Table 12. FAStT storage servers that are supported on Solaris systems*

Product name	Model	Product release and firmware version
IBM TotalStorage FAStT900 Fibre Channel Storage Server	1742-90U	Appware 5.40.03.00 NVSRAM N1742F900R840V00
IBM TotalStorage FAStT700 Fibre Channel Storage Server	1742-1RU	Appware 5.40.03.00 NVSRAM N1742F700R840V00
IBM TotalStorage FAStT600 Fibre Channel Storage Server	1722-60U, 1722-60X	Snapware 5.40.03.02 NVSRAM N1722F600R840V02

Table 13 lists the FAStT storage servers that are supported with Storage Manager 8.4.

*Table 13. Supported versions of hardware for Solaris systems*

Product Name	Model	Product release and firmware version
IBM TotalStorage FAStT700 EXP700 Storage Expansion Unit	1740-1RU	ESM 9324
IBM TotalStorage FAStT500 EXP500 Storage Expansion Unit	3560-1RU	ESM 9166
JNI FC Adapter	FC64-1063	fcaw2.5.18.pkg
JNI FC Adapter	FCE-1063 S-bus 64 bit	JNIC.pkg, version 4.1.1.1

Table 13. Supported versions of hardware for Solaris systems (continued)

Product Name	Model	Product release and firmware version
JNI FC Adapter	FCE-1473 S-bus 64 bit	JNIC146x.pkg, version 5.2.1
JNI FC Adapter	FCE2-1473 S-bus 64 bit	JNIC146x.pkg, version 5.2.1
JNI FC Adapter	FCE-6410-N 33 Mhz	JNIC.pkg, version 4.1.1.1
JNI FC Adapter	FCE-6460-PCI 64 bit	JNIC146x.pkg, version 5.2.1
JNI FC Adapter	FCE2-1063 S-bus 64 bit	JNIC.pkg, version 4.1.1.1
JNI FC Adapter	FCE2-6412 66 Mhz 64 bit	JNIC.pkg, version 4.1.1.1
JNI FC Adapter	FCI-1063	fca-pci.2.5.18.pkg
JNI FC Adapter	FCC-6562	JNIC146x.pkg, version 5.2.1
JNI FC Adapter	FCC2-6562	JNIC146x.pkg, version 5.2.1
JNI FC Adapter	FCX-6562	JNIC146x.pkg, version 5.2.1
JNI FC Adapter	FCC\X2-6562	JNIC146x.pkg, version 5.2.1
Brocade switch	2109-S08, 2109-S16	2.6.0j
Brocade switch	2109-F16	3.0.2.9
Brocade switch	2109-F8	3.0.2.K
Brocade switch	2109-M12, 2109-F32	4.0.2b
McData switch	2032-064, 2032-140	4.01.00
McData switch	2031-016	4.01.00
McData switch	2031-216, 2031-224	4.01.00
InRange switch	2042-001	4.1.06
Cisco switch	2062-D01, 2062-D07, 2062-T07	1.1

**Note:** Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. To ensure that you have the latest versions of the firmware and the NVSRAM, read the readme file that is shipped with the product. You can also find the latest readme file at the Web site that is appropriate for your FASTT Storage Server:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FASTT Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FASTT Storage Manager for Solaris.

For system-level hardware and software requirements and patch levels, see Appendix C, “Solaris system requirements,” on page 105.

---

## Installing the client software

Use the procedures in this section to install the client software on a Solaris storage management station.

Install the software in the following order:

1. SMruntime
2. SMclient

**Note:** The SMclient is dependent on SMruntime, which is a Java compiler for the SMclient and must be installed first.

## Prerequisites

Before installing the client software, ensure that the following conditions are met:

- This is the SUN SPARCstation workstation that you have identified as the storage management station.
- This machine is running Solaris 7 or 8 and meets the minimum hardware and software requirements described in Appendix C, “Solaris system requirements,” on page 105.
- Neither SMruntime nor SMclient is installed on the host and you are ready to install them on this machine.

## Installing SMruntime

In the following procedure, the installation CD is mounted at /cdrom/sm84. Adjust these instructions as required for your specific installation location. No restart is required during the client installation process.

**Before you begin:** Visit the Web sites that are listed in “Hardware and firmware requirements” on page 63 to ensure you have the most recent version of the software.

1. Insert the Solaris installation CD in the CD-ROM drive.
2. Start the installation process by typing the following command:

```
pkgadd -d /cdrom/SM84/SUN_SParc/SM8runtime-Sparc-filename.pkg
```

where *filename* is the name of the package on the Solaris installation CD that you want to install.

3. Information about packages that can be installed in the specified directory is displayed on the command line. The following is an example of what you might see displayed.

```
The following packages are available:  
1 SMruntime  
IBM FASTT Storage Manager 8 Runtime (sparc)  
version number  
Select package(s) you wish to process (or 'all' to process all  
Packages). (default:all) [?,??,q]:
```

4. Type the value of the package that you are installing and press Enter. The installation process begins. The following prompt is displayed:

```
This package contains scripts which will be executed with super-user
Permission during the process of installing this package.
Do you want to continue with the installation of <SMruntime>
[y, n, ?]
```

5. Type `y` and press Enter. The installation process continues. When the SMruntime software has been successfully installed, the following message is displayed:

```
Installation of <SMruntime> was successful.
```

6. Type the following command to verify that the installation was successful:

```
# pkginfo -l SMruntime
```

The installation was successful if no output is displayed on the screen.

## Installing SMclient

Use the following procedure to install and integrate the client software on a Solaris storage management station.

**Note:** SMclient is supported on Solaris 7 and 8.

In the following procedure, the installation CD is mounted at `/cdrom/sm84`. Adjust these instructions as required for your specific installation location. No restart is required during the client installation process.

1. Insert the Solaris installation CD in the CD-ROM drive.
2. Start the installation process by typing the following command:

```
# pkgadd -d /cdrom/SM84/SUN_Sparc/SM8client-Sparc-filename.pkg
```

where *filename* is the name of the package on the Solaris installation CD that you want to install.

Information about packages that can be installed in the specified directory is displayed on the command line. The following is an example of what you might see displayed.

```
The following packages are available:

1 SMclient                IBM FAStT Storage Manager 8 Client
                           (sparc) version number

Select package(s) you wish to process (or 'all' to process all
packages). (default:all) [?,?,q]:
```

3. Type the value of the package that you are installing and press Enter. The installation process begins. The following prompt is displayed:

```
This package contains scripts which will be executed with super-user
permission during the process of installing this package.

Do you want to continue with the installation of <SMclient>

[y, n, ?]
```

4. Type `y` and press Enter.

The installation process continues. When the SMclient software has been successfully installed, the following message is displayed:

```
Installation of <SMclient> was successful.
```

5. Type the following command to verify that the installation was successful:

```
# pkginfo -l SMclient
```

The installation was successful if no output is displayed on the screen.

6. You are finished with the client software installation on this Solaris storage management station. Remove the installation CD from the CD-ROM drive.

**Note:** To ensure redundancy in a cluster environment, you must install the client software on at least one additional storage management station or cluster server. To install the client software additional storage management stations, repeat step 1 on page 66 through step 6 of the installation procedure. Use the corresponding installation profile for each storage management station as a guide.

---

## Installing the host software

After you install the client software and configure your storage subsystems, use these instructions to install the appropriate host software.

The host software for Solaris consists of the following packages:

- SMagent (optional - for in-band management only)
- SMutil (required)
- Failover driver (RDAC or DMP)

This section contains the procedure for installing SMagent and SMutil. For information about how to install RDAC and DMP, see “Installing RDAC on Solaris hosts” on page 80 or “Installing DMP on Solaris hosts” on page 82.

## Prerequisites

Before installing the host software, ensure that the following conditions are met:

- This is the Sun SPARCstation workstation that you have identified as the storage management station.
- This machine is running Solaris 7 or 8, and meets the minimum hardware and software requirements described in Appendix C, “Solaris system requirements,” on page 105.
- The SMagent, SMutil, and RDAC software packages are not installed and you are ready to install them on this machine.

## Installing SMagent (optional)

SMagent is required for in-band management only. It is not required for out-of-band management.

Complete the following steps to install SMagent:

1. Type the following command to start installing the SMagent package:

```
pkgadd -d /cdrom/SM84/SUN_SParc/SM8agent-Sparc-filename.pkg
```

where *filename* is the name of the package on the Solaris installation CD that you want to install.

The installation process begins.

Information about packages that can be installed in the specified directory is displayed on the command line. The following is an example of what you might see displayed.

```
The following packages are available:

1 SMagent                IBM FAStT Storage Manager 8 Agent
                        (sparc) version number

Select package(s) you wish to process (or 'all' to process all
packages). (default:all) [?,??,q]:
```

2. Type the value of the package that you are installing and press Enter.  
The installation process begins. The following prompt is displayed:

```
This package contains scripts which will be executed with super-user
Permission during the process of installing this package.
Do you want to continue with the installation of <SMagent>
[y n, ?]
```

3. Type *y* and press Enter.  
The installation process continues. When the SMagent software has been successfully installed, the following message is displayed:

```
Installation of <SMagent> was successful.
```

4. Type the following command to verify that the installation was successful:

```
# pkginfo -l SMagent
```

The installation was successful if no output is displayed on the screen.

5. Remove the installation CD from the CD-ROM drive.

## Installing SMutil (required)

Complete the following steps to install SMutil:

1. Type the following command to start installing the SMutil package:

```
pkgadd -d ./pathname/SMutil-Sparc-filename.pkg
```

where *filename* is the name of the package on the Solaris installation CD that you want to install.

The installation process begins.

Information about packages that you can install in the specified directory is displayed on the command line. An example of what you might see follows.

```
The following packages are available:

SMutil IBM FAStT Storage Manager 8 Util
        (sparc)version number

Select package(s) you wish to process (or 'all'
to process all packages). (default:all) [?, ??, q]:
```

2. Type the value of the package that you are installing and press Enter. The installation process begins. The following prompt is displayed:

```
This package contains scripts which will be executed with super-user
Permission during the process of installing this package.
Do you want to continue with the installation of <SMutil>
[y, n, ?]
```

3. Type y and press Enter.
4. Type the following command to verify that the installation was successful:

```
# pkginfo -l SMutil
```

The installation was successful if no output is displayed on the screen.

When the SMutil has been successfully installed, the following message is displayed:

```
Installation of <SMutil> was successful.
```

You have finished installing the host software on this Solaris host.

---

## Configuring storage subsystems on Solaris hosts

To configure Storage Manager 8.4 for a Solaris system, complete the following procedures in the order that they are described in this section:

- Add storage subsystems to SMclient
- Update NVSRAM and FAStT firmware (if necessary)

**Before you begin:** Read the following information:

- All FAStT storage servers have an access volume set to LUN 31.

**Note:** Do not delete the access LUN or the access volume.

- If you have purchased a Storage Partitioning premium feature, ensure that the feature is enabled. See “Enabling your premium features” on page 4 for more information.
- Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. To ensure that you have the latest versions of the firmware and the NVSRAM, read the readme file that is shipped with the product. You can also find the latest readme file at the Web site that is appropriate for your FAStT Storage Server:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FAStT Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FAStT Storage Manager for Solaris.

**Note:** If you do not have the latest versions of firmware and NVSRAM, download them and complete the procedure described in “Updating NVSRAM and FAStT firmware” on page 70. If the version numbers are current, you can skip that procedure.

## Adding storage subsystems to SMclient

Complete the following steps to specify the IP addresses of the controllers:

1. In the Enterprise Management window, click **Edit** —> **Add Device**.
2. In the Add Device window, type the IP address of the first controller in the storage subsystem and click **Add**.
3. Type the IP address of the second controller and click **Add**, and then click **Close**.

## Updating NVSRAM and FAStT firmware

**Before you begin:** Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. To ensure that you have the latest versions of the firmware and the NVSRAM, read the readme file that is shipped with the product. You can also find the latest readme file at the Web site that is appropriate for your FAStT Storage Server:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FAStT Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FAStT Storage Manager for Solaris.

If you do not have the latest versions of the firmware and NVSRAM, press the **Back** button on your browser to return to the previous Web page. You can download the correct versions by clicking the appropriate link that is listed in the IBM FAStT Controller Firmware matrix.

Complete the following steps to upgrade the NVSRAM and then upgrade the firmware:

1. In the Subsystem Management window, click **Storage Subsystem** —> **Download** —> **NVSRAM**.
2. In the NVSRAM window, go to the directory where the latest NVSRAM file resides.
3. Type or select the full pathname of the NVSRAM file, and then click **Update** —> **OK**.
4. Click **Storage Subsystem** —> **Download** —> **Firmware**.
5. Type or select the full path name of the firmware file, and then click **Update** —> **OK**.

The firmware is downloaded to the controllers. When the download is finished, the firmware becomes unresponsive and you are returned to the Enterprise Management window.

The SMclient is now able to connect to the storage subsystem.

---

## Creating direct-attached and SAN-attached configurations

Storage Manager 8.4 supports IBM FAStT Fibre Channel Storage Servers in direct-attached Solaris configurations or in a SAN environment through switches in Solaris configurations.

### Creating a direct-attached configuration

In a direct-attached configuration, one or two Solaris servers can be connected to FAStT storage servers.



**Requirements:**

- Two-server FAStT700 or FAStT900 configurations require four host-side minihubs, each with exactly one fibre-channel connection from each HBA to a minihub.

**Note:** FAStT600 storage servers do not have minihubs.

- No external hubs can be used.

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

1. Connect the HBAs to each controller or mini-hub port of the FAStT storage server.
2. Configure and verify the configuration.

## Creating a SAN-attached configuration

Use the following procedure to create a SAN-attached configuration.

**Requirements:**

- Multiple HBAs within the same server must be unable to “see” the same FAStT controller port.
- The JNI HBAs must be isolated from each other if they are connected to the same switch that is connected to the same FAStT controller port.
- Each HBA and controller port must be in its own fabric zone, if they are connecting through a single switch, such as a 2109-F16.

See the documentation provided by the switch manufacturer for more information about zoning. Multiple FAStT devices can be configured to the same set of HBAs through a fibre-channel switch.

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

1. Connect the HBAs to the switch or switches.
2. Connect the FAStT storage subsystems to the switch or switches.
3. Set the required zones on the fibre-channel switch or switches, if applicable.

**Note:** For information about zoning and enabling zones, see the documentation that is provided by the switch manufacturer.

4. Configure and verify the configuration.

---

## Configuring the host bus adapter cards

Before you can install the failover driver, you must install the HBA driver package and modify the HBA settings using the following procedures:

- “Installing the JNI adapter driver package”
- “Modifying the JNI HBA settings” on page 72 (for SAN-attached configurations only)

## Installing the JNI adapter driver package

The RDAC software includes the following shell scripts that you can use to configure JNI cards for use with connections through fibre-channel switches.

**Note:** The following scripts are not available for configurations that use DMP for failover. DMP configurations require you to manually update the `/kernel/drv/sd.conf` file to reflect the attached FAStT storage server.

- For FCI-1063 cards, /etc/raid/bin/genfcaconf
- For all jnic.conf cards, /etc/raid/bin/genjnicconf
- For FC64-1063 and all other cards, /etc/raid/bin/genscsiconf, which calls other scripts as appropriate

**Before you begin:**

- Ensure that the JNI HBAs have been installed and attached directly to the controllers or to a SAN fabric switch.
- If attached to SAN fabric switch, ensure that the zones for the FAStT Storage subsystem have been created and enabled. For information about enabling zones, see the documentation that is provided by the switch manufacturer.

**Note:** All fabric switches must be zoned in such a way that a single HBA can access only one controller per storage array.

Complete the following steps to install the JNI adapter driver package:

1. On Table 14, identify the correct driver package for the installed HBAs.

Table 14. JNI adapter configuration files

JNI HBA model numbers	JNI adapter driver package	Configuration file
FC64-1063-N	fcaw2.5.18.pkg	/kernel/drv/fcaw.conf
FCI-1063-N	fca-pci.2.5.18.pkg	/kernel/drv/fca-pci.conf
FCE-1063, FCE2-1063, FCE2-1063, FCE-6410, FCE2-6412	JNIC.pkg, version 4.1.1.1	/kernel/drv/jnic.conf
FCE-1473, FCE2-1473, FCE-6412 (2 Gb), FCE-6460, FCC-6562, FCC2-6562, FCX-6562 and FCC/X2-6562	JNIC146x.pkg, version 5.2.1	/kernel/drv/jnic146x.conf

2. Download the most current adapter driver package from the following Web site:

[www.jni.com/Drivers](http://www.jni.com/Drivers)

3. Run the following command to install the JNI adapter driver package:

```
#pkgadd -d adapter_driver_package
```

where *adapter\_driver\_package* is the name of the adapter driver package that you want to install, as in the following example:

```
#pkgadd -d JNIC146x.pkg
```

4. Run the following command to verify that the JNI adapter driver package is installed:

```
#pkginfo adapter_driver_package
```

where *adapter\_driver\_package* is the name of the adapter driver package that you installed.

## Modifying the JNI HBA settings

The loop settings in the JNI configuration file are set by default to private loop for direct-attach configurations. For a SAN-attached configuration that uses a fabric

switch, modify the loop settings to bind the HBAs to the FASSt storage controller before you install the failover driver on the host.

**Attention:** If you have a direct-attached configuration, skip this section and go to “Installing RDAC on Solaris hosts” on page 80 or “Installing DMP on Solaris hosts” on page 82. You do not need to modify JNI HBA settings if you have a direct-attached configuration.

### **Modifying the JNI HBA settings for McData, Cisco, InRange and Brocade 1 Gb switches**

If you have a Brocade 2 Gb switch, you need to force the HBA (FCC-6460, FCE2-1473, or FCE-21473) to be a public loop device. See “Modifying the JNI HBA settings for a Brocade 2 Gb switch” on page 75 for the correct modification procedures for a Brocade 2 Gb switch.

**Before you begin:** Be aware that some of the steps in these procedures refer to Appendix E, “JNI host bus adapter settings,” on page 109.

Complete the following procedures to modify the JNI HBA settings.

- “Modifying the loop settings”
- “Gathering the binding information”
- “Binding the HBAs to storage controllers” on page 74

#### ***Modifying the loop settings:***

Complete the following steps to modify the loop settings:

1. Run the following commands.

```
#cd /kernel/drv
#vi JNI_configuration_file
```

where *JNI\_configuration\_file* is the JNI configuration file whose HBA settings you want to modify, as in the following example:

```
#cd /kernel/drv
#vi jnic146x.conf
```

2. In the Vi Editor, uncomment and modify the loop attributes using the information in Appendix E, “JNI host bus adapter settings,” on page 109.
3. Run the following command to save the changes that were made to the JNI configuration file.

```
#:wq
```

4. Run the following command to restart the Solaris host.

```
#reboot -- -r
```

#### ***Gathering the binding information:***

Complete the following steps to gather the binding information:

1. After the host restarts, run the following commands:

```
#cd /var/adm
#more messages
```

The messages log displays.

2. Search the messages log for the most recent HBA information. You can do this with a backwards search for the installed HBAs.

```
# ?Sun0S
```

3. After you find the most recent HBA information in the messages log, record the following information for future reference.
  - Target of the controller that is attached to the HBA
  - WWPN of the controller that is attached to the HBA

### ***Binding the HBAs to storage controllers:***

Complete the following steps to bind the HBAs to the storage controllers:

The examples in this procedure assume that you are binding two JNIC FCE-6460 HBAs to the FAStT controllers.

1. Run the following commands to open the JNI configuration file.

```
#cd /kernel/drv
#vi JNI_configuration_file
```

where *JNI\_configuration\_file* is the name of the JNI configuration file that you want to open. For example, the following commands open the jnic146x.conf file.

```
#cd /kernel/drv
#vi jnic146x.conf
```

2. Set and change the target variables to the specified values, as shown in the following examples.

#### ***target0\_hba variables:***

- a. Set the target to the first value that you recorded from the */var/adm/messages* file.

Example:

```
targetZ_hba = "jnic146x0"
```

where *Z* represents the target number for the first HBA from the */var/adm/messages* file.

- b. Set the target to the second value that you recorded from the */var/adm/messages* file.

Example:

```
targetY_hba = "jnic146x0"
```

where *Y* represents the target number for the second HBA from the */var/adm/messages* file.

#### ***target\_wwpn variables:***

- a. Set the target to the WWPN of the first controller using the value that you recorded from the `/var/adm/messages` file.

Example:

```
target_Z_wwpn="controller_1_wwpn"
```

where `z` represents the target number for the first HBA from the `/var/adm/messages` file.

- b. Set the target to the WWPN of the second controller using the value that you recorded from the `/var/adm/messages` file.

Example:

```
target_Y_wwpn="controller_2_wwpn"
```

where `y` represents the target number for the second HBA from the `/var/adm/messages` file.

3. Run the following command to save the changes to the JNI configuration file.

```
#:wq
```

4. Run the following command to restart the Solaris host.

```
#reboot -- -r
```

### **Modifying the JNI HBA settings for a Brocade 2 Gb switch**

If you are using a Brocade 2 Gb switch, you need to force the HBA (FCC-6460, FCE-1473, or FCE2-1473 operating in 2 Gb mode) to be a public loop device.

If you are using any other switch, see “Modifying the JNI HBA settings for McData, Cisco, InRange and Brocade 1 Gb switches” on page 73 for the correct modification procedures.

Complete the following procedures to modify the JNI HBA settings for a Brocade 2 Gb switch:

- “Modifying the loop settings”
- “Opening `jnic146x.conf`” on page 76
- “Binding the HBAs to the storage controllers” on page 77

#### ***Modifying the loop settings:***

Complete the following steps to modify the loop settings:

1. Open the `/var/adm/messages` file by typing the following command:

```
# more /var/adm/messages
```

2. Perform a backwards search of the `/var/adm/messages` file by typing the following command:

```
# ?Sun0S
```

3. Look for the HBA in the `/var/adm/messages` file. The following example is for an FCE-6460-N adapter.

```

May 6 10:02:06 solar unix: jnic146x0:
Hba: JNI,FCR Model: FCE-6460-N
May 6 10:02:06 solar unix: jnic146x0:
FCode: Version 3.8.9 [ba79]
May 6 10:02:06 solar unix: jnic146x0:
IRQ: 1 Channel: 1
May 6 10:02:06 solar unix: jnic146x0:
SubVend: 1242 Sub: 6460 Rev: 100Vend:242 Dev: 1460
May 6 10:02:06 solar unix: jnic146x0:
WWNN: 100000017300284e WWPN: 200000017300284e
May 6 10:02:07 solar unix: jnic146x0:
Auto-negotiating link speed
May 6 10:02:07 solar unix: jnic146x0:
Configured as Public Loop port
May 6 10:02:08 solar unix: jnic146x0:
JNIC v5.2.1 (02111400)
May 6 10:02:08 solar unix: jnic146x0:
Copyright(c) 1995-2002 JNI Corp, All Rights Reserved.
May 6 10:02:10 solar unix: jnic146x0:
Link Up: 2Gig
May 6 10:02:11 solar unix: jnic146x0:
Port 011000 (WWN 200200a0b80f478e:200300a0b80f478f) online.
May 6 10:02:12 solar unix: jnic146x0: Network Port
fffc01 (WWN 1000006069500f0d:20fd006069500f0d) available

```

4. Record the target. In the following example, the target for the first FCE-6460-N adapter is **target 0**. The second FCE-6460-N adapter is **target 3**:

```

May 6 10:02:11 solar unix: jnic146x0: Port 011000
(WWN 200200a0b80f478e:200300a0b80f478f) online.

May 6 10:02:11 solar unix: jnic146x3: Port 011000
(WWN 200200a0b80f478e:200300a0b80f478f) online.

```

5. Record the WWPN for each FCE-6460-N adapter that is installed on the host. In this example, the WWPN is **200300a0ba0f478f** for an adapter on **target 0**, and would be **200200a0ba0f478f** for an adapter on **target 3**:

```

May 6 10:02:11 solar unix: jnic146x0: Port 011000
(WWN 200200a0b80f478e:200300a0b80f478f) online.
May 6 10:02:11 solar unix: jnic146x3: Port 610300
(WWN 200200a0b80f478e:200200a0b80f478f) online.

```

**Attention:** In the messages file, notice that each adapter has a network port and a port. Do not use the WWPN for the network port; only use the WWPN for the port.

#### **Opening *jnic146x.conf*:**

The examples in this procedure assume that you are binding two JNIC FCE-6460 HBAs to the controllers.

**Before you begin:** See Appendix E, “JNI host bus adapter settings,” on page 109 and modify settings accordingly.

Complete the following steps to open the *jnic146x.conf* file:

1. Type the following command:

```
vi /kernel/drv/jnic146x.conf
```

2. Look for the section titled Parameters: FcLoopEnabled and FcFabricEnabled. Highlight and copy the following text:

```
-jnic 146x0-FcLoopEnabled=1;
-jnic 146x0-FcFabricEnabled=0;
```

3. Paste the text immediately following the text that you copied in step 2, as shown in the following example:

```
-jnic 146x0-FcLoopEnabled=1;
-jnic 146x0-FcFabricEnabled=0;
-jnic 146x0-FcLoopEnabled=1;
-jnic 146x0-FcFabricEnabled=0;
```

4. Change the target values according to the information that you gathered from the /var/adm/messages file. In this example, one controller is on **target 0** and the other controller is on **target 3**:

```
-jnic 146x0-FcLoopEnabled=1;
-jnic 146x0-FcFabricEnabled=0;
-jnic 146x3-FcLoopEnabled=1;
-jnic 146x3-FcFabricEnabled=0;
```

5. Set the FcLoopEnabled and FcFabricEnabled attributes, as shown in the following example, in which both controllers are attached to a 2 Gb switch:

```
-jnic 146x0-FcLoopEnabled=1;
-jnic 146x0-FcFabricEnabled=1;
-jnic 146x3-FcLoopEnabled=1;
-jnic 146x3-FcFabricEnabled=1;
```

**Note:** Brocade 2 Gb switches (public):

- FcLoopEnable=1
- FcFabricEnable=1

### ***Binding the HBAs to the storage controllers:***

Complete the following steps to set and change the target variables to the specified values:

1. Search for a section titled Configuration Parameters for target to FC device mappings, as shown in the following example:

```
#####
#Configuration Parameters for target to FC device #mappings
#targetX_hba,
#targetX_LunY_hba,
#targetX_wwnn,
#targetX_wpnn,
#targetX_port,

#type: string
#Default
#####"
```

2. Ensure that the following lines have been added for each HBA:

```
targetZ_hba = "jnic146x0"
targetZ_wwpn = " "
```

A list is displayed, as shown in the following example:

```
#####
#Configuration Parameters for target to FC device #mappings
#targetX_hba,
#targetX_LunY_hba,
#targetX_wwnn,
#targetX_wpnn,
#targetX_port,

#type: string
#Default

targetZ_hba = 'jnic146x0'
target_Z_wwpn=" "
targetY_hba = 'jnic146x0'
target_Y_wwpn=" "

#####
```

3. Set the target variables to the values that are specified in the /var/adm/messages file.

The targets in this example are **target 0** and **target 3**:

```
target0_hba = "jnic146x0"
target_Z_wwpn="200300a0b80f478f"
target3_hba="jnic146x3"
target_Y_wwpn=" "
```

where Z represents the target number for the first HBA and Y represents the target number for the second HBA from the /var/adm/messages file.

4. Set the target to the WWPN of the first controller, using the value that you recorded from the /var/adm/messages file.

The WWPNs in this example are **200300a0b80f478f** for the HBA on **target 0** and **200200a0b80f478f** for the HBA on **target 3**:

```
target0_hba = "jnic146x0"
target_0_wwpn="200300a0b80f478f"
target3_hba="jnic146x3"
target_3_wwpn="200200a0b80f478f"
```

5. Type the following command to save the changes to the JNI configuration file:

```
#:wq
```

6. Type the following command to restart and configure the Solaris host:

```
#reboot -- -r
```

When you are finished, install the failover driver on the host. See “Installing RDAC on Solaris hosts” on page 80 or “Installing DMP on Solaris hosts” on page 82 for more information.



---

## Setting up a Solaris host group

Complete the following steps to set up a Solaris host group.

**Note:** Create the Solaris host group at the storage subsystem level. Do not create host groups at the default group level.

In a cluster partition, perform logical drive mappings on the host group level so that all the hosts can see the same storage. In a normal partition, perform logical drive mappings on the host level.

1. Rescan the storage subsystem, and then click **Manage the Device** to return to the Subsystem Management window.
2. In the Subsystem Management window, click the **Mappings View** tab.
3. In the Mappings window, create a new host group by clicking **Mappings** → **Define** → **Host Group**.
4. Type the name of the new host group (for example, Solaris). Click **Add**, and then click **Close**.
5. Select the new host group and click **Mappings** → **Define** → **Host**.
6. Define the new host. Type the name of the Solaris host to which the storage subsystem is attached.
  - a. Click **Add**, and then click **Close**.
  - b. Right-click the host that you just added and select **Define New Host Port**.
  - c. Select the desired host port for the first HBA, and then change the host type to **Solaris** and click **Add**.

**Note:** Failure to change the host type from the default to Solaris causes undesired results.

- d. Choose the host port for the second HBA and click **Add**, and then click **Close**.

**Note:** If you use two HBAs you must define two host ports. Failure to do so causes undesired results.

- e. Click **File** → **Exit**.

---

## Mapping LUNs to a FAS*T* storage partition

Complete the following steps to map LUNs to a storage partition:

1. Select the Mappings View of the Subsystem Management window.
2. In the topology tree, right-click the host partition on which you want to map LUNs, and select **Define Additional Mappings**. The Define Additional Mappings window opens.
3. In the Define Additional Mappings window, select the following options, and then click **Add**:
  - Host group or host
  - Logical unit number (LUN)
  - The logical drive you want to map

Repeat these steps for each LUN that you want to map to the partition.

---

## Installing RDAC on Solaris hosts

This section describes how to install RDAC.

### Before you begin:

- You must install the JNI adapter driver package before you install RDAC. If you have a SAN-attached configuration, you must also set the bindings in the JNI configuration file before you install RDAC. If you fail to follow the procedures in this order, problems will occur.

For information about how to install the JNI adapter driver package, see “Installing the JNI adapter driver package” on page 71.

For information about how to set the bindings, see “Modifying the JNI HBA settings” on page 72.

- Go to one of the following Web sites to ensure that you have the most recent RDAC:

ssddom02.storage.ibm.com/techsup/webnav.nsf/support/fastt600  
ssddom02.storage.ibm.com/techsup/webnav.nsf/support/fastt700  
ssddom02.storage.ibm.com/techsup/webnav.nsf/support/fastt900

Complete the following steps to install RDAC:

1. Insert the Solaris installation CD in the CD-ROM drive.

**Note:** In this procedure, the installation CD is mounted at /cdrom/SM84. Adjust the procedure as required for your specific installation location.

2. Type the following command to start installing the RDAC package. :

```
# pkgadd -d /cdrom/SM84/SUN_Sparc/SM8rdac-Sparc-filename.pkg
```

where *filename* is the name of the package on the Solaris installation CD that you want to install.

The installation process begins.

Information about packages that can be installed in the specified directory is displayed on the command line, as in the following example:

```
The following packages are available:

1 RDAC                               Redundant Disk Array Controller
                                      (sparc) version number

Select package(s) you wish to process (or 'all' to process all
packages). (default:all) [?,??,q]:
```

3. Type the value of the package you are installing and press Enter.  
The installation process begins.
4. The software automatically checks for package conflicts. If any conflicts are detected, a message is displayed indicating that some files are already installed and are in use by another package.

The following prompt is displayed:

```
Do you want to install these conflicting files [y, n, ?]
```

Type y and press Enter.

5. The following prompt is displayed:

```
This package contains scripts which will be executed with super-user
permission during the process of installing this package.

Do you want to continue with the installation of <RDAC>

[y, n, ?]
```

Type *y* and press Enter.  
The installation process continues.

6. When the RDAC package has been successfully installed, the following message is displayed:

```
Installation of <RDAC> was successful.
```

Ensure that the variables in the configuration files for your JNI adapter cards have been set to the correct values. For information about these configuration files and their variables, see “Modifying the JNI HBA settings” on page 72.

**Attention:** Modifying failover settings in the JNI configuration file after installing RDAC requires the removal of the RDAC from the host. In this case, complete the following steps, in which you remove RDAC and restart the host.

**Note:** You do not need to remove RDAC or restart the host when you modify or add targets or WWPNs for the controllers. New HBAs can bind to controllers without removing RDAC or restarting the host. To modify or add targets or WWPNs for controllers, do not complete the following steps; simply open and edit the JNI configuration file using the Vi Editor.

If you need to modify the failover settings in the JNI configuration file, complete the following steps:

1. Uninstall the RDAC driver package using the following command:

```
#pkgrm RDAC_driver_pkg_name
```

where *RDAC\_driver\_pkg\_name* is the name of the RDAC driver package that you want to uninstall.

2. Verify RDAC drive package removal using the following command:

```
#pkginfo RDAC_driver_pkg_name
```

where *RDAC\_driver\_pkg\_name* is the name of the RDAC driver package that you uninstalled.

3. Restart the Solaris host using the following command:

```
#reboot -- -r
```

4. Modify the JNI configuration file using the following command:

```
#cd /kernel/drv
#vi JNI_configuration_file
```

where *JNI\_configuration\_file* is the name of the JNI configuration file that you want to modify. When you have finished making changes, run the following command to save the changes:

```
# :wq
```

5. Install the RDAC driver package using the following command:

```
#pkgadd -d RDAC_driver_pkg_name
```

where *RDAC\_driver\_pkg\_name* is the name of the RDAC driver package that you want to install.

6. Verify package installation using the following command:

```
#pkginfo RDAC_driver_pkg_name
```

where *RDAC\_driver\_pkg\_name* is the name of the RDAC driver package that you installed.

7. Restart the Solaris host using the following command:

```
#reboot -- -r
```

---

## Installing DMP on Solaris hosts

This section describes how to install VERITAS Dynamic Multipathing (DMP), which is a failover driver for Solaris hosts. While RDAC supports only 32 LUNs, DMP supports up to 256 LUNs.

**Important:** For more information about using VERITAS DMP, see the VERITAS Volume Manager and VERITAS File System v3.5 documentation for Solaris, which you can download from the following Web site:

[www.veritas.com](http://www.veritas.com)

## System requirements

Ensure that your system meets the following requirements for installing DMP:

- Solaris operating system
- VERITAS Volume Manager 3.5
- SMibmasl.pkg (enables Solaris to recognize the FASTT machine type)

## DMP installation overview

Ensure that your system meets the following prerequisites for installing DMP:

- The HBAs are installed on the Solaris host.
- The JNI HBA package is installed.
- The parameter settings in the JNI configuration file (for example, Jnic146x.conf) are modified.
- In a SAN environment, bindings are configured.
- The zones are created and enabled for the Solaris partition.
- Storage is mapped to the Solaris partition.

Perform the following procedures, in the order listed, to complete the DMP installation:

1. "Preparing for VERITAS DMP installation" on page 83
2. "Installing VERITAS Volume Manager packages for DMP" on page 85

3. "Installing the SMibmasl package" on page 88
4. "Configuring VERITAS Volume Manager" on page 88
5. "Starting the VERITAS Enterprise Administrator" on page 92

## Preparing for VERITAS DMP installation

Complete the following steps to prepare the host for installing VERITAS DMP:

1. Choose the Solaris host on which you want to install DMP.
2. Manually define the targets and LUNs in the `/kernel/drv/sd.conf` file, by completing the following steps.

By default, the `/kernel/drv/sd.conf` file defines targets 0, 1, 2, and 3. LUN0 also is defined for targets 0, 1, 2, and 3.

### Notes:

- Each target represents a controller to a subsystem, and each LUN represents a logical volume.
  - If you are adding additional target or LUN definitions to the `/kernel/drv/sd.conf` file for an existing DMP configuration, be sure to reboot the Solaris host.
- a. Open the `/kernel/drv/sd.conf` file with the Vi Editor, using the following command:

```
# vi /kernel/drv/sd.conf
```

The file will look similar to the following example:

```
#  
# Copyright (c) 1992, Sun Microsystems, Inc.  
#  
#ident "@(#)sd.conf 1.9 98/01/11 SMI"  
  
name="sd" class="scsi" class_prop="atapi"  
target=0 lun=0;  
  
name="sd" class="scsi" class_prop="atapi"  
target=1 lun=0;  
  
name="sd" class="scsi" class_prop="atapi"  
target=2 lun=0;  
  
name="sd" class="scsi" class_prop="atapi"  
target=3 lun=0;
```

- b. Add additional target and LUN definitions, using the Vi Editor. In the following example, it is assumed that the Solaris host is attached to one FASTT subsystem with three LUNs mapped to the FASTT storage partition. In addition, the access LUN must be mapped to the partition.

```

#
# Copyright (c) 1992, Sun Microsystems, Inc.
#
#ident "@(#)sd.conf 1.9 98/01/11 SMI"

name="sd" class="scsi" class_prop="atapi"
target=0 lun=0;

name="sd" class="scsi" class_prop="atapi"
target=1 lun=0;

name="sd" class="scsi" class_prop="atapi"
target=2 lun=0;

name="sd" class="scsi" class_prop="atapi"
target=3 lun=0;

name="sd" class="scsi" target=0 lun=1;
name="sd" class="scsi" target=0 lun=2;
name="sd" class="scsi" target=0 lun=3;
name="sd" class="scsi" target=0 lun=31;
name="sd" class="scsi" target=1 lun=1;
name="sd" class="scsi" target=1 lun=2;
name="sd" class="scsi" target=1 lun=3;
name="sd" class="scsi" target=1 lun=31;

```

- c. Save the new entries in the /kernel/drv/sd.conf file, using the following command:

```
# :wq
```

3. Verify that RDAC is not installed on the host, using the following command:

```
# pkg info -l RDAC
```

4. If RDAC is installed, remove it using the following command:

```
# pkgrm RDAC
```

5. Verify that a host partition has been created. If not, create one by following the procedure that is described in "Setting up a Solaris host group" on page 79.

**Note:** Set the host port type to Solaris DMP. Failure to do so results in an inability to map for more than the RDAC limit of 32 LUNs, and causes other undesired results.

6. Ensure that all of the paths are optimal, and are in a preferred path state from the SMclient.
7. Reboot the host and ensure that the devices show up, using the following command:

```
# SMdevices
```

8. Verify that you have a 1 GB logical drive available for the rootdg.
9. Label the logical drive that you are using for the rootdg, using the following command:

```
# format
```

10. Reboot the Solaris host, using the following command:

```
# reboot -- -r
```

## Installing VERITAS Volume Manager packages for DMP

The installation steps that are described in this section are based on a CD installation of VERITAS.

**Before you begin:** Ensure that you have the VERITAS Volume Manager license key, and any other VERITAS licenses that you want to install, available during the installation process.

Complete the following steps to install VERITAS Volume Manager packages for DMP:

1. Insert the VERITAS CD into the CD-ROM drive.
2. Navigate to the mounted CD directory. If you are unsure about the mount point path to the CD-ROM, use the following command:

```
#df
```

The result is similar to the following example:

```
/          (/dev/dsk/c0t0d0s0):22222222 blocks 173544 files
/proc      (/proc          ):          0 blocks 29903 files
/dev/fd    (fd              ):          0 blocks   0 files
/etc//mnttab (mnt            ):          0 blocks   0 files
/var/run   (swap           ): 6764416 blocks 210436 files
/tmp       (swap           ):6764416 blocks 210436 files
/cdrom/storage_solutions_solaris_3.5cd1
(/vol/dev/dsk/c1t6d0/storage_solutions_solaris_3.5cd1):
22222222 blocks 500 files
```

**Note:** In this example, you would use the following command to go to the mounted CD directory:

```
# cd /cdrom/storage_solutions_solaris_3.5cd1
```

3. Run the VERITAS installer script, using the following commands:

```
# ls
```

**Note:** The output of the **# ls** command is similar to the following:

```
cluster_server      menu
database_ac_for_oracle9i sanpoint_foundation_suite
file_system         traffic_director
installer           volume_manager
installer.pdf       win32
```

```
# ./installer
```

- A new screen displays. Type y (yes) to install VRTSvlic, as shown in the following example:

```

VERITAS Storage Solutions
Looking for package VRTSvlic
Currently installed 0
Minimum Version:3.00.000

For release Train installation to continue, VRTSvlic
must installed or upgraded.
Do you want to install it now? [y,n]: y

```

- The VERITAS Storage Solutions screen displays. Install the license for VERITAS Volume Manager 3.5 by selecting option 1 (Add License Key), as shown in the following example:

```

VERITAS Storage Solutions
VERITAS Product      Currently Installed  Licensed
=====
Volume Manager      Not Installed      No
File System         Not Installed      No
Foundation Suite    Not Installed      No
Volume Replicator   Not Installed      No
Flash Snap          Not Installed      No
Database Edition for Ora Not Installed      No

1= Add License Key 2=Installation Menu 3=Refresh h=help
p= Product Description q=quit

Enter [1,2,3,h,p,q]: 1

```

- Type the VERITAS license key, as shown in the following example:

```

VERITAS Storage Solutions
Please enter your VERITAS license key: XXXX-XXXX-XXXX-XXXX-XXXX

```

- After the license is successfully installed, a product summary screen displays. Install VERITAS Volume Manager by selecting Option 2 (Installation Menu), as shown in the following example.

**Note:** Allow VERITAS to install conflicting files. At minimum, you must install the VRTSvmpro file. If you want to use the GUI version of VERITAS Volume Manager, you must also install additional packages. See the VERITAS Volume Manager 3.5 installation documentation if you want to install the VERITAS Volume Manager GUI.



VERITAS Storage Solutions		
VERITAS Product	Currently Installed	Licensed
Volume Manager	Not Installed	<b>Yes</b>
File System	Not Installed	<b>Yes</b>
Foundation Suite	Not Installed	<b>Yes</b>
Volume Replicator	Not Installed	No
Flash Snap	Not Installed	No
Database Edition for Ora	Not Installed	No

1= Add License Key 2=**Installation Menu** 3=Refresh h=help  
p= Product Description q=quit

Enter [1,2,3,h,p,q]: 2

8. A list of available products displays. Install VERITAS Volume Manager by selecting option 1 (Volume Manager) from the products list, then type y (yes), as shown in the following example:

VERITAS Storage Solutions
Available products:
1) <b>Volume Manager</b>
2) File System
3) Foundation Suite (Quick Start, HA & Flash Snap)
4) Volume Replicator
5) Database Edition for Oracle
6) Cluster Server
7) SanPoint Foundation Suite
8) Cluster Server QuickStart
9) Database Edition/Advance Cluster for Oracle 9i
10) Cluster Server Traffic Director
q) Return to the main menu
h) Installation help
Enter the number of the product to install or [q,h]: 1
VERITAS Storage Solutions
You are about to begin installation of Volume Manager
Do you want to continue? [y,n]: y

9. A list of available products displays again. Install VERITAS file systems by selecting option 2 (File System), then typing y (yes).

**Note:** Allow VERITAS to install conflicting files, and when prompted to install setuid/setgid files and the VRTSvxfs file, answer y (yes) to both.

10. Exit the VERITAS installer by selecting option q (Return to the main menu) on the products screen.
11. A product summary screen displays. Exit the screen by selecting option q (quit), as shown in the following example:

VERITAS Storage Solutions		
VERITAS Product	Currently Installed	Licensed
=====		
Volume Manager	3.5, REV=06.21.2002.23.14	Yes
File System	3.5, REV=GA06	Yes
Foundation Suite	3.5	Yes
Volume Replicator	3.5, REV=06.21.2002.23.14	Yes
Flash Snap	3.5, REV=06.21.2002.23.14	Yes
Database Edition for Ora	Not Installed	No
1= Add License Key 2=Installation Menu 3=Refresh h=help p= Product Description <b>q=quit</b>		
Enter [1,2,3,h,p,q]: <b>q</b>		

## Installing the SMibmasl package

Complete the following steps to install the SMibmasl package:

1. Install the SMibmasl package, using the following command:

**Note:** You can select either the default (all), or select option 1.

```
#pkgadd -d SMibmasl_pkg
```

2. Reboot the Solaris host, using the following command:

```
# reboot -- -r
```

## Configuring VERITAS Volume Manager

Complete the following steps to configure the VERITAS volume manager:

1. Initialize one disk for rootdg, using the following command:

```
# vxinstall
```

**Note:** You have already entered a license key for VERITAS Volume Manager and VERITAS File System. You do not need to install additional VERITAS software at this time. Unless you want to install additional VERITAS software at this time, type n (no) in response to both of the following questions:

```
Some licenses are already installed.
Do you wish to review them?
[y,n,q,?] (default: y) n

Do you wish to enter another
license key [y,n,q,?]
(default: n) n
```

2. The Volume Manager Installation screen displays. Choose whether to set up enclosure-based names for the FAStT-attached disks by typing y (yes) or n (no), as shown in the following example:

```

Volume Manager Installation
Menu: Volume Manager/Install

VxVM will use the following format to name disks on the host:

enclosurename_diskno

In the above format, enclosurename is the logical name
of the enclosure to which the disk belongs.
VxVM assigns default enclosure names which
can be changed accordingly to the user requirements.

Some examples would be:

FAStT_2 - second disk detected in enclosure 'hitachio'
Jbod_1 - first disk detected in the jbod category

For non-public loop disks (Ex. FC disks directly
connected to the host or through Hubs),
you could choose to use the c#t#d#s# naming format.

Do you want to use enclosure based names for all disks?
[y,n,q,?] (default: n) n

```

3. The Volume Manager Installation screen displays. Press the Return key to continue the installation process, as shown in the following example:

```

Volume Manager Installation
Menu: Volume Manager/Install

The Volume Manager has detected the following
categories of storage connected to your system:

Enclosure: Disk IBM_FAStT0

Hit RETURN to continue

```

4. The Volume Manager Installation Options screen displays. Select option 2 (Custom Installation), as shown in the following example.

```

Volume Manager Installation Options
Menu: VolumeManager/Install

1. Quick Installation
2. Custom Installation
3. Prevent multipathing/Suppress devices from VxVM's view

? Display help about menu
?? Display help about the menuing system
q Exit from menus

Select an operation to perform: 2

```

5. The Volume Manager Custom Installation screen displays. Select n (do not encapsulate the boot disk), as shown in the following example:

```
Volume Manager Custom Installation
Menu: VolumeManager/Install/Custom

The CxTxDx disk is your boot disk.
You can add it as a new disk.
If you encapsulate it, you will
make your root file system and
system areas on the Boot Disk
into volumes. This is required if
you wish to mirror your root file
system or system swaparea.

Encapsulate Boot Disk [y,n,q,?] (default: n) n
```

6. The Volume Manager Custom Installation screen displays. Press the Return key to continue, as shown in the following example:

```
Volume Manager Custom Installation
Menu: VolumeManager/Install/Custom/Disk

Disk array serial number: DISKS

Generating list of disks in disk array Disk ...

<excluding root disk c0t0d0>

The volume Manager has detected the following disks in
Enclosure Disk:

c0t1d0

Hit RETURN to continue.
```

7. The Installation Options for Controller Disk screen displays. Select option 3 (Install one disk at a time), as shown in the following example:

```
Installation Options for Controller Disk
Menu: Volume Manager/Install/Custom/Disk

1 Install all disks as pre-existing disks. (encapsulate)
2 Install all disks as news disks. (discard data on disks!)
3 Install one disk at a time.
4 Leave these disks alone.

? Display help menu
?? Diplay help about the menuing system
q Exit from menus

Select an operation to perform: 3
```

8. The Installation Options for Disk XXXXXX screen displays (similar to the screen that is shown in step 7). Select option 3 (Install one disk at a time).

9. The Volume Manager Custom Installation screen displays. Press the Return key to continue, as shown in the following example:

```

Volume Manager Custom Installation
Menu: VolumeManager/Install/Custom/disk/IBM_FASTT0

Disk array serial number : 600A0B800000F144000000

Generating list of disk in disk array IBM_FASTT0 ....

    The Volume Manager has detected the following
disk in enclosure IBM_FASTT0:

    C8t4d0 c8t1d1 c8t4d2 c8t4d3

Hit RETURN to continue.

```

10. The Installation Options for Controller YYYYYY displays (similar to the screen that is shown in step 7). Select option 3 (Install one disk at a time).
11. The Installation Options for Disk ZZZZZZ displays. For the rootdg, select option 2 (Install as a new disk).  
In the following example, c8t4d0 is the logical volume that is being used as the rootdg for VERITAS DMP:

```

Installation options for disk c8t4d0
Menu: VolumeManager /Install/Custom/Disk/IBM_FASTT0

    1 Install as pre-existing disk. (encapsulate)
    2 Install as a new disk. (discard data on disks!)
    3 Leave this disk alone.

    ? Display help menu
    ?? Display help about the menuing system
    q Exit from menus

Select an operation to perform: 2

Are you sure (destroys data on c8t4d0) [y,n,q,?]
    (default: n) Y

Enter disk name for c8t4d0 [<name>,q,?] (default: disk 01)

```

12. The Installation Options for Disk XYXYXY displays. Select option 3 (Leave disk alone) for all non-rootdg logical volumes, as shown in the following example:

```

Installation options for disk c8t4d1
Menu: VolumeManager /Install/Custom/Disk/IBM_FASTT0

    1 Install as pre-existing disk. (encapsulate)
    2 Install as a new disk. (discard data on disks!)
    3 Leave this disk alone.

    ? Display help menu
    ?? Display help about the menuing system
    q Exit from menus

Select an operation to perform: 3

```

13. Be sure to repeat step 12 for each of the remaining disks on the FASTT storage array.

14. A summary screen displays, similar to the following example. Press Enter.

```
Volume Manager Custom Installation
Menu: VolumeManager /Install/Custom/Disk/IBM_FAStT0

The following is a summary of your choices.

C8t4d0  New disk

Is this correct [y,n,?] (default: y) ENTER
```

15. Status information displays, similar to the following example. When the display has completed, select y (yes) to reboot the system.

```
The Volume Manager is now reconfiguring (partition phase) ...
Volume Manager: Partitioning c8t4d0 as a new disk
The Volume Manager in now reconfiguring (initialization phase) ...
Volume Manager: Adding disk01 (c8t4d0) as new disk.
The volume Daemon has been enabled for tranactions.
The system now must be shut down and rebooted in order to
continue the reconfiguration.
Shutdown and reboot now [y,n,q,?] (default:n) Y
```

## Starting the VERITAS Enterprise Administrator

After you have installed the VERITAS packages, and configured the rootdg, you must stop and restart the VERITAS Enterprise Administrator (VEA).

**Note:** VEA starts automatically after a reboot.

Complete the following steps to start VEA:

1. Stop the VEA service, using the following command at the command prompt:

```
# /opt/VRTSob/bin/vxsvc -k
```

2. Restart the VEA service, using the following command:

```
# /opt/VRTSob/bin/vxsvc
```

3. Verify the state of the VEA service, using the following command:

```
# /opt/VRTSob/bin/vxsvc -m
```

4. Start the VEA GUI, using the following command:

```
# /opt/VRTSob/bin/vea &
```

5. Login to the VEA GUI, and rescan.

When you are done, you have completed installing VERITAS DMP for the Solaris host.

See the VERITAS documentation for information about how to complete the following tasks:

- Set up disk groups
- Create volumes
- Create file systems
- Mount file systems

---

## Verifying external storage

After you install the failover driver, complete the following steps to verify that the host can "see" your external storage.

**Before you begin:** SMutil must be installed on the host to enable the **SMdevices** and **hot\_add** commands, which you use in the following procedure. For information about how to install SMutil, see "Installing SMutil (required)" on page 68.

**Note:** Do not delete the access LUN or the access volume. RDAC uses the access LUN for communication between controllers and SMclient. Therefore, a storage subsystem with two controllers would require two access LUNs. The access LUN is typically assigned the LUN number 31, by default.

1. Run the following command to verify that your host can see your external FAS*T* storage:

```
#cd /etc/raid/bin/SMdevices
```

You must see two access LUNs, and all configured storage (logical drives). If any of these are missing, run the following command:

```
#cd /etc/raid/bin/hot_add
```

2. Run the following command to cross-verify between SMutil and what the host sees:

```
#format
```

You must see two access LUNs, and all configured storage (logical drives). If you still do not see all your storage check the following:

- Recheck your zones.
- Make sure that the zones have been enabled.
- Recheck the targets and WWPNs.
- Check to see if the FAS*T* Controllers and expansion drawers are powered on.
- Check to see if the switch or switches are powered on.
- Check fibre-channel cables.

---

## Redistributing volumes in case of failure

Auto Volume Transfer (AVT) is disabled, by default, on Solaris hosts. Therefore, if a failure occurs that initiates a controller failover, you must manually redistribute logical drives to their preferred paths.

Complete the following steps to redistribute logical drives to their preferred paths.

1. Repair or replace any faulty components. For more information, see the *IBM TotalStorage FAStT Installation and Support Guide* for the appropriate FAStT Fibre Channel Storage Server.
2. Redistribute volumes to their preferred paths by clicking **Subsystem Management** → **Storage Subsystem** → **Redistribute Logical Drive**.



---

## Chapter 5. Completing the software configuration

After you finish installing Storage Manager 8.4, you must complete your configuration. This chapter describes how to complete the Storage Manager 8.4 configuration by performing the following tasks:

- “Configuring storage subsystems”
- “Configuring alert notifications” on page 97
- “Renaming storage subsystems” on page 97
- “Creating a storage subsystem profile” on page 98
- “Performing other storage subsystem management tasks” on page 98

**Attention:** For cluster configurations, complete all applicable configuration procedures for each storage subsystem *before* installing the storage management software on a second host or cluster server.

---

### Overview of heterogeneous host configurations

The heterogeneous hosts feature enables hosts that are running different operating systems to access a single storage subsystem. Storage Manager 8.4 supports up to 64 storage partitions, which enables a multiple host-type subsystem to share storage capacity, consolidate storage, and reduce storage management costs.

Host computers can run on completely different operating systems (for example, AIX and Solaris) or variants of the same operating system (for example, Solaris running in a cluster environment). When you define a host type 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 and error conditions) to the needs of the operating system or variant of the host that is sending the information.

**Important:** When you define host types in a heterogeneous environment, you must set each host type to its appropriate operating system so that the firmware on each controller can respond correctly for the appropriate operating system.

Before you begin setting up the configuration for you heterogeneous host, see the *IBM FAS*™*T Storage Manager Concepts Guide* available on your installation CD or at the following Web site:

[www.ibm.com/pc/support/](http://www.ibm.com/pc/support/)

---

### Configuring storage subsystems

Use the following procedures to start the SMclient from either the storage management station or from a host that is acting as a storage management station (a host with the client software installed). Use the SMclient to discover and configure each attached storage subsystem.

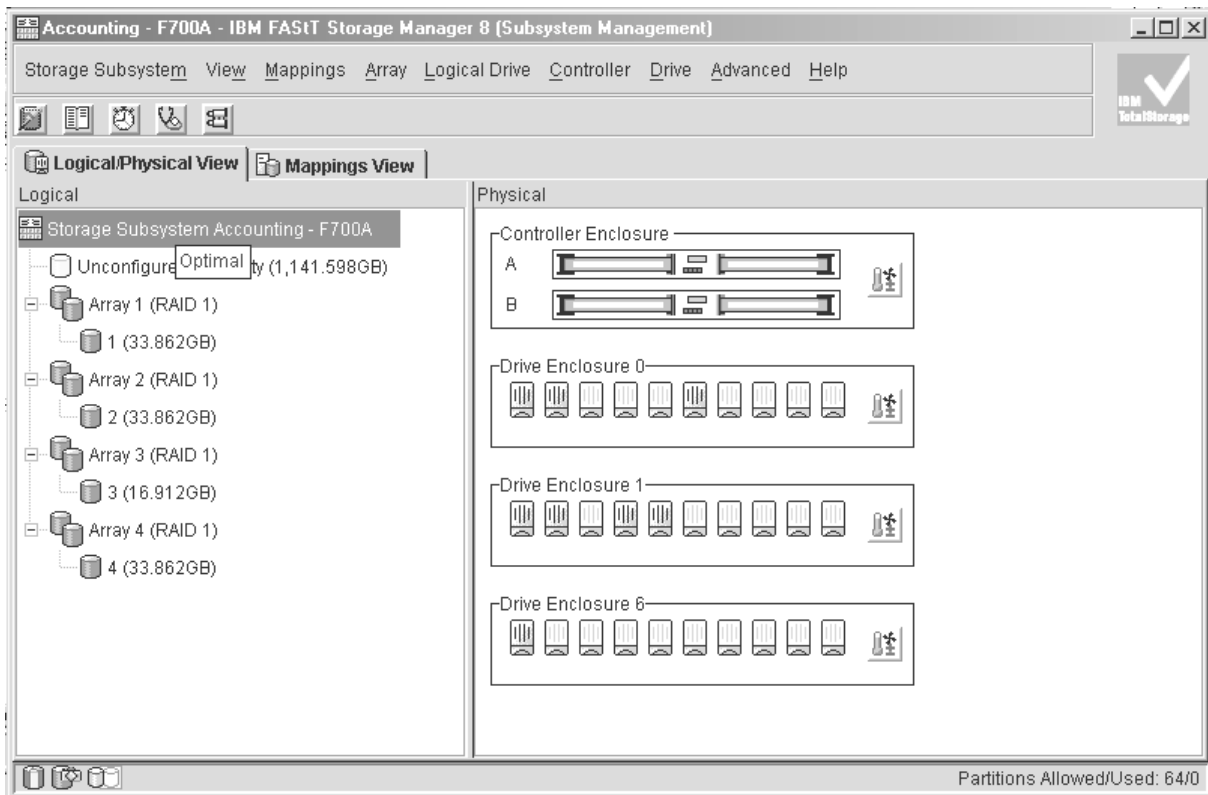
### Performing an initial automatic discovery of storage subsystems

Complete the following steps to begin an initial automatic discovery of all the attached hosts and storage subsystems:

1. If you are running the SMclient from AIX, first change to the /SMclient directory and then type SMclient. If you are running the client software from Solaris 8, type SMclient.
2. Click **Yes** to begin the initial automatic discovery.

**Note:** It can take up to one minute for the Enterprise Management window to refresh after an initial automatic discovery. If you need to stop the automatic discovery operation for any reason, close the Enterprise Management window.

When the initial automatic discovery is finished, all attached hosts and attached storage subsystems are displayed in the Enterprise Management window, as shown in Figure 12.



SJ001148

Figure 12. Enterprise Management window

3. Ensure that all of the attached hosts and storage subsystems are displayed as expected. If they are not, complete the following steps:
  - a. Check the hardware and connections for possible problems (see the hardware documentation for specific procedures).
  - b. See the Enterprise Management window help topic on discovering storage subsystems and take the appropriate action that is indicated.
  - c. Ensure that the device is on the local subnetwork. If it is not, click **Edit** → **Add Device** to add it. See the Enterprise Management window help topic on adding devices.

**Note:** Failure to add both controllers results in a partially-managed device.

- d. If a storage subsystem is duplicated in the device tree after an automatic discovery, remove the duplicate storage subsystem icon from the device tree by clicking **Edit** → **Remove Device** in the Enterprise Management window.
4. Ensure that the status of each storage subsystem is **Optimal**:
  - If any device shows a status of **Unresponsive**, remove the device from the management domain, and then add it again. See the Enterprise Management window help topic on removing and adding devices.
  - If the device still shows an unresponsive status, contact your IBM technical-support representative.
5. Go to “Configuring alert notifications.”

---

## Configuring alert notifications

After you have added devices to the management domain, you should set up alert notification options to report critical events on the storage subsystems. The following alert notification options are available:

- Alert notifications are sent to a designated network management station (NMS) using simple network management protocol (SNMP) traps.
- Alert notifications are sent to a designated e-mail address. See the Enterprise Management window help for specific procedures. To send e-mail to IBM, contact your customer service representative.
- Alert notifications are sent to a designated alphanumeric pager when third-party software is used to convert e-mail messages. See the Enterprise Management window help for specific procedures.

For more information about notification options, see the *IBM FAST Storage Manager Concepts Guide*, which is available on your installation CD, or at the following Web site:

[www.ibm.com/pc/support/](http://www.ibm.com/pc/support/)

Complete the following steps to set up alert notifications using SNMP traps. You need to set up the designated management station only once.

1. Ensure that the installation CD is inserted in the CD-ROM drive on your designated NMS.
2. From the installation CD, copy the SM8.MIB file from the SM8mib directory to the NMS.
3. Follow the steps required by your NMS to compile the MIB. For details, contact your network administrator or see the documentation for the storage management product you are using.

---

## Renaming storage subsystems

When you start the storage management software for the first time, the storage subsystems are unnamed. In the Subsystem Management window, click **Storage Subsystem** → **Rename**. Rename each storage subsystem from <unnamed> to a name that is appropriate for your network.

---

## Creating a storage subsystem profile

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. In the event of a catastrophic failure, you can use the storage subsystem profile to help recover the configuration.

Complete the following steps to create a storage subsystem profile:

1. Click **View** → **Storage Subsystem Profile** in the Storage Subsystem Management window. The Storage Subsystem Profile window opens.
2. Click **Save As**.
3. Type a file name for the storage subsystem profile and save it to a directory.

If you have a storage server with firmware 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, upgrade your controller to firmware 04.01.02.34 or later.

Complete the following steps to create a storage subsystem profile by using the Capture State Information feature.

1. Click **Advanced** → **Capture State Information**. The State Capture window opens.
2. Click **Browse** to specify the file name for the state capture information.
3. Click **Start** to start the capture process.
4. Click **Cancel** to close the State Capture window when the capture is complete.

---

## Performing other storage subsystem management tasks

You can also perform other storage subsystem management tasks at this time. To perform the following tasks and other storage subsystem management tasks, see the appropriate topics in the Subsystem Management window help.

- Locate a storage subsystem
- View a storage subsystem profile
- Configure a storage subsystem password
- Create and manage arrays and array groups
- Use the performance monitor
- Create storage partitions (if Storage Partitioning is enabled on your system)

If you are installing the storage management software in a cluster environment, repeat all applicable client software installation procedures for a second storage management station and for all applicable host software on a second host. See Chapter 2, “Installing storage management station software on AIX systems,” on page 17, Chapter 3, “Installing storage management station software on HP-UX systems,” on page 47, or Chapter 4, “Installing storage management station software on Solaris systems,” on page 63 for installation instructions.

---

## Chapter 6. Storage Manager 8.4 with high-availability cluster services

The high-availability clustering services provided by Storage Manager 8.4 allow application services to continue when a hardware or software failure occurs. This system protects you from software failures as well as from the failure of a CPU, disk, or LAN component. If a component fails, its redundant partner component takes over cluster services and coordinates the transfer between components.

---

### General information

You can use Storage Manager 8.4 with the following cluster services.

Operating System	High-Availability Cluster Service
HP-UX	MC/Service Guard A.11.09, A.11.13, and A11.14
Solaris	VERITAS Cluster Server 1.3, 2.0, and 3.5 VERITAS Volume Manager 3.2, and 3.5 VERITAS File Systems 3.2 and 3.5 <b>Note:</b> If you are using DMP, you must have VERITAS version 3.5.

This document does not describe how to install or configure cluster services. See the documentation that is provided with your cluster service products for this information.

**Note:** When using storage partitioning in conjunction with a cluster solution, all partitions in the clusters must "see" the same storage. Therefore, logical drive mapping to cluster partitions must be done on the host group level.

---

### Using cluster services on HP-UX systems

You can choose among many configurations when you set up clustering on an HP-UX system. A minimum configuration consists of two servers that are configured with both a primary and two standby LANs to establish a heartbeat LAN.

Provide fibre connections to the storage subsystem through two switches that provide the necessary redundant data path for the hosts. Ensure that each server has two HP Tachyon host bus adapters.

---

### Using cluster services on Solaris systems

The following sections contain general hardware requirements and additional information about the cluster services.

#### General hardware requirements

Each Solaris system in the cluster requires the following hardware:

- At least three Ethernet ports:
  - Two for the private network connections
  - At least one for the public network connection
- Two fibre host bus adapters for connection to the storage subsystem
- A SCSI connection for operating system disks

- Each VERITAS Cluster Server system requires at least 128 MB of RAM and 35 MB of free disk space

## System dependencies

This section provides information about VERITAS Volume Manager, RDAC IDs, and single points of failure.

### RDAC IDs

Add up to eight additional IDs to the `/etc/symsm/rmparams` file. Complete the following steps to add them:

1. Open the `/etc/symsm/rmparams` file in the vi text editor by typing the following command:

```
# vi /etc/symsm/rmparams
```

2. Modify the `Rdac_HotAddIDs` line as follows:

```
Rdac_HotAddIDs:0:1:2:3:4:5:6:7:8
```

3. Save and close the `/etc/symsm/rmparams` file.

### Single points of failure

When setting up cluster services, it is important to eliminate single points of failure because a single point of failure makes a cluster only as strong as its weakest component. Set up the storage subsystem for shared storage; for example, all the nodes in the cluster must recognize the same storage and the host types must be set correctly.

---

## Appendix A. AIX system requirements

This appendix lists the minimum hardware and software requirements that an AIX system must meet to be used in a FAST600, FAST700, or FAST900 storage subsystem that is managed by Storage Manager 8.4.

A readme file that contains the latest installation and user information about the storage management software, AIX filesets, and hardware components is located in the AIX FAST Installation CD. The most recent copy, which supercedes this document, is maintained on the following Web site:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FAST Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FAST Storage Manager for AIX.

---

### Hardware requirements

The following hardware is required at a minimum:

- Any RS/6000® or IBM @server pSeries™ server that supports FC 6227, FC 6228 or FC 6239 host bus adapters

---

### Software requirements

The following software must be the specified versions:

- AIX 4.3.3, AIX 5.1 or 5.2
- Filesets associated with IBM RDAC driver installations listed in Table 15, Table 16, or Table 17 on page 102.

---

### RDAC installation requirements

The filesets that are listed in Table 15, Table 16, and Table 17 on page 102 must be the specified versions or later.

*Table 15. Filesets required for AIX 4.3.3 RDAC*

PTF filesets	Version
devices.fcp.disk.array.diag	4.3.3.50
devices.fcp.disk.array.rte	4.3.3.86
devices.common.IBM.fc.rte	4.3.3.75
devices.pci.df1000f7.com	4.3.3.89
devices.pci.df1000f7.rte	4.3.3.76
devices.pci.df1000f9.rte	4.3.3.76
devices.scsi.sccarray.rte	4.3.3.50

*Table 16. Filesets required for AIX 5.1 RDAC*

PTF filesets	Version
devices.fcp.disk.array.diag	5.1.0.50
devices.fcp.disk.array.rte	5.1.0.53

Table 16. Filesets required for AIX 5.1 RDAC (continued)

PTF filesets	Version
devices.common.IBM.fc.rte	5.1.0.50
devices.pci.df1000f7.com	5.1.0.53
devices.pci.df1000f7.rte	5.1.0.35
devices.pci.df1000f9.rte	5.1.0.35

Table 17. Filesets required for AIX 5.2 RDAC

PTF filesets	Version
devices.fcp.disk.array.diag	5.2.0.10
devices.fcp.disk.array.rte	5.2.0.13
devices.common.IBM.fc.rte	5.2.0.10
devices.pci.df1000f7.com	5.2.0.12
devices.pci.df1000f7.rte	5.2.0.10
devices.pci.df1000f9.rte	5.2.0.10

**Note:** The AIX RDAC driver files are not included on the FAStT installation CD. Either install them from the AIX Operating Systems CD, if the correct version is included, or download them from the following Web site:

[techsupport.services.ibm.com/server/aix.fdc](http://techsupport.services.ibm.com/server/aix.fdc)

For more information, see “Installing RDAC on AIX hosts” on page 24.



---

## Appendix B. HP-UX system requirements

This appendix lists the minimum hardware and software requirements that an HP-UX system must meet to be used in a FAST600, FAST700, or FAST900 storage subsystem that is managed by Storage Manager 8.4.

A readme file that contains the latest installation and user information about the storage management software, and hardware components located in the HP-UX FAST Installation CD. The most recent copy, which supercedes this document, is maintained on the following Web site:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FAST Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FAST Storage Manager for HP-UX.

---

### Hardware requirements

The HP-UX system must be an HP 9000/Series 800 server with:

- 400 MHz processor or faster
- 0.7 MB available on /opt and root (or root-equivalent) privileges for installing SMutil and SMagent
- 47.5 MB available disk space on /opt and at least 95 MB available on /tmp for installation in an SMruntime environment

---

### Software requirements

Ensure that the HP-UX host is running one of the following operating systems with the appropriate patches. Because patches can be superseded by more recent versions, refer to your operating system documentation or contact your operating system supplier to ensure that you have the correct patches.

- HP-UX 11.0 (64 bit) with the following patches:
  - PHKL\_23939, version 1.0
  - PHKL\_24004, version 1.0
  - PHKL\_24027, version 1.0
  - PHKL\_27364, version 1.0
  - PHKL\_27003, version 1.0
  - To run HP-UX SDK for Java 2 Platform applications and applets using GUIs, you must also ensure that the HP C++ runtime libraries are installed on the HP-UX system; the latest version is available as patch PHSS\_1658
- HP-UX 11.i (64 bit) with the following patches:
  - B.11.11.09
  - PHKL\_23666, version 1.0
  - PHKL\_26743, version 1.0
  - PHKL\_27408, version 1.0
  - PHKL\_26519, version 1.0
- For high-availability clusters of HP 9000/Series 800 computers, install the HP MC/Service Guard software package.

Ensure that the following maximum kernel parameters are configured, as shown in Table 18.

*Table 18. HP-UX kernel parameter configuration requirements*

<b>Parameter</b>	<b>Description</b>	<b>Configuration</b>
max_thread_proc 64	Maximum threads per process	1024
maxfiles	Soft-file limit per process	2048
maxuser	Influences other parameters	256 or greater
ncallout	Number of pending timeouts	4144

---

## Appendix C. Solaris system requirements

This appendix lists the minimum hardware and software requirements that a Solaris system must meet to be used in a FAST600, FAST700, or FAST900 storage subsystem that is managed by Storage Manager 8.4.

A readme file that contains the latest installation and user information about the storage management software, and hardware components located in the Solaris FAST Installation CD. The most recent copy, which supercedes this document, is maintained on the following Web site:

[ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/disk)

Click the link for your FAST Storage Server. When the page opens, click **Storage Manager v8.4**. Accept the license agreement, then click the **v8.4** link for IBM FAST Storage Manager for Solaris.

---

### Hardware requirements

The Solaris system must be an Sparc S20 processor with:

- 256 MB system memory
- CD-ROM drive
- Mouse or similar pointing device
- Ethernet network interface card
- 1 MB available on /opt and root (or root-equivalent) privileges for installing RDAC

---

### Software requirements

Ensure that the Solaris host is running one of the following operating systems with the appropriate patches. The patches listed in this document can be superseded by more recent versions, so see your Solaris operating system documentation or contact your operating system supplier to ensure that you have the correct patches.

- Solaris 7 with the following patches (minimum versions):
  - 106541-23
  - 108376-42 (or later)
  - 107544-03
- Solaris 8 with the following patches (minimum versions):
  - 06 Jumbo Patch
  - 111293-04
  - 111310-01
  - 111111-03
  - 108987-12
- For high-availability clusters of Sparc S20 systems, install the VERITAS Cluster Server software package. Check the VERITAS Cluster Server (VCS) documentation for the latest patches.



---

## Appendix D. MC/Service Guard configuration details

**Note:** The Hewlett Packard publication *Managing MC/ServiceGuard* suggests using **vgimport -m -s** with LVM commands during the configuration distribution process. It is important to consider, however, that the **vgimport** command does not preserve the primary and alternate paths of the imported volume groups.

When **vgimport** reconstructs the newly imported volume groups, entries are made in the `/etc/lvmtab` file. In this process of reconstruction, the system reorders disks in the file. The revised order of LUNs on the list causes LUNs to remain on non-preferred paths after failover. You might expect this condition to occur during distribution of the volume groups using the following LVM command:

```
vgimport -s -m /tmp/vg_group_name.map /dev/vg_group_name
```

where `vg_group_name` is the name of the volume group that is being distributed.

This precaution applies only when you use the `-s` option to import devices or disks with redundant paths. The condition occurs because the `-s` option causes a search on the system for each disk when used with **vgimport**.

When the new list is prepared, the links that were previously designated as primary and alternate might not remain as they had been configured on node *A*.

Complete the following steps to correct the paths that were changed in this way when using **vgimport -m -s** with LVM commands.

**Note:** The following instructions are for a two-node cluster. You can easily expand or adapt these instructions to accommodate a cluster which has more than two nodes.

1. Identify and note the primary and alternate paths for each device by typing the following command:

```
# SMdevices
```

2. Compare the primary and alternate paths for each device on node *A* to Node *B* by using the **vgdisplay -v** command. As previously noted, an expected behavior of the **vgimport -m -s** command is that the primary and alternate paths change during export.

On node *A*:

```
#vgdisplay -v volume_group_name
```

where `vg_group_name` is the name of the volume group whose paths you want to display.

On node *B*:

```
#vgdisplay -v volume_group_name
```

where `vg_group_name` is the name of the volume group whose paths you want to display.

3. If the original primary path of a disk becomes an alternate path after the newly imported volume group entry is created in `/etc/lvmtab`, the order can be easily reverted by using **vgreduce** to remove the wrong primary path and then using

**vgextend** to add the path back again:

```
#vgreduce  
vg1 /dev/dsk/device_name#vgextend  
vg1 /dev/dsk/device_name
```

## Appendix E. JNI host bus adapter settings

The following tables detail settings for the various HBA cards for Sun Solaris.

The JNI cards are not plug-and-play with auto-configuration. Instead, you might need to change the settings or bindings.

Table 19. Configuration settings for FCI-1063

Original value	New value	Comments
fca_nport = 0;	fca_nport = 1;	
ip_disable = 0;	ip_disable = 1;	
failover = 0;	failover = 30;	
busy_retry_delay= 5000;	busy_retry_delay = 5000;	
link_recovery_delay = 1000;	link_recovery_delay = 1000;	
scsi_probe_delay = 5000;	scsi_probe_delay = 5000;	
def_hba_binding = "fca-pci*";	def_hba_binding = "nonjni";	
def_wwnn_binding = "\$xxxxxx"	def_wwnn_binding = "xxxxxx"	Uncomment the line.
def_wwpn_binding = "\$xxxxxx"	Same as the original entry.	Uncomment the line.
Will be added by reconfigure script	name="fca-pci" parent="physical path" unit-address="#"	Uncomment the line.
Will be added by reconfigure script	target0_hba="fca-pci0" target0_wwpn="controller wwpn";	
Will be added by reconfigure script	name="fca-pci" parent="physical path" unit-address="#"	
Will be added by reconfigure script	target0_hba="fca-pci1" target0_wwpn= "controller wwpn";	

**Note:** You might need to run the `/etc/raid/bin/genjnicnf` reconfigure script from the Solaris shell.

```
# /etc/raid/bin/genjnicnf
```

Table 20. Configuration settings for FCE-1473/FCE-6460/FCX2-6562/FCC2-6562

Original value	New value	Comments
FcLoopEnabled = 1	FcLoopEnabled = 0	Uncomment the line.
FcFabricEnabled = 0	FcFabricEnabled = 1	Uncomment the line.
FailoverDelay = 30;	FailoverDelay = 30;	Uncomment the line.
JniCreationDelay = 5;	JniCreationDelay = 10;	Uncomment the line.
def_wwnn_binding = "\$xxxxxxxxxxx"	def_wwnn_binding = "xxxxxxxxxxx"	Uncomment the line.
def_wwpn_binding = "\$xxxxxxxxxxx"	Same as the original entry.	Uncomment the line.
Add	target0_hba = "jnic146x0";	

Table 20. Configuration settings for FCE-1473/FCE-6460/FCX2-6562/FCC2-6562 (continued)

Original value	New value	Comments
Add	target0_wwpn = "<controller_wwpn>"	
Add	target1_hba = "jnic146x1";	
Add	target1_wwpn = "<controller_wwpn>"	

**Note:** You might need to run the `/etc/raid/bin/genjnicnf` reconfigure script from the Solaris shell.

```
# /etc/raid/bin/genjnicnf
```

Table 21. Configuration settings for FCE-1063/FCE2-1063/FCE-6410/FCE2-6410

Original value	New value	Comment
FcLoopEnabled = 1	FcLoopEnabled = 0	Uncomment the line.
FcFabricEnabled = 0	FcFabricEnabled = 1	Uncomment the line.
FailoverDelay = 30;	FailoverDelay = 60;	Uncomment the line.
JniCreationDelay = 5;	JniCreationDelay = 10;	Uncomment the line.
def_wwnn_binding = "\$xxxxxxxxxxx"	def_wwnn_binding = "xxxxxxxxxxx"	Uncomment the line.
def_wwpn_binding = "\$xxxxxxxxxxx"	Same as the original entry.	Uncomment the line.
Add	target0_hba = "jnic146x0";	
Add	target0_wwpn = "controller_wwpn"	
Add	target1_hba = "jnic146x1";	
Add	target1_wwpn = "controller_wwpn"	

**Note:**

- You might need to run the `/etc/raid/bin/genjnicnf` reconfigure script from the Solaris shell.

```
# /etc/raid/bin/genjnicnf
```

- Set `portEnabled = 1`; only when you see JNI cards entering non-participating mode in the `/var/adm/messages` file. Under that condition:
  - Set `FcPortCfgEnabled = 1`;
  - Restart the host.
  - Set `FcPortCfgEnabled = 0`;
  - Restart the host again.

When you have done so, check `/var/adm/messages` to be sure that it sets the JNI cards to Fabric or Loop mode.

Table 22. Configuration settings for FC64-1063

Original value	New value	Comments
fca_nport = 0;	fca_nport = 1;	



Table 22. Configuration settings for FC64-1063 (continued)

Original value	New value	Comments
ip_disable = 0;	ip_disable=1;	
failover = 0;	failover =30;	
busy_retry_delay = 5000;	busy_retry_delay = 5000;	
link_recovery_delay = 1000;	link_recovery_delay = 1000;	
scsi_probe_delay = 5000;	scsi_probe_delay = 5000;	
def_hba_binding = "fcaw*";		Uncomment the line.
def_wwnn_binding = "\$xxxxxx"	def_wwnn_bindindef_hba_ binding = "nonjni"; g = "xxxxxx"	Uncomment the line.
def_wwnn_binding = "\$xxxxxx"	Same as the original entry.	Uncomment the line.
Will be added by reconfigure script	name="fcaw" parent="<physical path>"unit-address="<#>"	
Will be added by reconfigure script	target0_hba="fcaw0" target0_wwpn="<controller wwpn>";	
Will be added by reconfigure script	name="fcaw" parent="<physical path>"unit-address="<#>"	
Will be added by reconfigure script	target0_hba="fcaw0" target0_wwpn= "<controller wwpn>";	

**Note:** You might need to run the `/etc/raid/bin/genscsiconf` reconfigure script from the shell prompt.

```
# /etc/raid/bin/genscsiconf
```



## 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/](http://ssddom02.storage.ibm.com/techsup/webnav.nsf/support/fastt/)

### FAStT900 Fibre Channel Storage Server library

Table 23 associates each document in the FAStT900 Fibre Channel Storage Server library with its related common user tasks.

Table 23. 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 23. 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 and Problem Determination Guide, GC26-7528						✓

## FAStT700 Fibre Channel Storage Server library

Table 24 associates each document in the FAStT700 Fibre Channel Storage Server library with its related common user tasks.

Table 24. 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 FAStT700 Installation and Support Guide, 32P0171	✓	✓		✓		
IBM FAStT700 Fibre Channel Cabling Instructions, 32P0343	✓	✓				
IBM FAStT700 Fibre Channel Storage Server User's Guide, 32P0341				✓	✓	✓
IBM EXP700 Storage Expansion Unit Installation and User's Guide, 32P0178	✓	✓		✓	✓	✓
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 Fibre Channel Hardware Maintenance Manual, 19K6130						✓
IBM Fibre Channel Problem Determination Guide, 48P9804						✓

## FAStT600 Fibre Channel Storage Server library

Table 25 associates each document in the FAStT600 Fibre Channel Storage Server library with its related common user tasks.

Table 25. TotalStorage FAStT600 Fibre Channel Storage Server document titles by user tasks

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

## FAStT-related documents

Table 26 associates each of the following documents related to FAStT operations with its related common user tasks.

Table 26. TotalStorage FAStT related document titles by user tasks

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





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## Glossary

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

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

This glossary also includes terms and definitions from:

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

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

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

### See also

Refers you to a related term.

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

**accelerated graphics port (AGP).** A bus specification that gives low-cost 3D graphics cards faster access to main memory on personal computers than the usual 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.

**ADT.** See *auto-logical drive transfer feature*.

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

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

**auto-logical drive transfer (ADT) feature..** ADT is a built-in feature of the controller firmware that allows logical drive-level failover rather than controller-level failover.

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

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

**AWT.** See *Abstract Windowing Toolkit*.

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

**BIOS.** See *basic input/output system*.

**BOOTP.** See *bootstrap protocol*.

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

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

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

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

**CDPD.** See *cellular digital packet data*.

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

**CGA.** See *color graphics adapter*.

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

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

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

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

**CRC.** See *cyclic redundancy check*.

**CRT.** See *cathode ray tube*.

**cyclic redundancy check (CRC).** (1) 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, storage.

**DHCP.** See *Dynamic Host Configuration Protocol*.

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

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

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

**E\_port.** See *expansion port*.

**ECC.** See *error correction coding*.

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

**EGA.** See *enhanced graphics adapter*.

**electrically erasable programmable read-only memory (EEPROM).** A type of non-volatile storage device that can be erased with an electrical signal. Writing to EEPROM takes much longer than reading. It also can only be reprogrammed a limited number of times before it wears out. Therefore, it is appropriate for storing small amounts of data that are changed infrequently.

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

**enhanced graphics adapter (EGA).** An IBM video display standard that provides text and graphics with a resolution of 640 x 350 pixels of 16 colors. It emulates the Color Graphics Adapter (CGA) and the Monochrome Display Adapter (MDA) and was superseded by the Video Graphics Display (VGA).

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

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

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

**ESD.** See *electrostatic discharge*.

**ESDI.** See *enhanced small device interface*.

**EXP.** See *expansion unit*.

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

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

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

**F\_port.** See *fabric port*.

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

**fabric port (F\_port).** A fabric port (F\_port) that supports a node port (N\_port) on a fibre-channel switch.

**FASt MSJ.** See *FASt Management Suite Java*.

**FASt Management Suite Java (FASt 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.

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

**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 command, data, and status information between a SCSI initiator and a SCSI target across the FC link by using FC frame and sequence formats.

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

**FRU.** See *field replaceable unit*.

**GBIC.** See *gigabit interface converter*.

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

**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*.

**GPIB.** See *general purpose interface bus*.

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

**GUI.** See *graphical user interface*.

**HBA.** See *host bus adapter*.

**hdisk.** An AIX term that represents 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 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.** A host group is 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.** Host ports physically reside on the host adapters and are automatically discovered by the FAS*St*T Storage Manager software. To give a host computer access to a partition, you must define its associated host ports.

**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 IBM Storage Area Network device driver that is used in a Novell NetWare environment to provide multipath 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).** A bus standard for IBM compatibles that allows components to be added as cards plugged into standard expansion slots. ISA was originally introduced in the IBM PC/XT with an 8-bit data path. It was later expanded to permit a 16-bit data path when IBM introduced the PC/AT.

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

**integrated circuit (IC).** 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).** Also known as an Advanced Technology Attachment Interface (ATA). 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.

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

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

**Internet Protocol (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.

**IP address.** See *Internet Protocol address*.

**IPL.** See *initial program load*.

**IRQ.** See *interrupt request*.

**ISA.** See *Industry Standard Architecture*.

**ISDN.** See *Integrated Services Digital Network*.

**isolated group.** A collection of isolated devices not connected to the 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 JRE. The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

**JRE.** See *Java Runtime Environment*.

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

**LAN.** See *local area network*.

**LBA.** See *logical block addressing*.

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

**logical block addressing (LBA).** A hard disk sector addressing scheme in which the addressing conversion is performed by the hard disk firmware. LBA is used on all small computer system interface (SCSI) hard disks and on ATA-2 conforming integrated drive electronics (IDE) hard disks.

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

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

**loop group.** A collection of 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 (FL\_port).** A node port (N-port) or fabric port (F-port) that supports arbitrated loop functions associated with an arbitrated loop topology.

**LUN.** See *logical unit number*.

**MAC.** See *medium access control*.

**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.

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

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

**MCA.** See *micro channel architecture*.

**MIB.** See *management information base*.

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

**MIDI.** See *musical instrument digital interface*.

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

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

**NDIS.** See *network device interface specification*.

**network device interface specification (NDIS).** An application programming interface (API) definition that allows disk operating systems (DOS) or OS/2 to support one or more network adapters and protocol stacks. NDIS is a 16-bit, Ring 0 (for the OS/2 operating system) application programming interface (API) that defines a specific way for writing drivers for layers 1 and 2 of the OSI model. NDIS also handles the configuration and binding of these network drivers to multiple protocol stacks.

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

executes management application programs that monitor and control network elements.

**NMI.** See *non-maskable interrupt*.

**NMS.** See *network management station*.

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

**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.

**N\_port.** See *node port*.

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

**NVS.** See *nonvolatile storage*.

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

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

**ODM.** See *Object Data Manager*.

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

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

**PDF.** See *portable document format*.

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

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

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

**port.** The hardware entity that connects a device to a fibre-channel topology. A device can contain one or more ports.

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

**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.

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

**PTF.** See *program temporary fix*.

**RAM.** See *random-access memory*.

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

**RDAC.** See *redundant disk array controller*.

**read-only memory (ROM).** Memory in which the user cannot change stored data 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.

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

**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.

**RGB.** See *red, green, blue*.

**ROM.** See *read-only memory*.

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

**RVSD.** See *recoverable virtual shared disk*.

**SAN.** See *storage area network*.

**scope.** Defines a group of controllers by their Internet Protocol (IP) addresses. You must create and configure a scope so that dynamic IP addresses can be assigned to controllers on your network.

**SCSI.** See *small computer system interface*.

**segmented loop port (SL\_port).** A segmented loop port (SL\_port) allows you to divide a fibre-channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

**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 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 system's OS cached data 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*.

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

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

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

**SRAM.** See *static random access memory*.

**SSA.** See *serial storage architecture*.

**static random access memory (SRAM).** Random access memory based on the logic circuit known as flip-flop. It is called *static* because it retains a value as long as power is supplied, unlike dynamic random access memory (DRAM), which must be regularly

refreshed. It is however, still volatile, meaning that it can lose its contents when the power is switched off.

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

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

**storage partition.** Storage partitions are 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. You must define the host port, host computer and host group topological elements 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.

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

**SVGA.** See *super video graphics array*.

**sweep method.** A method of sending Simple Network Management Protocol (SNMP) requests for information to all the devices on a subnet by sending the request to every device on the network. Sweeping an entire network can take a half an hour or more. If broadcast is disabled, the recommended method is to enter the individual Internet Protocol (IP) addresses of the storage area network (SAN) devices into the SANavigator tool. This method produces good results without unnecessarily using time to wait for responses from every IP address in the subnet, especially for IP addresses where no devices are present. There might, however, be times when a full subnet sweep will produce valuable diagnostic information about the network or a device's configuration.

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

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

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

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

**TCP.** See *Transmission Control Protocol*.

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

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

**TFT.** See *thin-film transistor*.

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

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

**TL\_port.** See *translated loop port*.

**transceiver.** A device that is used is used to transmit and receive data. "Transceiver" is an abbreviation of "transmitter-receiver."

**translated loop port (TL\_port).** Each translated loop port (TL\_port) connects to a private loop and allows connectivity between the private loop devices and *off loop* devices (devices not connected to that particular TL\_port).

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

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

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

**trap recipient.** Receiver of a forwarded 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. Each such action is considered a *user action event*.

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

**VGA.** See *video graphics adapter*.

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

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

**VRAM.** See *video random access memory*.

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

**worldwide name (WWN).** A registered, unique 64-bit identifier assigned to nodes and ports.

**write-once read-many (WORM).** Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered. Typically the storage medium is an optical disk whose surface is permanently etched by using a laser in order to record information. WORM media are high-capacity storage devices and have a significantly longer shelf life than magnetic media.

**WWN.** See *worldwide name*.

**XGA.** See *eXtended graphics array*.

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



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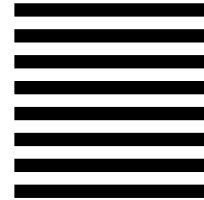
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