IBM TotalStorage FAStT Storage Manager
Version 8.21 for UNIX and AIX Environments

IBM

# Installation and Support Guide

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> **Note:**
> Before using this information and the product it supports, read the information in "Notices" on page 143.

**Third Edition (February 2003)**

This edition is an update and replaces GC26-7490-01

# Contents

I

# Figures

# Tables

# About this document

This document provides information about setting up, installing, configuring, and working with the IBM TotalStorage™ Fibre Array Storage Technology (FAStT) Storage Manager Version 8.21 in UNIX® and AIX™ environments.

Throughout this document, the terms *storage management software* and *Storage Manager 8.21* refer to the IBM TotalStorage FAStT Storage Manager Version 8.21. Individual components of the storage management software are identified by name.

Use this document to:
- Determine what is required to install the management software into your subsystem network
- Install the management software
- Upgrade controller NVSRAM and firmware
- Identify management features that are unique to your specific installation

**Note:** This document does not address hardware or integration. These topics are covered in the FAStT Hardware Installation Guide.

## 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 RAID, SCSI, and fibre-channel technology, and should also have working knowledge of the applicable operating systems that are used with the management software.

## How this document is organized

Chapter 1, "Introduction", on page 1 provides an introduction to the Storage Manager 8.21 product, including information about product resources in addition to this document.

Chapter 2, "Installing storage management station software on AIX systems", on page 11 provides information about installing and using Storage Manager 8.21 with an AIX operating system, step-by-step instructions for installing the AIX software on a management station, and step-by-step instructions for installing the AIX management software on a host.

Chapter 3, "Installing storage management station software on HP-UX systems", on page 33 provides information about installing and using Storage Manager 8.21 with the HP-UX operating system, step-by-step instructions for installing the HP-UX software on a management station, and step-by- step instructions for installing the HP-UX management software on a host.

Chapter 4, "Installing storage management station software on Solaris systems", on page 45 provides information about installing and using Storage Manager 8.21 with the Solaris operating system, step-by-step instructions for installing the Solaris software on a management station, and step-by-step instructions for installing the Solaris management software on a host.

Chapter 5, "Completing the software installation", on page 63 provides step-by-step instructions for performing post-installation tasks. Tasks include creating storage arrays, logical drives, and partitioning storage .

Chapter 6, "Storage Manager 8.21 with high-availability cluster services", on page 71 provides information about the high-availability clustering system options, General Parallel File System (GPFS), and High Availability Cluster Management Program (HACMP).

Chapter 7, "FlashCopy and the FAStT Storage Server", on page 81 introduces FlashCopy, which is a premium feature of the IBM TotalStorage FAStT Storage Manager 8.21. It describes the various components of FlashCopy, followed by a step-by-step guide to using the features.

Appendix A, "AIX system requirements", on page 131, Appendix B, "HP-UX system requirements", on page 133, and Appendix C, "Solaris system requirements", on page 135 list the minimum hardware and software requirements that AIX, HP-UX, and Solaris systems, respectively, must meet to be used in a storage system with Storage Manager 8.21.

Appendix D, "MC/ServiceGuard configuration details", on page 137 provides the procedure for correcting the primary and alternate paths of the imported volume groups that are changed after using **vgimport -m -s** with LVM commands.

Appendix E, "JNI host bus adapter settings", on page 139 contains JNI host bus adapter (HBA) settings.

## FAStT installation process overview

Figure 1 on page xiii gives an overview of the installation process for FAStT hardware and FAStT Storage Manager. Figure 1 on page xiii.

## Figure 1 content

| Install Process | Publications | | | |
|---|---|---|---|---|

**Install Process**

- Install Storage Server in Rack
- Determine Management Method
  - Out-of-Band | In-Band
- Install Management Hardware
- Make Network Connection
- Install RAID Controller Enclosure(s) / Storage Expansion Unit(s)
- Make Fibre Channel Connections

**Publications**

- FAStT Storage Server Installation Guides
- FAStT SM install and Support OS Guides

- FAStT and FC-2 HBA Install and Users Guide
  - * FC Planning and Integration: User's Guide and Service Information
  - FAStT Storage Server Installation Guides

- FAStT RAID Controller Enclosure Unit Install and User's Guide
- FAStT Storage Exp Units Install and User's Guides

- FAStT Fibre Channel Storage Server Installation Guides
- Fibre Channel Cable Instructions

* For pSeries Server and 6227 or 6228 HBA use only

**Right column flow**

- Connect Power and Start Server
- Verify Server operation w / LEDs
- Prepare for Installation of SM Software
- Install and Verify SM Client SW on Host
- Install and Verify SM Host SW on Host
- Configure Storage Hardware
- Configure Storage Subsystems on Host
- Complete SM SW Installation
- Test Installation

**Right column publications**

- FAStT Storage Server Installation Guides
- Fibre Channel Hardware Maintenance and Problem Determination Guide

- FAStT SM Install and Support OS Guides

- FAStT Storage Server User's Guides

- FAStT Remote Mirror Option Installation and User's Guide

Figure 1. Process flow by current publications

## FAStT documentation

The following tables present an overview of the FAStT700, FAStT500, and FAStT200 Fibre Channel Storage Server and FAStT Storage Manager 8.21 document libraries, as well as related documents. Each table lists documents that included in the libraries and where to locate information that you need to accomplish common tasks.

The documents are available in Adobe Acrobat PDF on the Storage Manager 8.21 installation CD and at the following Web site:

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

You can also order publications through the IBM Publications Ordering System at the following Web site:

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

# FAStT700 Fibre Channel Storage Server library

Table 1 associates each document in the FAStT700 Fibre Channel Storage Server library with its related common user tasks.

*Table 1. 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 |
| FAStT700 Installation and Support Guide, 32P0171 | ✔ | ✔ | | ✔ | | |
| FAStT700 Fibre Channel Cabling Instructions, 32P0343 | ✔ | ✔ | | | | |
| FAStT700 Fibre Channel Storage Server User's Guide, 32P0341 | | | | ✔ | ✔ | ✔ |
| EXP700 Storage Expansion Unit Installation and User's Guide, 32P0178 | ✔ | ✔ | | ✔ | ✔ | ✔ |
| FAStT Host Adapter Installation and User's Guide, 59P5712 | | ✔ | | | ✔ | |
| FAStT FC-2 Host Bus Adapter Installation and User's Guide, GC26-7532 | | ✔ | | | ✔ | |
| TotalStorage FAStT FC2-133 Host Bus Adapter Installation and User's Guide, 48P9823 | | ✔ | | | ✔ | |
| FAStT Management Suite Java User's Guide, 32P0081 | | | | | ✔ | ✔ |
| Fibre Channel Hardware Maintenance Manual, 19K6130 | | | | | | ✔ |
| Fibre Channel Problem Determination Guide, 48P9804 | | | | | | ✔ |

# FAStT500 Fibre Channel Storage Server library

Table 2 associates each document in the FAStT500 Fibre Channel Storage Server library with its related common user tasks.

*Table 2. TotalStorage FAStT500 and FAStT High Availablity Storage Server document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | Planning | Hardware Installation | Software Installation | Configuration | Operation and Administration | Diagnosis and Maintenance |
| FAStT500 RAID Controller Enclosure Unit User's Guide, 48P9847 | | | | ✔ | ✔ | ✔ |
| FAStT EXP500 Storage Expansion Unit Installation and User's Guide, 59P5637 | ✔ | ✔ | | ✔ | ✔ | ✔ |
| FAStT Host Adapter Installation and User's Guide, 59P5712 | | ✔ | | | ✔ | |
| FAStT FC-2 Host Bus Adapter Installation and User's Guide, GC26-7532 | | ✔ | | | ✔ | |
| TotalStorage FAStT FC2-133 Host Bus Adapter Installation and User's Guide, 48P9823 | | ✔ | | | ✔ | |
| FAStT Management Suite Java User's Guide, 32P0081 | | | | | ✔ | ✔ |
| Fibre Channel Hardware Maintenance Manual, 19K6130 | | | | | | ✔ |
| Fibre Channel Problem Determination Guide, 48P9804 | | | | | | ✔ |

# FAStT200 Fibre Channel Storage Server library

Table 3 associates each document in the FAStT200 Fibre Channel Storage Server library with its related common user tasks.

*Table 3. TotalStorage FAStT200 and FAStT High Availablity Storage Server document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | **Planning** | **Hardware Installation** | **Software Installation** | **Configuration** | **Operation and Administration** | **Diagnosis and Maintenance** |
| FAStT200 and FAStT200 HA Storage Servers Installation and User's Guide, 59P6243 | ✔ | ✔ | | ✔ | ✔ | |
| FAStT200 Fibre Channel Cabling Instructions, 21P9094 | ✔ | ✔ | | | | |
| FAStT Host Adapter Installation and User's Guide, 59P5712 | | ✔ | | | ✔ | |
| FAStT FC-2 Host Bus Adapter Installation and User's Guide, GC26-7532 | | ✔ | | | ✔ | |
| FAStT FC2-133 Host Bus Adapter Installation and User's Guide, 48P9823 | | ✔ | | | ✔ | |
| FAStT Management Suite Java User's Guide, 32P0081 | | | | | ✔ | ✔ |
| Fibre Channel Hardware Maintenance Manual, 19K6130 | | | | | | ✔ |
| Fibre Channel Problem Determination Guide, 48P9804 | | | | | | ✔ |

# FAStT Storage Manager Version 8.21 library

Table 4 associates each document in the FAStT Storage Manager library with its related common user tasks.

*Table 4. TotalStorage FAStT Storage Manager Version 8.21 document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | **Planning** | **Hardware Installation** | **Software Installation** | **Configuration** | **Operation and Administration** | **Diagnosis and Maintenance** |
| Installation and Support Guide for Windows® NT and Windows 2000, 02R0669 | ✔ | | ✔ | ✔ | | |
| Installation and Support Guide for Linux, 02R0670 | ✔ | | ✔ | ✔ | | |
| Installation and Support Guide for Novell NetWare, 02R0671 | ✔ | | ✔ | ✔ | | |
| Installation and Support Guide for UNIX and AIX Environments, GC26-7490 | ✔ | | ✔ | ✔ | | |
| FAStT Remote Mirror Option Installation and User's Guide, 48P9821 | ✔ | | ✔ | ✔ | ✔ | |
| IBM FAStT Storage Manager Script Commands (see product CD) | | | | ✔ | | |
| IBM FAStT Storage Manager Version 7.10 Concepts Guide, 25P1661 | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |

# FAStT related documents

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

*Table 5. TotalStorage FAStT related document titles by user tasks*

| Title | User Tasks | | | | | |
|---|---|---|---|---|---|---|
| | Planning | Hardware Installation | Software Installation | Configuration | Operation and Administration | Diagnosis and Maintenance |
| IBM FAStT500 RAID Controller Enclosure Unit Installation Guide, 59P6244 | | ✔ | | | ✔ | |
| IBM FAStT500 RAID Controller Enclosure Unit User's Reference, 48P9847 | | ✔ | | | ✔ | |
| IBM Netfinity® Fibre Channel Cabling Instructions, 19K0906 | | ✔ | | | | |
| IBM FAStT200 Fibre Channel Cabling Instructions, 21P9094 | | ✔ | | | | |
| IBM TotalStorage FAStT EXP700 Storage Expansion Unit Installation and User's Guide, 32P0178 | | ✔ | | | ✔ | |
| IBM FAStT EXP500 Installation and User's Guide, 59P5637 | | ✔ | | | ✔ | |
| IBM Fibre Channel SAN Configuration Setup Guide, 25P2509 | ✔ | | ✔ | ✔ | ✔ | |

# How to send your comments

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

- E-mail

  Submit your comments electronically to:

  starpubs@us.ibm.com

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

- Mail 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.

# Chapter 1. Introduction

The IBM TotalStorage FAStT Storage Manager Version 8.21 for UNIX and AIX environments, known as *Storage Manager 8.21*, is a set of client and host tools that allow you to manage IBM FAStT200, FAStT500, and FAStT700 storage subsystems from a storage management station.

You can install Storage Manager 8.21 on a *storage management station*, which is the system that is responsible for managing all, or a portion of, a storage network. The storage management station 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.

Typically, a storage management station is a remote system, connected to an Ethernet network, that is used to manage one or more storage subsystems. A storage management station can also be a host that is connected to the storage subsystem with a fibre-channel I/O path; you use this same path to manage the attached storage subsystems. 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 agent communicates with the controllers over the fibre-channel connection through the Access Volume.

This document provides system administrators with information about installing, configuring, and working with Storage Manager 8.21 in UNIX and AIX environments. Before installing Storage Manager 8.21, consult the following documentation:

**readme.txt files**
> Read these first. Text files containing the latest installation and user information about the storage management software and hardware components are located in each operating system subdirectory on the installation CD. The most recent copies are maintained on the following Web site:
>
> www.pc.ibm.com/qtechinfo/MIGR-43839.html
>
> After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

**IBM FAStT Storage Manager Concepts Guide**
> Use this reference document to become familiar with the terminology and the features of the Storage Manager 8.21 software. This document is available on the installation CD and maintained at the following Web site:
>
> www.storage.ibm.com/hardsoft/disk/fastt/

For information about installing Storage Manager 8.21 software on AIX, HP-UX, or Solaris systems, refer to this document. When you have completed the entire installation process, refer to the following online help systems, which contain 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 8.21 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 8.21 features

Storage Manager 8.21 supports FAStT200, FAStT500, and FAStT700 storage servers, and provides the features that are described in this section.

**Event monitoring**
> Event monitoring allows you to monitor storage subsystems, even when the Enterprise Management window is not open. A toolbar button and an option, **Tools —> Update monitor**, allow updates to the monitor if changes have occurred to your storage subsystem configuration.

**Heterogeneous environment**
> IBM TotalStorage FAStT Storage Manager Version 8.21 for UNIX and AIX environments now provides heterogeneous host support. Storage partitioning allows you a high degree of flexibility when attaching multiple hosts that are running different operating systems to the same storage server. Support is achieved through the use of independent and dedicated storage partitions. Heterogeneous support has the limitation of one operating system per dedicated storage partition and the constraint of 64 partitions per FAStT700 storage server. Separate dedicated storage partitions are required because a partition will have unlimited access to all logical drives in a particular storage partition. For more detailed information about how to create and set up storage partitions see:
> - Chapter 2, "Installing storage management station software on AIX systems", on page 11
> - Chapter 3, "Installing storage management station software on HP-UX systems", on page 33
> - Chapter 4, "Installing storage management station software on Solaris systems", on page 45

**Configuration replication**
> Configuration replication allows you to save the logical configuration of a storage subsystem, and then load it on an identical storage subsystem. This feature can be used to replicate a logical configuration from one storage subsystem to another, or to save a storage subsystem configuration for backup.

**Auto Volume Transfer/Auto Disk Transfer (AVT/ADT)**
> Auto Volume Transfer (AVT), also known as Auto Disk Transfer (ADT) and referred to in this document as AVT/ADT, is a failover method. By this method, the storage subsystem initiates the transfer of a volume, or volumes, when it detects a controller or path failure. If the host detects the failure, it automatically sends I/O to the remaining functional path, simultaneously initiating an AVT/ADT event. The alternative to this approach is the Redundant Dual Active Controller (RDAC) model. By this model, the host initiates an explicit failover for all path failure events, except a controller failure.

**Command-line interface**
> The command-line interface is based on the script-engine commands found in the script editor and allows you to issue commands to the storage subsystems. See the SMcli.txt file on the installation CD or the command-line interface (CLI) online help topic for usage information.

**Controller diagnostics**

You can access the controller diagnostics from the **Controller —> Run Diagnostics** menu in the storage management software. These diagnostics allow you to test the host-side and drive-side fibre-channel loops.

**Access volume mapping**

Access volume mapping allows you to assign and change the LUN assignment for the access volume. An access volume is required for communicating in a host-agent-managed environment using the fibre-channel input/output (I/O) path, but is not required for a directly-managed storage subsystem that is connected through the Ethernet cable connection.

**High-availability cluster services**

A high-availability clustering system allows 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 local area network (LAN) component. If a component fails, the redundant component takes over cluster services and coordinates the transfer between components.

**Redundant Dual Active Controller (RDAC)**

The Redundant Dual Active Controller (RDAC) package, also known as the Redundant Disk Array Controller (RDAC) package, is a multipath device driver that provides controller failover support when a failure occurs anywhere along the fibre-channel I/O path.

**Direct-attached configuration**

Storage Manager 8.21 supports FAStT200, FAStT500, and FAStT700 storage servers in direct-attached homogenous environments.

**FlashCopy®**

FlashCopy, a premium feature of the FAStT Storage Manager 8.21, can be used on FAStT200, FAStT500, and FAStT700 storage servers. A FlashCopy logical drive is a point-in-time (PIT) image of a logical drive. It is the logical equivalent of a complete physical copy that is created much more quickly than a physical copy, and that requires less disk space.

# Storage Manager 8 software packages

Storage Manager 8.21 contains the following software packages:

- Storage Manager 8 client software:
  - SMruntime
  - Storage Manager 8 client package (SMclient)
- Storage Manager 8 host software:
  - Storage Manager 8 agent package (SMagent)
  - Storage Manager 8 utility package (SMutil)
  - Storage Manager 8 multipath device drivers (RDAC)

Install the software packages in the sequences shown in Table 6 on page 4. For installation instructions, see the referenced sections. For an overview of each package, see the subsections that follow the table.

*Table 6. Installation sequences of Storage Manager 8.21 software packages by host type*

| Step | AIX | HP-UX | Solaris |
|------|-----|-------|---------|
| 1 | SMruntime (see "Installing SMruntime on AIX hosts" on page 14) | SMruntime (see "Installing the host software on HP-UX hosts" on page 34) | SMruntime (see "Installing the runtime software on Solaris hosts" on page 46) |
| 2 | SMclient (see "Installing SMclient on AIX hosts" on page 14) | SMclient (see "Installing the host software on HP-UX hosts" on page 34) | SMclient (on Solaris 8 only; see "Installing the client software on Solaris hosts" on page 47; supports Solaris 2.6, 2.7, and 2.8) |
| 3 | RDAC (see "Installing host RDAC software on AIX hosts" on page 14) | SMagent (see "Installing the SMagent on HP-UX hosts" on page 36) | RDAC (see "Installing host software on Solaris hosts" on page 49) |
| 4 | | SMutil (see "Installing SMutil on HP-UX hosts" on page 37) | SMagent (see "Installing SMagent on Solaris hosts (optional)" on page 49) |
| 5 | | | SMutil (see "Installing host software on Solaris hosts" on page 49) |

# Storage Manager 8 client software package

The Storage Manager 8.21 client software, SMclient, is a Java™-based GUI interface that allows you to configure, manage, and troubleshoot FAStT200, FAStT500, or FAStT700 storage servers as well as the EXP700 expansion enclosure in a storage subsystem through a host system or through a storage management station. Specifically, SMclient allows you to:

- 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
- Change RAID-type arrays
- Monitor the status of FAStT storage servers
- Configure and add additional host partition with the premium Partitioning feature.
- Expand capacity using the EXP700 1 Gb or 2 Gb fibre-channel enclosure

Additionally, SMclient with FAStT700 allows you to:

- Loop four fibre-channel hosts using eight host connections with either 1 Gb or 2 Gb channels
- Assign redundant RAID controllers

The SMclient contains two main components:

**Enterprise Management**
This component allows you to add, remove, and monitor storage subsystems in the management domain.

**Subsystem Management**
> This component allows you to manage the components of an individual storage subsystem.

For more information about this software, see either Chapter 2, "Installing storage management station software on AIX systems", on page 11, Chapter 3, "Installing storage management station software on HP-UX systems", on page 33, or Chapter 4, "Installing storage management station software on Solaris systems", on page 45 and the *IBM FAStT Storage Manager Concepts Guide*.

## Storage Manager 8 agent software package

The Storage Manager 8.21 agent (SMagent) package contains the host-agent software, which you can use on HP-UX host systems to manage storage subsystems through the host fibre-channel connection. The host-agent software 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 the host agent, see "Host-agent (in-band) management method" on page 6.

## Storage Manager 8 utility software package

Use the Storage Manager 8.21 utility (SMutil) package to register and map new logical drives to the operating system. Install SMutil on all HP-UX and Solaris host systems attached to a storage subsystem. The host computers are attached to the storage subsystem through the fibre channel.

## RDAC

AIX and Solaris host systems require an RDAC driver for fibre-channel path redundancy. 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 8.21 installation CD; you must follow the instructions in "Installing host RDAC software on AIX hosts" on page 14 to download them from the appropriate Web site.

## Storage subsystem management methods

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

- The host-agent (in-band) management method. In this method, you manage the storage subsystems through the fibre-channel I/O path to the host.

  **Note:** You cannot use this management method on AIX systems.

- The direct (out-of-band) management method. In this method, you manage the storage subsystems directly over the network through the Ethernet connection to each controller.

# 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.

**Note:** You cannot use the host-agent (in-band) management method on AIX systems.

Storage subsystems

Controller

Controller

Running the host-agent software

Host computer

Fibre Channel I/O path

Controller

Controller

Storage subsystems

Network

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

Management station (one or more)

SJ000707
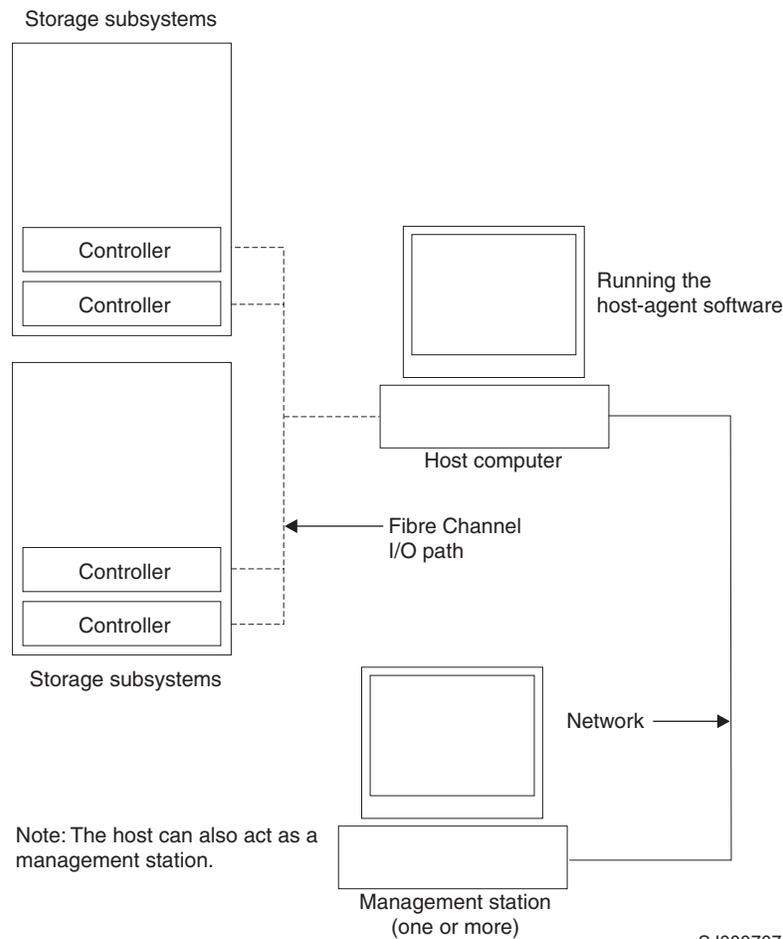
*Figure 2. Host-agent (in-band) managed storage subsystems*

Managing storage subsystems using the host-agent (in-band) management method has 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 11, Chapter 3, "Installing storage management station software on HP-UX systems", on page 33, or Chapter 4, "Installing storage management station software on Solaris systems", on page 45).

- 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.

Managing storage subsystems using the host-agent (in-band) management method has the following disadvantages:

- 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.
- If you are upgrading controllers from firmware version 3.x to version 4.x and your host system has already configured its maximum number of LUNs, you must give up a LUN to be used as an access volume.
- When both fibre-channel paths to the controllers are lost, the SMclient is no longer available for use.

**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 8 shows the direct (out-of-band) management method.
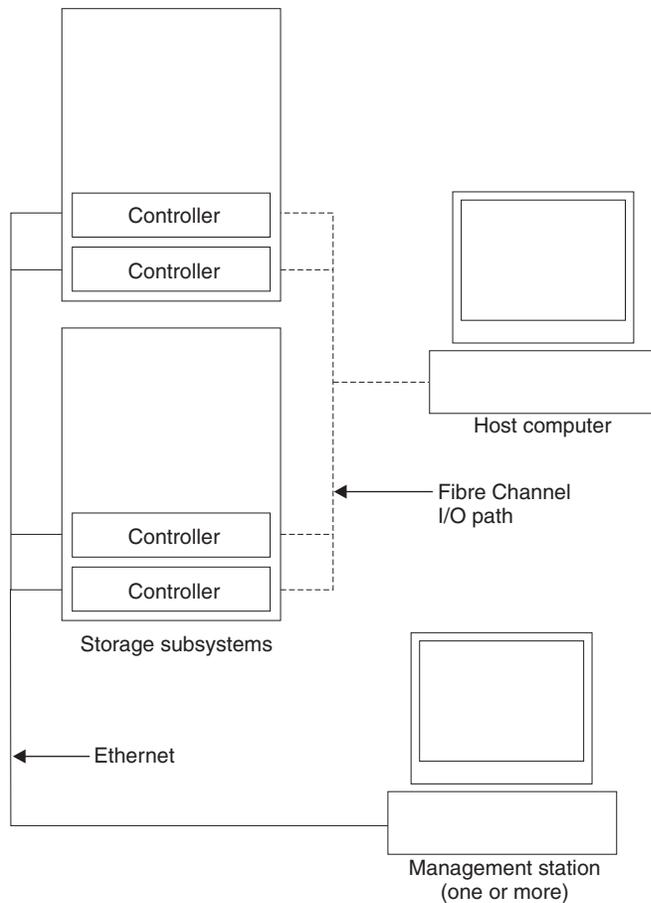
Figure 3. Direct (out-of-band) managed storage subsystems

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

- 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 or Windows 2000
  - Solaris
  - Any other operating systems that are supported by Storage Manager 8.21

Managing storage subsystems 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.

## Operating system requirements

Storage Manager 8.21 supports the FAStT200, FAStT500, and FAStT700 storage servers in the following environment:

- IBM AIX 4.3.3 or 5.1 (see Appendix A, "AIX system requirements", on page 131)
- HP-UX 11.0 (32 bit or 64 bit), HP-UX 11.11, or HP-UX 11i (see Appendix B, "HP-UX system requirements", on page 133)
- Sun Solaris 2.6, 2.7, or 2.8 (see Appendix C, "Solaris system requirements", on page 135)

## Setting up IP addresses for FAStT storage controllers

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.

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

Before setting the controller IP address, have the following information available:

- Two IP addresses
- Your Gateway IP address
- Your Submask address

Complete the following steps to set up the FAStT controller IP addresses using serial ports:

1. Stop all I/O to the FAStT controllers.
2. Connect a null modem serial cable from one of the controllers to a system with a terminal emulator available.

    **Note:** Use HyperTerminal Private Edition Version 6.3 or later. Download the latest version from the following Web site:www.hilgraeve.com

3. Open the HyperTerminal and from the menu bar click **File —> Properties —> Configure**. Choose the following settings:
    - 115200 Baud
    - 8 Data Bits
    - 1 Stop Bit
    - No parity
    - XON/XOFF Flow Control
4. Connect to the FAStT 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 password: `infiniti`
10. Type `netCfgShow` to show the current network configuration.

    **Note:** The following default 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 network settings.
14. Disconnect from the first controller and connect to the second controller.
15. Repeat steps 1 on page 9 - 14 to assign the second IP address to the second controller.
16. Restart the FAStT storage server by turning the controller unit off and on.

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

This chapter provides the following specific information for AIX operating systems:

- Hardware and firmware requirements
    - Creating a direct-attached configuration
    - Creating a SAN-attached configuration
- AIX restrictions
- Installing client software
- Installing host software
- AIX configuration information
- Installing RDAC
- Disk array errors

## Hardware and firmware requirements

Table 7 lists the supported versions of hardware to use with Storage Manager 8.21.

*Table 7. Supported versions of hardware for AIX systems*

| Product Name | Model | Product release and firmware version |
|---|---|---|
| IBM TotalStorage FAStT700 RAID Controller Enclosure Unit | 1742-1RU | Appware 05.21.05.09, NVSRAM CNV1742R821NT012 |
| IBM TotalStorage FAStT700 EXP700 Storage Expansion Unit | 1740-1RU | ESM 9319 |
| IBM FAStT500 RAID Controller Enclosure Unit | 3552-1RU | Appware 05.21.05.09, NVSRAM CNV3552R821NT012 |
| IBM FAStT500 EXP500 Storage Expansion Unit | 3560-1RU | ESM 9163 |
| IBM FAStT200 RAID Controller Enclosure Unit | 3542-1RU and FC 2101 | Snapware 05.20.12.09, NVSRAM CNV3542R821NT030 |
| IBM FAStT200 RAID and Storage Unit, Double Controller | 3542-2RU | Snapware 05.20.12.09, NVSRAM CNV3542R821NT030 |
| IBM HA Emulex LP7000 | FC 6227 | 3.22A1 |
| IBM HA Emulex LP9000 | FC 6228 | 3.82A1 |
| Brocade switch | 2109-S08, 2109-S16 | 2.6.0.e |
| Brocade switch | 2109-F16 | 3.0.2f |
| Brocade switch | 2109-M12 | 4.0.2 |
| Brocade switch | 3534-F08 | 3.0.2h |
| McData switch | 2032-064 2031-216 2031-232, 2032-140 | 4.01.00 |
| INRANGE switch | 2042-001 2042-128 | 3.2.1 |

Read the readme.txt file that is shipped with the product and go to one of the following Web sites to ensure that you have the latest versions of the firmware, NVSRAM, disk drive firmware, and host adapter device drivers:

www.pc.ibm.com/qtechinfo/MIGR-43839.html

After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

## Creating a direct-attached configuration

Storage Manager 8.21 supports FAStT200, FAStT500, and FAStT700 storage servers in direct-attached AIX configurations.

To create a direct-attached configuration, you must ensure that:
- One or two AIX servers can be connected to the FAStT storage server:
    - FAStT200 can support one AIX server.
    - FAStT500 can support two AIX servers.
    - FAStT700 can support two AIX servers.
- Two server FAStT500 or FAStT700 configurations require four host-side mini-hubs, each with exactly one FC connection from each HBA to a mini-hub.
- There are two or four host bus adapters (HBAs) (FC 6227 or FC 6228) per FAStT storage server. Each pair must be configured to one FAStT partition.
- No external hubs are being used.

To set up a direct-attached configuration, follow these steps:
1. Connect the HBAs to each controller or mini-hub port of the FAStT storage server.
2. Start the system.
3. Configure and verify the configuration as shown in the next sections.

## Creating a SAN-attached configuration

Storage Manager 8.21 supports FAStT200, FAStT500, and FAStT700 storage servers in a SAN environment through fibre channel switches in AIX configurations. 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.
- If connecting through a single fibre-channel switch, such as a IBM 2109-F16, each fibre-channel HBA and controller port must be in its own fabric zone.

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

To set up a SAN-attached configuration, follow these steps:
1. Connect the HBAs to the fibre-channel switch or switches.
2. Connect the FAStT storage subsystems to the switch or switches.
3. Set the required zones on the fibre-channel switch, if applicable.

4. Start the system.

5. Configure and verify the configuration, as shown in the next sections.

## AIX restrictions

The following restrictions apply to FAStT200, FAStT500, and FAStT700 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 two or four host bus adapters (FC 6227 or 6228) and up to two FAStT storage partitions, each requiring two host bus adapter connections per FAStT storage server. Additional HBA pairs 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 mini-hub is allowed.
- Single HBA configurations are not allowed. Each connection to a partition must have two HBAs configured.
- Single-switch configurations are allowed, but each HBA and FAStT 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 "Performing the initial configuration of storage subsystems on AIX hosts" on page 15.
- Other storage devices, such as tape devices or other disk storage, must be connected through separate HBAs and SAN zones.

## Installing the host software on AIX hosts

Use the following procedure to install the host software on an AIX storage management station. Install the software in the following order:

1. SMruntime

2. SMclient

3. Update RDAC device driver

The FAStT client is dependent on SMruntime, which is a Java compiler for the SMclient and must be installed first.

## Prerequisites

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

- The AIX host on which you are installing the SMruntime software meets the minimum hardware and software requirements described in "Hardware and firmware requirements" on page 11 and "Software requirements" on page 131.
- The correct filesets are present on the system.

   **Note:** If the filesets are not present, follow the instructions in "Installing host RDAC software on AIX hosts" on page 14 to download them from the appropriate Web site.

   – For a list of AIX 4.3.3 filesets, see Table 15 on page 131.

## Installing SMruntime on AIX hosts

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-08.20.65.02.bff SMruntime.aix.rte
```

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

```
# lslpp -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 on AIX hosts

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-08.20.65.02.bff SMclient.aix.rte
```

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

```
# lslpp -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.

## Installing host RDAC software on AIX hosts

After you install the Storage Manager 8.21 client software and configure your storage subsystems, use these instructions to install the appropriate Storage Manager 8.21 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 temporary fix (PTF) 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 PTFs on an AIX system and describes how to verify the current RDAC drive PTF.

### Prerequisites for installing RDAC

See Table 15 on page 131 or Table 16 on page 131 for a list of PTF filesets required by version.

### Verifying AIX RDAC software

Use the **lslpp** command to verify that the correct version numbers of the AIX host RDAC software is installed:

```
# lslpp -ah filename
```

Where *filename* is one of the required filesets listed in Table 15 on page 131 or Table 16 on page 131.

For example:

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

## Installing RDAC on AIX hosts

Complete the following procedure to update the RDAC driver PTF (devices.fcp.disk.array.rte) on an AIX system. Repeat this procedure for all AIX systems that are connected to the storage subsystem. You do not need to perform this installation if you have verified that the RDAC level is correct.

1. Go to one of the following Web site:

   www.pc.ibm.com/qtechinfo/MIGR-43839.html

   After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

2. Click **Downloads** in the downloads section of the Web page.

3. Scroll to the operating system-specific updates section of the Web page.

4. Follow the link to the appropriate sets of files for your operating system and follow the installation instructions.

5. 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.

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

```
# cfgmgr -v
```

## Performing the initial configuration of storage subsystems on AIX hosts

Complete the following procedure to configure Storage Manager 8.21 for an AIX system. This can be done from the Storage Manager client running on an AIX or a non-AIX system.

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 9 for information about assigning IP addresses to the controllers.

2. After the disk subsystem is configured on the network, start the SMclient software 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.

## Updating FAStT firmware and NVSRAM

Perform the following steps to update the FAStT controller firmware and NVSRAM:

1. In the Subsystem Management window, click **View —> Storage Subsystem Profile** and review the summary portion of the output. Verify that the controller firmware and NVSRAM are at the correct versions. If they are not at the correct versions, upgrade the firmware, then upgrade the NVSRAM.

   **Note:** Even though concurrent firmware upgrades are supported, I/O should be quiesed before you upgrade the firmware. Concurrent upgrades of NVSRAM, however, are not supported.

2. After you ensure that all I/O to the controllers is stopped, complete the following steps to upgrade the controller firmware:

   a. Mount and locate the firmware file on the installation CD (`/cdrom/Firmware/3542`, `/cdrom/Firmware/3552` or `/cdrom/Firmware/1742`), or download the correct version from the Web site. Place the file in a designated directory on the host system.

   b. In the Subsystem Management window, click **Storage Subsystem —> Download —> Firmware**.

   c. Type or select the full pathname of the firmware file.

   d. Click **OK** to update both controllers.

   e. Click **Yes** to start the download. A new window opens.

   f. Close the Subsystem Management window and then reopen it to complete the firmware update.

   g. Verify that the firmware was successfully installed.

3. Complete the following steps to upgrade the NVSRAM:

   a. Ensure that all I/O to the controllers has been been stopped.

   b. Mount and locate the NVSRAM file on the installation CD (`/cdrom/NVSRAM/3542`, `/cdrom/NVSRAM/3552`, or `/cdrom/NVSRAM/1742`), or download the correct version from the Web site. Place the file in a designated directory on the host system.

c.  In the Subsystem Management window, click **Storage Subsystem —>**
**Download —> NVSRAM**.

  d.  Type or select the full pathname of the NVSRAM directory.

  e.  Double-click the NVSRAM filename or click **OK** to select the correct file.

  f.  Click **Yes** to start the download.

  g.  Verify that the NVSRAM was successfully installed.

## Setting up an AIX host group

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

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:** To verify that the host port matches the AIX host, run the **lsdev -Cc
        adapter | grep fcs** command. Identify the fcs by associating the
        number of host bus adapters (HBAs), then run the **lscfg -vl fcs#
        |grep Network** command. Verify that the number that displays under
        Network Address matches the host port number in the GUI. Repeat
        this procedure for the second host port.

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

## AIX configuration information

This section contains the following AIX configuration information:

*   Viewing and setting attributes of the RDAC driver for AIX
*   Viewing ODM attributes in AIX
*   Changing ODM attribute setting 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

## 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 current and
        deferred paths to all LUNs (hdisks on AIX).

**dac**    The disk array controller devices represents 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 device attribute settings" on page 23. Use the **lsattr -El** command to view attribute settings on an AIX system, as shown in the following examples.

## 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 **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. 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 8, Table 9 on page 19, and Table 10 on page 20. Display the default with the **lsattr -Dl** command.

*Table 8. Attributes for dar devices*

| Attribute | Definition | Changeable (T/F) | Possible value |
|---|---|---|---|
| *act_controller* | List of controllers in the active state at the time of configuration. | False | Set at configuration by RDAC software. |
| *all_controller* | List of controllers that comprise this array; usually there are two dac devices. | False | Set at configuration by RDAC software. |
| *held_in_reset* | Name of the controller that was in the held-in-reset state at the time of configuration, or **none** if no controllers were in that state. | True | Set at configuration by RDAC software (should not be changed). |
| *load_balancing* | Indicator that shows whether load balancing is enabled (**yes**) or disabled (**no**); see the definition of the *balance_freq* attribute for more information. | True | Yes or no (see"Restrictions for dar ODM attributes" on page 23) |
| *autorecovery* | Indicator that shows whether the device returns the array to dual-active mode when it detects proper operation of both paths and controllers (**yes**) or not (**no**). | True | Yes or no (see "Restrictions for dar ODM attributes" on page 23) |
| *lun_bitmap* | Bitmap that shows which controller own which LUN at the time of configuration. | True | While changeable, this should not changed. LUN ownership should be controlled by the Storage Manager. |

| Table 8. Attributes for dar devices  (continued)

| Attribute | Definition | Changeable (T/F) | Possible value |
|---|---|---|---|
| *hlthchk_freq* | Number that specifies how often health checks are performed, in seconds. | True | 1—9999 (should not be changed). |
| *aen_freq* | Number that specifies how often polled AEN checks are performed, in seconds. | True | 1—9999 (should not be changed). |
| *balance_freq* | If *load_balancing* is enabled, number that specifies how often the system performs load-balancing on the array, in seconds. | True | 1—9999 (should not be changed). |
| *fast_write_ok* | Indicator that shows whether fast-write write-caching is available for this system (**yes**) or not (**no**). | False | Yes or no. State of FAStT at configuration. |
| *cache_size* | Cache size for both controllers, in megabytes; **0** if the sizes do not match. | False | 512 or 1024. Set by FAStT. |
| *switch_retries* | Number that specifies how many times to retry failed switches, in integers. | True | 0—255 (should not be changed). |

*Table 9. Attributes for dac devices*

| Attribute | Definition | Changeable (T/F) | Possible value |
|---|---|---|---|
| *passive_control* | Indicator that shows whether this controller was in passive state at the time of configuration (**yes**) or not (**no**). | False | Yes or no. State of FAStT at configuration. |
| *alt_held_reset* | Indicator that shows whether the alternate controller was in the held-in-reset state at the time of configuration (**yes**) or not (**no**). | False | Yes or no. State of FAStT at configuration. |
| *controller_SN* | Serial number of this controller. | False | Set by FAStT. |
| *ctrl_type* | Type of array this controller belongs to; a value of **3542** indicates FAStT200; a value of **3552** indicates FAStT500; a value of **1742** indicates FAStT700. | False | 3542, 3552, 1742. Set by FAStT. |
| *cache_size* | Cache size of this controller, in megabytes. | False | 512, 1024. Set by FAStT. |
| *scsi_id* | SCSI identifier of this controller. | False | Set by SAN, reported by AIX. |
| *lun_id* | Logical unit number of this controller. | False | Set by FAStT. |

*Table 9. Attributes for dac devices (continued)*

| Attribute | Definition | Changeable (T/F) | Possible value |
|-----------|-----------|------------------|----------------|
| *utm_lun_id* | Logical unit number of this controller, or **none** if UTM (access volumes) is not enabled. | False | 0—31. Set by FAStT Storage Manager. |
| *location* | User-defined location label for this controller; the system does not use this value. | True | Set by FAStT Storage Manager. |
| *ww_name* | Fibre-channel worldwide name of this controller. | False | Set by FAStT. |
| *GLM_type* | GLM type used for this controller. | False | High or low. Set by FAStT. |

*Table 10. Attributes for hdisk devices*

| Attribute | Definition | Changeable (T/F) | Possible value |
|-----------|-----------|------------------|----------------|
| *pvid* | AIX physical volume identifier, or **none** if not set. | False | Set by AIX. |
| *q_type* | Queueing type for this device; must be set to **simple**. | False | Set by AIX, must be"simple". |
| *queue_depth* | 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 |
| *reserve_lock* | 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 (**yes**) or not (**no**). | True | Yes or no |
| *write_cache* | Indicator that shows whether write-caching is enabled on this device (**yes**) or not (**no**); see the definition of the *cache_method* attribute for more information. | True | Yes or no |
| *size* | Size of this volume. | False | Set by FAStT. |
| *raid_level* | Number that specifies the RAID level of this device. | False | 0, 1, 3, 5. Set by FAStT Storage Manager. |
| *rw_timeout* | 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). |

*Table 10. Attributes for hdisk devices  (continued)*

| Attribute | Definition | Changeable (T/F) | Possible value |
|-----------|------------|------------------|----------------|
| *reassign_to* | 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). |
| *scsi_id* | SCSI identifier at the time of configuration. | False | Set by SAN, reported by AIX. |
| *lun_id* | Logical unit number of this device. | False | 0—31. Set by FAStT Storage Manager. |
| *cache_method* | If *write_cache* is enabled, the write-caching method of this array; set to one of the following:<br><br>• **default**. Default mode; the word "default" is not seen if *write_cache* is set to yes.<br><br>• **fast_write**. Fast-write (battery-backed, mirrored write-cache) mode.<br><br>• **fw_unavail**. Fast-write mode was specified but could not be enabled; write-caching is not in use.<br><br>• **fast_load**. Fast-load (non-battery-backed, non-mirrored write-cache) mode.<br><br>• **fl_unavail**. Fast-load mode was specified but could not be enabled. | True | default, fast_write, fast_load, fw_unavail, fl_unavail |
| *prefetch_mult* | Number of blocks to be prefetched into read cache for each block read. | True | 0—100 |
| *ieee_volname* | IEEE unique volume name identifier for this volume. | False | Set by FAStT |

## Viewing ODM attributes in AIX

To view the attributes for dars, dacs, and hdisks, use the AIX **lsattr** command. The following examples demonstrate using the **lsattr -El** command, which shows the attributes that are currently set on the system. To view the default settings, use the `-Dl` flag instead of `-El`.

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

```
# lsattr -El dar0
act_controller dac0,dac1                            Active Controllers                       False
all_controller dac0,dac1                            Available Controllers                    False
held_in_reset  none                                 Held-in-reset controller                 True
load_balancing no                                   Dynamic Load Balancing                   True
autorecovery   no                                   Autorecover after failure is corrected   True
lun_bitmap     0000000000000000000000000000001010   LUN Ownership bitmap                     True
hlthchk_freq   600                                  Health check frequency in seconds        True
aen_freq       600                                  Polled AE frequency in seconds           True
balance_freq   600                                  Dynamic Load Balancing frequency in seconds True
fast_write_ok  yes                                  Fast Write available                     False
cache_size     512                                  Cache size for both controllers          False
switch_retries 5                                    Number of times to retry failed switches True
```

This example shows the attribute settings for a disk array controller (dac0):

```
# lsattr -El dac0
passive_control no                       Passive controller       False
alt_held_reset  no                       Alternate held in reset  False
controller_SN   1T04611221               Controller serial number False
ctrl_type       3552                     Controller Type          False
cache_size      512                      Cache Size in MBytes      False
scsi_id         0x210013                 SCSI ID                  False
lun_id          0x0                      Logical Unit Number      False
utm_lun_id      none                     Logical Unit Number      False
location                                 Location Label           True
ww_name         0x200800a0b80c1948       World Wide Name           False
GLM_type        low                      GLM type                 False
```

This example shows the attribute settings for a LUN on the array (hdisk4):

```
# 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          69270                     Size in Mbytes                         False
raid_level    5                         RAID Level                             False
rw_timeout    30                        Read/Write Timeout value               True
reassign_to   120                       Reassign Timeout value                 True
scsi_id       0x210013                  SCSI ID                                False
lun_id        0x0000000000000000        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  600A0B80000C1A70000000013B45FEA8 IEEE Unique volume name         False
```

## Changing ODM attribute settings in AIX

As discussed earlier, ODM attributes for the RDAC software and FAStT can be modified. This section shows the recommended settings for best performance and availability.

## hdisk device attribute settings

This section lists the attribute settings that should be used 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.

Some attributes can be changed from both the FAStT Storage Manager client software and through AIX. To make these changes permanent, the modifications must be made by changing the AIX ODM attribute. The specific hdisk attributes affected are:

- cache_write
- cache_method
- prefetch_mult

If the changes are made through the Storage Manager client software, they will operate properly until you either restart the host or restart cfgmgr. To make the changes permanent, you must use SMIT or the **chdev -P** command.

**Attention:** Controller Cache mirroring should not be disabled while cache_write is enabled. If this condition exists, the RDAC Software will automatically re-enable it the next time the system is restarted or when cfgmgr is run.

***Restrictions for dar ODM attributes:*** The *autorecovery* attribute should only be set to **yes** in single initiator configurations. If other hosts are configured on the same set of fibre-channel links, you should not enable this function.

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 this attribute incorrectly, it could result in the loss of filesystems and system panics.

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

512 / (number-of-hosts * 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 4:

512 / ( 4 * 32 ) = 4

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

```
# chdev -l hdiskX -a queue_depth=4 -P
```

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

# Verifying the installation and configuration of AIX hosts

After you set the ODM attributes, FAStT volumes and configurations, 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 each FAStT volume as a "3542 (200) Disk Array Device", each FAStT500 volume as a "3552 (500) Disk Array Device", or each FAStT700 volume as a "1742 (700) Disk Array Device". The following example shows the results of the command for a set of FAStT500 LUNs:

```
# lsdev -Cc disk
hdisk0  Available 10-88-00-8,0 16 Bit LVD SCSI Disk Drive
hdisk32 Available 31-08-01    3552    (500) Disk Array Device
hdisk33 Available 91-08-01    3552    (500) Disk Array Device
hdisk34 Available 31-08-01    3552    (500) Disk Array Device
hdisk35 Available 91-08-01    3552    (500) Disk Array Device
```

## Identifying the controller ID numbers

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

Perform the following steps to display the FAStT Controller Properties window:

1. In the Physical view of the Subsystem Management window, select a controller.

2. Right-click **Controller —> Properties**.

   Figure 4 on page 25 shows the Controller Properties window of the controller in slot A. This controller has a serial number of 1T04810361 and is represented by dac1.

```
# lsattr -El dac1
passive_control no                  Passive controller      False
alt_held_reset  no                  Alternate held in reset False
controller_SN   1T14610048          Controller serial number False
ctrl_type       3552                Controller Type         False
cache_size      512                 Cache Size in MBytes     False
scsi_id         0x210213            SCSI ID                  False
lun_id          0x0                 Logical Unit Number      False
utm_lun_id      none                Logical Unit Number      False
location                            Location Label           True
ww_name         0x200600a0b80c213d  World Wide Name           False
GLM_type        low                 GLM type                 False
```
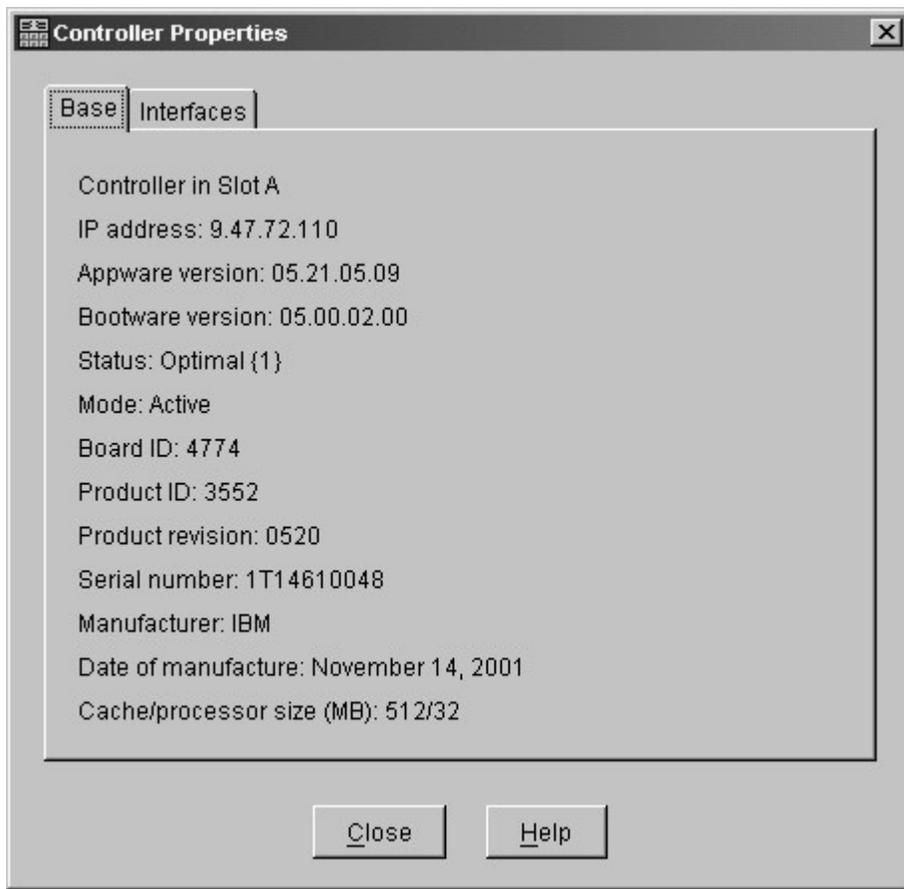
Figure 4. Controller Properties window

## 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 FAStT 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 FAStT storage subsystem. dars represent the disk array routers; dacs represent the disk array controllers, and hdisks represent the logical drives, or FAStT volumes.

AIX provides the following commands to help you determine the FAStT 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, or the last time that the **cfgmgr -v** command was run.

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

**fget_config**
Displays controllers and hdisks that are associated with a specified FAStT (dar). **fget_confg** shows the current state and volume (hdisk) ownership.

There are several ways to correlate a system's configuration and monitor the state of FAStT storage subsystems. The use of commands in validating configurations is shown in Figure 5.
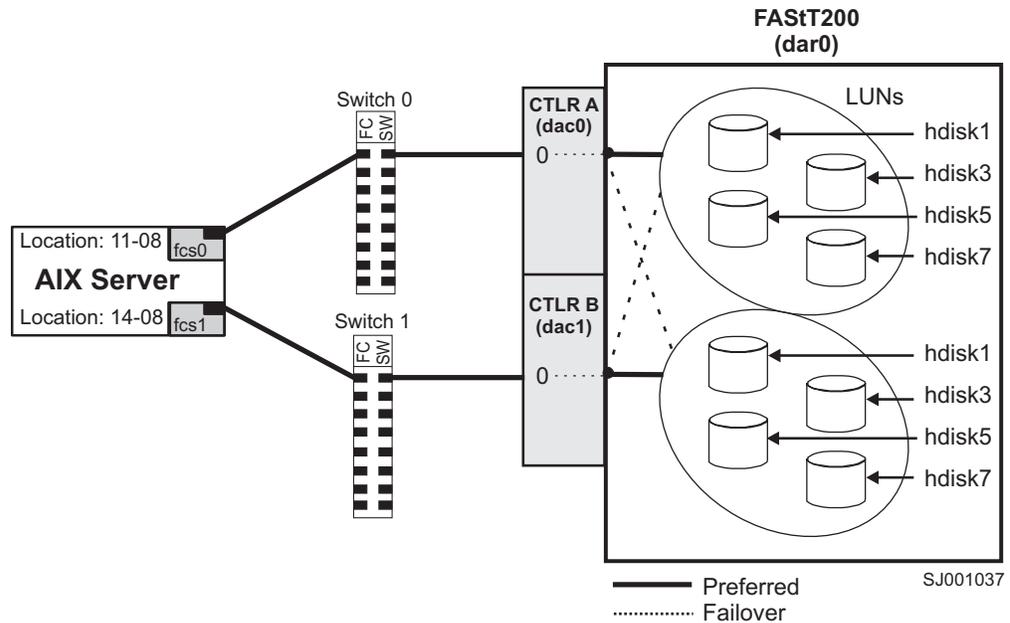


*Figure 5. Use of commands applied to validating system configuration*

## Using the lsdev command

The following example uses the **lsdev** command to show the status of dar, which represents a FAStT storage subsystem. This example shows dar as a machine type 3542, which is a FAStT200. 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              3542     (200) Disk Array Router
```

The following example uses the **lsdev** command to show the status of two dacs, which represent the FAStT storage subsystem controllers. As in the previous example, this shows a FAStT200 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     3542     (200) Disk Array Controller
dac1        Available 14-08-01     3542     (200) Disk Array Controller
```

The following example uses the **lsdev** command to show the status and location codes of eight FAStT200 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 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    3542    (200) Disk Array Device
hdisk2    Available 14-08-01    3542    (200) Disk Array Device
hdisk3    Available 11-08-01    3542    (200) Disk Array Device
hdisk4    Available 14-08-01    3542    (200) Disk Array Device
hdisk5    Available 11-08-01    3542    (200) Disk Array Device
hdisk6    Available 14-08-01    3542    (200) Disk Array Device
hdisk7    Available 11-08-01    3542    (200) Disk Array Device
hdisk8    Available 14-08-01    3542    (200) Disk Array Device
```

Another useful way of determine the full preferred path from hdisk to a fibre-channel fabric is to grep on the first two numbers of the location code, as 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    3542    (200) Disk Array Controller
hdisk1      Available 11-08-01    3542    (200) Disk Array Device
hdisk3      Available 11-08-01    3542    (200) Disk Array Device
hdisk5      Available 11-08-01    3542    (200) Disk Array Device
hdisk7      Available 11-08-01    3542    (200) Disk Array Device
hdisk8      Available 11-08-01    3542    (200) 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
passive_control no                    Passive controller     False
alt_held_reset  no                    Alternate held in reset False
controller_SN   1T01710113            Controller serial number False
ctrl_type       3552                  Controller Type        False
cache_size      512                   Cache Size in MBytes    False
scsi_id         0x11100               SCSI ID                False
lun_id          0x0                   Logical Unit Number    False


# lsattr -El dac1
passive_control no                    Passive controller     False
alt_held_reset  no                    Alternate held in reset False
controller_SN   1T03910039            Controller serial number False
ctrl_type       3552                  Controller Type        False
cache_size      512                   Cache Size in MBytes    False
scsi_id         0x11000               SCSI ID                False
lun_id          0x0                   Logical Unit Number    False


# lsattr -El hdisk1
----------- Parts removed:
scsi_id         0x11100               SCSI ID                False
lun_id          0x0000000000000000    Logical Unit Number    False
cache_method    fast_write            Write Caching method    True
```

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 FAStT 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 600A0B80000C1E6300000033BB39927 (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 FAStT storage subsystem. The **ieee_volname** and Unique Logical Drive Identifier can be found in the Change Mappings window, which is shown in Figure 6. (Click the **Mappings view** tab. Select **Logical Drive Name**. Right click and select **Change Mappings**.)
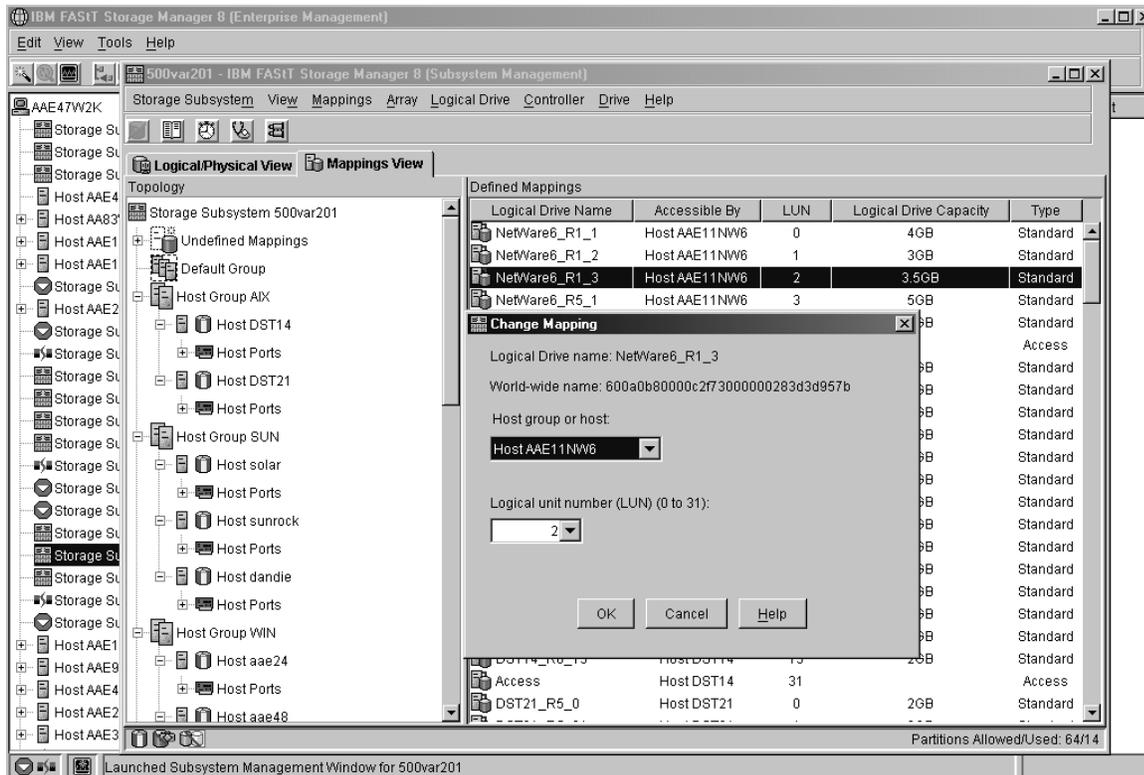


SJ000712

*Figure 6. 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 **Worldwide name**, **Capacity**, and **RAID level** properties, as shown in Figure 7 on page 30.

The following example shows a portion of the output of the **lsattr** command for hdisk20. Notice that the *ieee_volname* and *lun_id* attributes have the same values as the **Worldwide name** and **Subsystem ID (SSID)** properties shown in Figure 7 on page 30, 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
```
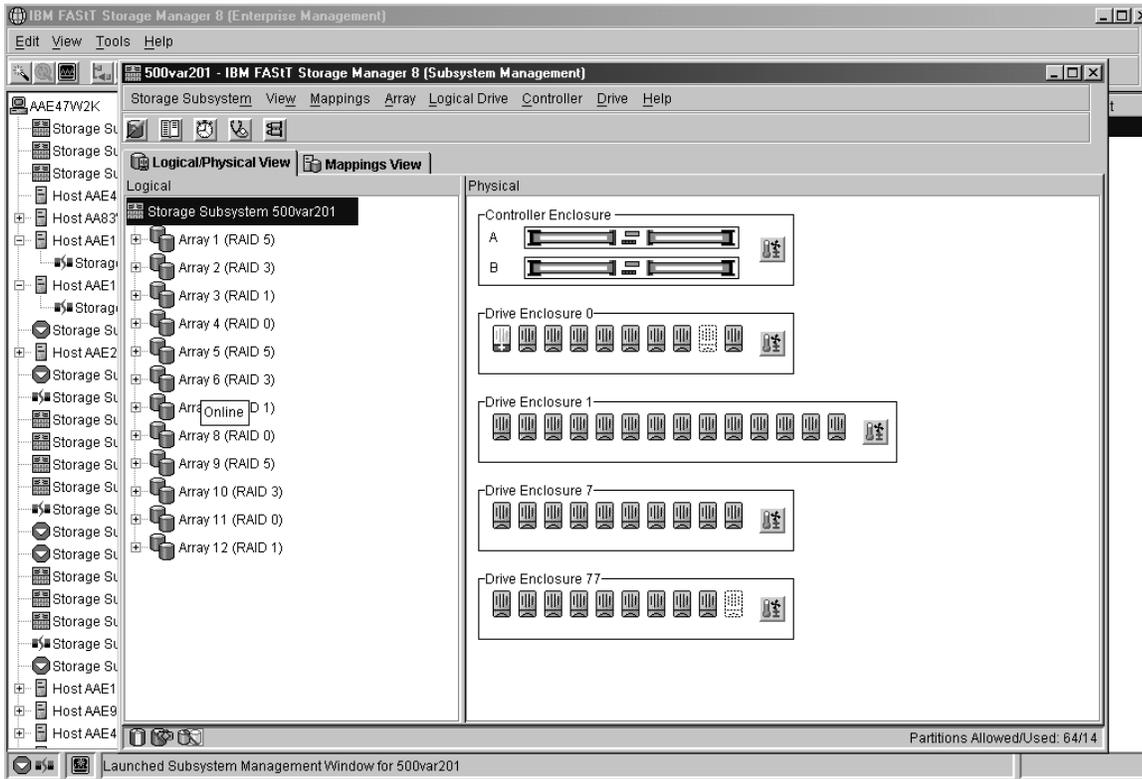
*Figure 7. Volume Properties window*

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## Disk array errors

This section shows a list of possible disk array errors that could be reported in the AIX error log. Should an error occur, check your Storage Manager Major Event Log (MEL) to see if there is any correlation between the host, SAN, and FAStT storage subsystem. You might also 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 error has occurred that does meet any of the known error conditions.

- **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*

A condition has occurred which caused an array controller switch to occur.

- **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*

  Communication error among array controllers has been detected.
- **FCP_ARRAY_ERR14** *ARRAY DRIVE FAILURE*

  A drive failure has been detected.
- **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.

## Redistributing volumes in case of failure

If a failure occurs that initiates a controller failover, follow this procedure to redistribute logical drives to their preferred paths:

1. Repair or replace any faulty components.
2. Redistribute volumes to their preferred paths by clicking **Subsystem Management —> Storage Subsystem —> Redistribute Logical Drive**.
3. Use 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 specific information for HP-UX operating systems:

- Hardware and firmware requirements
- Installing SMruntime
- Installing SMclient
- Installing SMagent
- Installing SMutil
- Configuring and partitioning storage for heterogeneous environments
- Enabling multipath I/O with PV-links
- Identifying the controller ID numbers
- Identifying device names and bus numbers

## Hardware and firmware requirements

For system-level hardware and software requirements, see Appendix B, "HP-UX system requirements", on page 133.

Table 11 lists the supported versions of hardware to use with Storage Manager 8.21.

**Note:** HP-UX 11.0 and HP-UX 11i require these patches:
- HP-UX 11.0: SCSI IO Cumulative patch - PHKL_27003
- HP-UX 11i: SCSI IO Cumulative patch - PHKL_26519

Failure to install these patches, impacts system performance.

*Table 11. Supported versions of hardware for HP-UX systems*

| Product Name | Model | Product release and firmware version |
|---|---|---|
| IBM TotalStorage FAStT700 RAID Controller Enclosure Unit | 1742-1RU | Firmware  05.21.05.09, NVSRAM  CNV1742R821NT012 |
| IBM TotalStorage FAStT700 EXP700 Storage Expansion Unit | 1740-1RU | ESM 9319 |
| IBM FAStT500 RAID Controller Enclosure Unit | 3552-1RU | Firmware  05.21.05.09, NVSRAM  CNV3352R821NT012 |
| IBM FAStT500 EXP500 Storage Expansion Unit | 3560-1RU | ESM 9163, 9165 |
| IBM FAStT200 RAID and Storage Unit, Single Controller | 3542-1RU and FC 2101 | Firmware  05.20.12.09, NVSRAM  CNV3542R821NT030 |
| IBM FAStT200 RAID and Storage Unit, Double Controller | 3542-2RU | Firmware  05.20.12.00, NVSRAM  CNV3542R821NT030 |
| HP FC Adapter | A5158A | B.11.00.06 (driver) |
| HP FC Adapter 2 Gb | A6795A | B.11.00.01 (driver) |
| Brocade switch | 2109-S08 2109-S16 | 2.6.0.e |
| Brocade switch | 2109-F16 | 3.0.2f |
| Brocade switch | 2109-M12 | 4.0.2 |

*Table 11. Supported versions of hardware for HP-UX systems (continued)*

| Product Name | Model | Product release and firmware version |
|---|---|---|
| Brocade switch | 3534-F08 | 3.0.2h |
| McData switch | 2032-064<br>2031-216<br>2031-232<br>2032-140 | 4.01.00 |
| INRANGE switch | 2042-001<br>2042-128 | 3.2.1 |

If the controllers are shipped with a firmware release prior to version 05.20.08.00 and an NVSRAM release prior to version CNV3542R821NT016 (for FAStT200 storage servers), or a firmware release prior to version 05.21.01.01 and an NVSRAM release prior to version CNV3552R821NT007 (for FAStT500 storage servers), or a firmware release prior to version 05.21.01.01 and an NVSRAM release prior to version CNV1742R821NT007 (for FAStT700 storage servers), they must be upgraded. Read the readme.txt file that is shipped with the product and go to one of the following Web sites to ensure that you have the latest versions of the firmware, NVSRAM, disk drive firmware, and host adapter device drivers:

www.pc.ibm.com/qtechinfo/MIGR-43839.html

After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

## Installing the host software on HP-UX hosts

The host software for HP-UX consists of the following three packages:
1. FAStT client (SMclient)
2. FAStT host agent (SMagent)
3. FAStT utilities (SMutil)

All three packages are dependent on SMruntime, which is a Java compiler for the SMclient, SMagent, and SMutil. The host software is dependent on Java Runtime Environment; if you do not install SMruntime you will receive errors during the software install analysis phase.

Use the following procedure 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. SMruntime
2. SMclient
3. SMagent
4. SMutil

## 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 133.

- Neither the SMruntime, SMclient, SMagent, or SMutil is installed on the host and you are ready to install it on this machine.

## Installing SMruntime on HP-UX hosts

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 cdcase -F cdfs /put device pathname here /cdrom # swinstall -s /cdrom/HP-UX/HPruntime_0804500
```

The Software Selection window opens and displays this message:

```
SMruntime
```

3. Select **SMruntime**.
4. Select **Actions —> Mark** for installation.
5. Select **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 on HP-UX hosts

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. Select **Actions —> Mark** for installation.
4. Select **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 envirnonment, you must install the client software on at least one additional storage management station or cluster server.

## Installing the client software on HP-UX hosts

Use the following procedure to install the client software. Install the software in the following order:

1. SMagent
2. SMutil

## Installing the SMagent on HP-UX hosts

In the following procedure, the installation CD is mounted at /cdrom. Adjust these instructions as required for you 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 the SMagent software installation on this HP-UX storage
   management station.

## Installing SMutil on HP-UX hosts

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 **SMutil**.

3. Select **Actions —> Mark** for Installation.

4. Select **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 and partitioning for heterogeneous environments

| After you install Storage Manager 8.21 software you need to configure the
| subsystem. System configuration includes configuring logical drives through the
| Subsystem Management window of the SMclient application, and creating storage
| arrays.

See "Configuring storage subsystems" on page 64 for additional information about
storage configuration.

Read the following before continuing:
- All FAStT storage servers ship with NVSRAM configured for Windows NT hosts
  and have an access volume set to LUN 31.
- AVT/ADT is enabled by default; leave it in that state for HP-UX hosts.
- If the controllers are shipped with a firmware release prior to version 05.20.08.00
  and an NVSRAM release prior to version NV3542R810N016 (for FAStT200

storage servers), or NV3552R821NT007 (for FAStT500 storage servers), or a firmware release prior to 05.21.01.01 and an NVSRAM release prior to CNV1742R821NT007 (for FAStT700 storage servers), they must be upgraded.

Read the readme.txt file that is shipped with the product and go to one of the following Web sites to ensure that you have the latest versions of the firmware and the NVSRAM:

www.pc.ibm.com/qtechinfo/MIGR-43839.html

After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

> **Note:** The versions of firmware and NVSRAM that ship with this product can be later releases than those described in this document.

- The Access LUN is required for HP-UX.

    **Attention:** Do not remove Access LUN or Access Logical Drive. It is detrimental to your system because it stops all communication between the controller and SMclient, and damages your DAC STORE region on the controllers.

## Configuring storage

Complete the following procedure to configure Storage Manager 8.21 for an HP-UX system:

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 8.21 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 the SMclient software 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 8.21 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**.

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

    Read the readme.txt file that is shipped with the product and go to one of the following Web sites to ensure that you have the latest versions of the firmware and the NVSRAM:

    www.pc.ibm.com/qtechinfo/MIGR-43839.html

    After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

5. Complete the following steps to upgrade the NVSRAM:

    a. Rescan the storage subsystem, and then click **Manage the Device** to return to the Subsystem Management window.

    b. Click **Storage Subsystem —> Download —> NVSRAM**.

c. In the NVSRAM window, go to the directory where the latest NVSRAM file resides.

d. Type or select the full pathname of the NVSRAM file, and then click **Update —> OK**.

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

6. Complete the following steps to upgrade the firmware:

a. Click **Storage Subsystem —> Download —> Firmware**.

b. Go to the directory where the firmware resides.

c. Type or select the full pathname 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.

7. Type the following command to restart the host:

```
# reboot
```

## Partitioning storage

**Note:** Before you partition the storage, 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
```

Perform the following steps to partition storage:

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.

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

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

# 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. Use the following procedure to establish redundant access to storage by using PV-links:

**Note:** The **hot_add** and **SMdevices** commands will not run if SMutil is not installed on your host.

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 8 on page 41. Notice that every logical drive or device and access logical unit number (LUN) is listed twice, because you have two paths to each logical drive.

```
#SMdevices
```

```
IBM FAStT Storage Manager Devices, Version 08.21.45.00
Built Wed Mar 20 00:58:59 GMT+00:00 2002
(C) Copyright International Business Machines Corporation, 2002
Licensed Material - Program Property of IBM.  All rights reserved.


/dev/rdsk/c28t0d2 [Storage Subsystem 700var201, Logical Drive hp_1, LUN 1,
Logical Drive WWN <600a0b8000075a54000000803d2c6de6>, Preferred Path
(Controller-A): In Use]

/dev/rdsk/c28t0d3 [Storage Subsystem 700var201, Logical Drive hp_2, LUN 2,
Logical Drive WWN <600a0b8000075a540000006d3d2c6d9f>, Alternate Path
(Controller-A): In Use]

/dev/rdsk/c28t0d4 [Storage Subsystem 700var201, Logical Drive hp_3, LUN 3,
Logical Drive WWN <600a0b8000075a54000000813d2c6df4>, Preferred Path
(Controller-A): In Use]

/dev/rdsk/cc28t0d5 [Storage Subsystem 700var201, Logical Drive hp_4, LUN 4,
Logical Drive WWN <600a0b8000075a540000006e3d2c6da9>, Alternate Path
(Controller-A): In Use]

/dev/rdsk/c28t3d7 [Storage Subsystem 700var201, Logical Drive Access, LUN 31,
Logical Drive WWN <600a0b8000075a540000000200000000>]


/dev/rdsk/c30t0d2 [Storage Subsystem 700var201, Logical Drive hp_1, LUN 1,
Logical Drive WWN <600a0b8000075e60000000803d2c6de6>, Preferred Path
(Controller-A): In Use]

/dev/rdsk/c30t0d3 [Storage Subsystem 700var201, Logical Drive hp_2, LUN 2,
Logical Drive WWN <600a0b8000075e600000006d3d2c6d9f>, Alternate Path
(Controller-A): In Use]

/dev/rdsk/c30t0d4 [Storage Subsystem 700var201, Logical Drive hp_3, LUN 3,
Logical Drive WWN <600a0b8000075e60000000813d2c6df4>, Preferred Path
(Controller-A): In Use]

/dev/rdsk/c30t0d5 [Storage Subsystem 700var201, Logical Drive hp_4, LUN 4,
Logical Drive WWN <600a0b8000075e600000006e3d2c6da9>, Aternate Path
(Controller-A): In Use]

/dev/rdsk/c30t3d7 [Storage Subsystem 700var201, Logical Drive Access, LUN 31,
Logical Drive WWN
<600a0b8000075e600000000200000000>]
```

*Figure 8. Device names*

3. Determine the primary and alternate path for each logical drive. A 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 access volumes in Figure 8, you will notice that they differ in only five digits, `75a54` and `75e60`. The WWNs for the logical drives also differ in these five digits.

In the example in Figure 8, the devices are viewed through the adapters c28 and c30. To determine the primary path of a specific logical drive do the following:

a. Find the WWN for each access LUN. In this case, Access LUN 1 is associated with c28 and has the WWN of 75a54. Access LUN 2 is associated with c30 and has the WNN of 75e60.

b. Identify the primary path by matching the logical drive WWN to an access LUN WWN. In this case, the WWN for the LUN 10 (75a54) is associated with adapter c28. Therefore, the primary path would be c28t1d2 and the alternate path would be c30t1d2.

c. For future reference, enter this path information into a primary and secondary path matrix, similar to the one in Table 12.

*Table 12. Primary and secondary path matrix information*

| Logical drive | Primary path | Secondary path |
|---|---|---|
| hp_1 | c28t1d2 | c30t1d2 |

d. Repeat these steps for each logical drive.

4. Define the primary paths by typing the following command. The system confirms the creation of the new physical volume:

```
#pvcreate /dev/rdsk/c28t0d0
```

5. Make a directory for volume group by typing the following command. You need the directory to reside in the /dev directory:

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

6. Make a node by typing the following command:

```
#mknod /dev/vg1/group c 64 0x01000
```

7. Create PV-links for the device with the primary path by typing the following command:

```
#vgcreate /dev/vg1 /dev/dsk/C28t1d2
```

8. Create file system with logical volumes.

9. Add an alternate path for the device by typing the following command:

```
#vgextend vg01 /dev/dsk/C30t1d2
```

10. Repeat steps 4 - 9 for each device.

11. Verify the primary and alternate paths for each device by typing the following command, where *vgname* is the volume group name:

```
#vgdisplay -v vgname
```

# Identifying the controller ID numbers

Complete this procedure to identify the controller ID numbers:

1. Select a controller in the Physical View of the Subsystem Management window.

2. Click **Controller —> Properties —> Interfaces**. The Controller Properties window opens, as shown in Figure 9 on page 43.
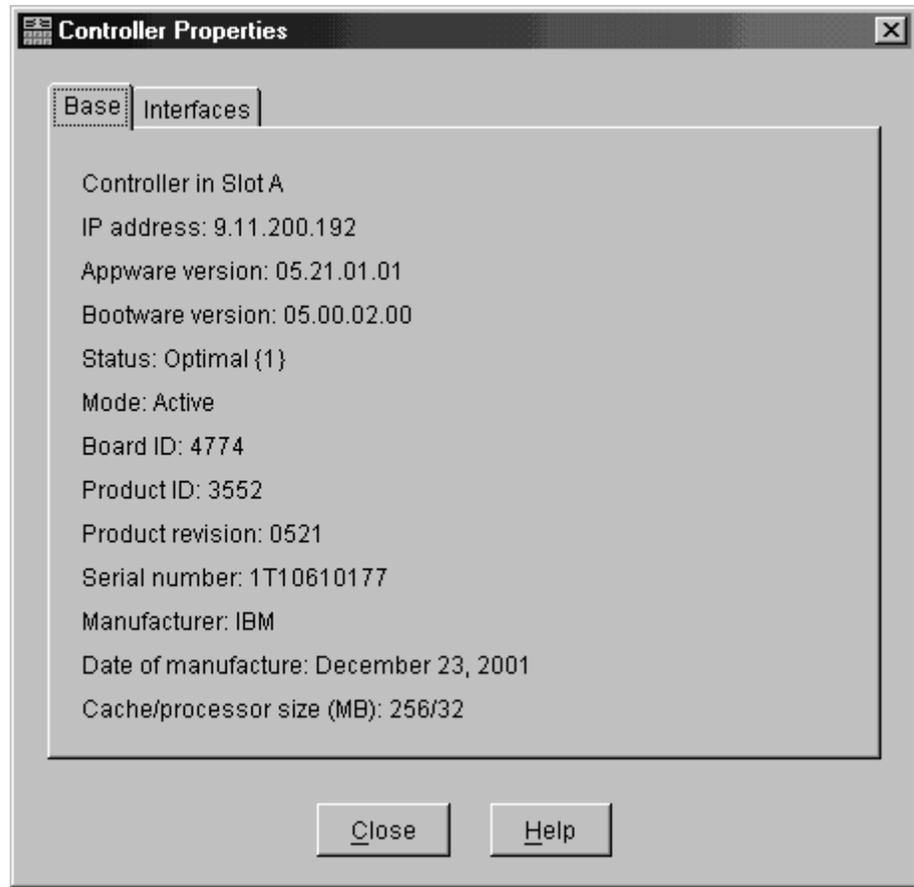
Figure 9. Controller Properties window

The first number in the **Current Loop ID** field is the controller ID, which can be one or two digits. For hubs and directly-connected subsystems, the controller ID number and the switch port ID can be found in the same window by converting the middle hexadecimal number to a decimal number.

# Identifying device names and bus numbers

Use the **ioscan** command to determine the full device names of data logical drives in the storage subsystem. This information allows you to determine the host adapter external bus numbers and the IDs of the controllers that the host adapters are connected to.

1. View the operating system list of devices by typing the following command:

```
# ioscan -f
```

2. The identification information for every device is displayed. See Figure 10 on page 44.

```
Class          I      H/W Path           Driver   S/W State   H/W Type      Description
================================================================================
bc             0                         root     CLAIMED     BUS_NEXUS
bc             1      8                   ccio     CLAIMED     BUS_NEXUS     I/O Adapter
fc             0      8/12                fcT1     CLAIMED     INTERFACE     HP Fibre Channel
Stora| External bus number of |          | Controller ID |
lan  |   the host adapter     |          |    number     | CLAIMED  INTERFACE  HP Fibre Channel
Storage Cntl
fcp            0      8/12.8              fcp | Target address |   INTERFACE     FCP Protocol Adapter
ext_bus        2      8/12.8.0.2.0.0      fcpdev   CLAIMED     INTERFACE     FCP Device Interface
target         39     8/12.8.0.2.0.0      tgt      CLAIMED     DEVICE
disk           130    8/12.8.0.2.0.0.0    sdis| LUN number |   DEVICE        IBM INF-01-00
disk           35     8/12.8.0.2.0.0.7    sdisk    CLAIMED     DEVICE        IBM Universal Xport
target         39     8/12.8.0.2.0.1      tgt      CLAIMED     DEVICE
disk           131    8/12.8.0.2.0.1.0    sdisk    CLAIMED     DEVICE        IBM INF-01-00
                          | Switch port |
                          | ID number   |
                                                                                      SJ000701
```

*Figure 10. Device identification information*

3.  Examine the information. LUN numbers range from 0 - 7 and target addresses from 0 - 3.

    Device names have the following format: c<*x*>t<*y*>d<*z*> where:

    **<*x*>**
    Represents the controller ID number

    **<*y*>**
    Represents the target address

    **<*z*>**
    Represents the LUN number

    For example, disk 130 in Figure 10 has a device name of c2t0d0.

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

This chapter provides the following specific information for Solaris operating systems:

- Hardware and firmware requirements
- Installing runtime software
- Installing client software
- Installing host software
- Uninstalling software
- Performing initial configuration
- Partitioning (default)
- Creating direct-attached and SAN-attached configurations
- Configuring JNI HBA cards
- Installing RDAC
- Verifying external storage

## Hardware and firmware requirements

Table 13 lists the supported versions of hardware to use with Storage Manager 8.3.

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

| Product Name | Model | Product release and firmware version |
|---|---|---|
| IBM TotalStorage FAStT900 RAID Controller Enclosure Unit | 1742-90U | Appware 05.30.07.00 NVSRAM N1742F900R830V03 |
| IBM TotalStorage FAStT700 RAID Controller Enclosure Unit | 1742-1RU | Appware 05.30.07.00 NVSRAM N1742F700R830V03 |
| IBM TotalStorage FAStT700 EXP700 Storage Expansion Unit | 1740-1RU | ESM 9321 |
| IBM FAStT500 RAID Controller Enclosure Unit | 3552-1RU | Appware 05.30.07.00 NVSRAM N3552F500R830V03 |
| IBM FAStT500 EXP500 Storage Expansion Unit | 3560-1RU | ESM 9166 |
| IBM FAStT200 RAID and Storage Unit, Single Controller | 3542-1RU and FC 2101 | Snapware 05.30.07.00 NVSRAM N3542-2RUR830V05 |
| IBM FAStT200 RAID and Storage Unit, Double Controller | 3542-2RU | Snapware 05.30.07.00 NVSRAM CNV3542R821NT030 |
| 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 |
| JNI FC Adapter | FCE-1473 S-bus 64 bit | JNIC146x.pkg, version 5.1.2 |
| 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 5.1.2 |

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

| Product Name | Model | Product release and firmware version |
|---|---|---|
| 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 |
| Brocade switch | 2109-S08, 2109-S16 | 2.6.0.e |
| Brocade switch | 2109-F16 | 3.0.2f |
| Brocade switch | 2109-M16 | 4.0.0.a |
| Brocade switch | 3534-F08 | 3.0.2h |
| McData switch | 2032-064, 2031-216, 2031-232, 2032-140, | 4.01.00 |
| INRANGE switch | 2042-001, 2042-128 | 3.2.1 |

Read the readme that is shipped with the product and go to one of the following Web sites to ensure that you have the latest versions of the firmware, NVSRAM, disk drive firmware, and host adapter device drivers:

www.pc.ibm.com/qtechinfo/MIGR-43839.html

After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

For system-level hardware and software requirements, see Appendix C, "Solaris system requirements", on page 135.

**Note:** Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. If you do not have the latest versions, download them from one of the Web sites listed above.

# Installing the runtime software on Solaris hosts

Use the following procedure to install the runtime software (SMruntime) on a Solaris storage management station.

## Prerequisites

Before installing SMruntime, 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 2.6, 2.7, or 8 and meets the minimum hardware and software requirements described in Appendix C, "Solaris system requirements", on page 135.
- SMruntime is not installed and you are ready to install it on this machine.

## Procedure

In the following procedure, the installation CD is mounted at /cdrom/sm83. 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 45 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/SM821/SUN_SParc/SM8runtime-Sparc-filename.pkg
```

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]:
```

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 <SMruntime>
[y, n, ?]
```

4. 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.
```

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

```
#pkgchk Smruntime
```

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

## Installing the client software on Solaris hosts

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

**Note:** SMclient is supported on Solaris 2.6, 2.7, and 8.

## 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 2.6, 2.7 or 8 and meets the other minimum hardware and software requirements described in Appendix C, "Solaris system requirements", on page 135.
- SMruntime is installed.
- SMclient is not installed and you are ready to install it on this machine.

## Installing SMclient on Solaris hosts

In the following procedure, the installation CD is mounted at /cdrom/sm821. 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/SM821/SUN_Sparc/SM8client-Sparc-filename.pkg
```

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:

```
# pkgchk 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 48 through step 6 on page 48 of the installation procedure. Use the corresponding installation profile for each storage management station as a guide.

## Installing host software on Solaris hosts

After you install the Storage Manager 8.21 client software and configure your storage subsystems, use these instructions to install the appropriate Storage Manager 8.21 host software.

All Solaris hosts in your storage subsystem must have the following host software packages installed on them:
- RDAC
- SMagent (for in-band management only)
- SMutil

This section contains the procedure for installing the software.

## 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 2.6, 7, or 8, and meets the minimum hardware and software requirements described in Appendix C, "Solaris system requirements", on page 135.
- The RDAC, SMagent, and SMutil software packages are not installed and you are ready to install them on this machine.

**Note:** If you plan to run Storage Manager 8.21 in an environment that includes storage arrays that you are not upgrading to 8.21, you must upgrade your existing storage manager to at least version 6.22. The Storage Manager 8.21 RDAC package replaces the version 6.22 RDAC files and is shared by version 6.22 and version 8.21 of the storage management software.

See the Storage Manager 6.x installation instructions for information about uninstalling the software.

## Installing SMagent on Solaris hosts (optional)

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

Perform the following procedure to install SMagent:

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

```
pkgadd -d /cdrom/SM83/SUN_SParc/SM8agent-Sparc-filename.pkg
```

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:

```
# pkgchk 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 on Solaris hosts

Perform the following steps to install SMutil:

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

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

   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:

```
# pkgchk SMagent
```

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 Storage Manager 8.213 software on this Solaris host.

## Uninstalling Storage Manager 8.21 software

When you uninstall SMruntime, RDAC, SMclient, SMagent, or SMutil software, the directory /var/opt/SM8 might not be removed. Delete this directory to ensure a clean installation of the new software.

## Performing the initial configuration of storage subsystems on Solaris hosts

To configure Storage Manager 8.21 for a Solaris system, complete the following procedures in the order that they are described in this section:

- Steps for specifying the IP addresses of the controllers
- Steps for updating FAStT firmware and NVSRAM
- Steps for setting up a Solaris host group

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

- All FAStT storage servers ship with NVSRAM configured for Windows NT hosts and have an access volume set to LUN 31. This should not present any problems for Solaris in recognizing the storage subsystem.
- If the controllers are shipped with a firmware release prior to version 05.20.08.00 and an NVSRAM release prior to version `CNV3542R821NT016` (for FAStT200 storage servers), or a firmware release prior to version 05.21.01.01 and an NVSRAM release prior to version `CNV3552R821NT007` (for FAStT500 storage servers), or a firmware release prior to version 05.21.01.01 and an NVSRAM release prior to version `CNV1742R821NT007` (for FAStT700 storage servers), they must be upgraded.

  Read the readme.txt file that is shipped with the product and go to one of the following Web sites to ensure that you have the latest versions of the firmware and the NVSRAM:

  www.pc.ibm.com/qtechinfo/MIGR-43839.html

  After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

  **Note:** Versions of firmware and NVSRAM that ship with this product might be later releases than those described in this document. If you do not have the latest versions, download them and perform the procedure described in "Steps for updating NVSRAM and FAStT firmware" on page 52. If the version numbers are current, you can skip that procedure.

# Steps for specifying the IP addresses of the controllers

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**.

# Steps for updating NVSRAM and FAStT firmware

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 pathname 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.

# Steps for setting up a Solaris host group

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

**Note:** 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**.
   d. Choose the host port for the second HBA and click **Add**, and then click **Close**.
   e. To view the added LUNs, click the host group, and then click **Mappings** —> **Define** —> **Define Additional Mapping**.

f. Type the following command to run the hot_add utility:

```
# /etc/raid/bin/hot_add
```

For information about the output of the utility, see "Default partitioning for Solaris devices".

g. Click **File —> Exit**.

h. Obtain the device name for each volume (or LUN) by typing the following command:

```
# format
```

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

# Default partitioning for Solaris devices

After you install the Storage Manager 8.21 software and configure the subsystems and logical drives through the Subsystem Management window of the SMclient application, run the /etc/raid/bin/hot_add utility from a shell prompt. (For additional information about the hot_add utility see the applicable man page.)

When the hot_add utility is run, each logical drive that is created in the Subsystem Manager presents a disk device to the operating system. The devices have the following naming convention:

```
/dev/[r]dsk/c<X>t<X>d<X>s<X>
          |   |   |   |
          |   |   |   s=slice
          |   |   d=drive
          |   t=target
          c=controller
     disk subdirectory
```

where X represents a number. The number following the slice (s) represents the partition on the disk and can be from 0 -7.

**Note:** To run the **hot_add** or **SMdevices** commands, you must have SMutil installed on the host.

You can overwrite disk information by using partitions or slices 0 - 2; this results in an inability to mount a disk. For this reason, do not use slices 0, 1, or 2. Using these slices can cause unpredictable results. Mount file systems only on slices 3, 4, 5, 6, or 7 on the devices that are derived from the logical drives on the storage subsystem.

# Direct-attached and SAN-attached configurations

Storage Manager 8.21 supports FAStT200, FAStT500, FAStT700 and FAStT900 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 the FAStT storage server, as follows:

- FAStT200 can support one Solaris server.
- FAStT500 can support two Solaris servers.
- FAStT700 can support two Solaris servers.

**Requirements:**

- Two server FAStT500 or FAStT700 configurations require four host-side mini-hubs, each with exactly one fibre-channel connection from each host bus adapter (HBA) to a mini-hub.
- There must be two or four JNI HBAs per FAStT storage server. Each pair must be configured to one FAStT partition.
- No external hubs can be used.

Perform 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. Start the system.
3. 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 IBM 2109-F16.

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

Perform 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:** See the documentation provided by the switch manufacturer for information about zoning and enabling zones.
4. Start the system.
5. Configure and verify the configuration.

# Configuring JNI host bus adapter cards

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

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

This section describes how to configure JNI HBA cards, including the following procedures:

- Installing the JNI adapter driver package
- Binding the HBAs to storage controllers (for SAN-attached configurations only)

**Note:** You must complete these procedures before you can install RDAC.

## Steps for installing the JNI adapter driver package

This procedure refers to Table 14.

**Before you begin:**
- Ensure that the JNI HBAs have been installed.
- Ensure that the JNI HBAs have been attached directly to the controllers or the JNI HBAs are attached to a SAN fabric switch.
- If attached to SAN fabric switch, the zones for the FAStT Storage subsystem must be created and enabled. Consult the documentation provided by the switch manufacturer for information about how to create and enable zones.

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

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

1. On Table 14, identify the driver package for the installed HBAs.
2. Download the most current adapter driver package from the following Web site:

   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 drive package is installed:

```
#pkginfo adapter_driver_package
```

   where *adapter_driver_package* is the name of the adapter driver package that you installed.

Table 14 lists the configuration file for each JNI adapter driver package.

*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 |
| FCE2-1063, FCE2-1063, FCE-6410, FCE2-6412 | JNIC.pkg, version 4.1.1.1 | /kernel/drv/jnic.conf |
| FCE-1473, FCE-6412 (2 Gb) | JNIC146x.pkg, version 5.1.2 | /kernel/drv/jnic146x.conf |

# Steps for modifying 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 FAStT storage controller before you install the RDAC driver on the host.

**Attention:** If you have a direct-attached configuration, skip this section and proceed to "Installing RDAC on Solaris hosts" on page 58. You do not need to modify JNI HBA settings if you have a direct-attached configuration.

This procedure refers to Appendix E, "JNI host bus adapter settings", on page 139.

**Before you begin:** Ensure that the configuration file for your adapter meets the following criteria:

- The *FCLoopEnabled* and *FcFabricEnabled* variables must be set appropriately for your configuration; see the configuration file for details.
- If the *fca_nport* variable is in the file, set it to 1.
- If the *ip-disable* variable is in the file, set it to 1.
- In fca*.conf files, set *BusyRetryDelay* to 5000.
- In fca*.conf files, set *scsi_probe_delay* to 5000.
- In fca*.conf files, set *link_recovery_delay* to 1000.
- The lines that contain these variables must be uncommented and set to the specified values:
  - *failover* or *FailoverDelay*, set to 30
  - *JniCreationDelay*, set to 10
  - *def_ww**n**n_binding*, remove the dollar-sign character ($) from the line
  - *def_ww**p**n_binding*
  - *def_hba_binding*

    **Notes:**

    1. *def_hba_binding* is for fca.pci.conf and fcaw.conf
    2. When the RDAC software is installed, the *def_hba_binding* variable in the fca-pci.conf and fcaw.conf files is set to nonjni. This is the correct behavior.
    3. fcaw.conf should be changed back to original value *-def_hba_binding*=″fcaw*″.

Perform the following procedures to modify JNI HBA settings:

1. Modify the loop attributes using the following steps:
   a. 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
```

   b. In the Vi editor, uncomment and modify the loop attributes using the information in Appendix E, "JNI host bus adapter settings", on page 139.

c.  Run the following command to save changes made to the JNI configuration
    file:

```
#:wq
```

d.  Run the following command to restart the Solaris host:

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

2.  Gather binding information using the following steps:

    a.  After the host restarts, run the following commands to gather binding
        information in the messages log:

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

    The messages log appears.

    b.  Search the messages log for the most recent HBA information. You can do
        this with a backwards search for the installed HBAs. For example, you can
        search for the JNI 2 Gb.HBA FCE-6064 by running the following command:

```
? FCE-6460
```

    c.  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

3.  Bind the HBA to storage controllers using the following steps:

    a.   Run the following commands to open the JNI configuration file:

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

    For example, the following commands open the jnic146x.conf file:

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

    b.  Set and change the following variables to the specified values.

        **Note:**  The examples in this step assume you are binding two JNIC
                   FCE-6460 HBAs to the FAStT controllers.

        **target0_hba**   1. Set the target to the first record value 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.

                          2. Set the target to the second record value 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**   1.Set the target to the wwpn of the first controller using the record value from the /var/adm/messages file.

Example:

```
targetz_wwpn="controller_1_wwpn"
```

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

2. Set the target to the wwpn of the second controller using the record value from the /var/adm/messages file.

Example:

```
targety_wwpn="controller_2_wwpn"
```

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

c.  Run the following command to save the changes to the JNI configuration file:

```
#:wq
```

d.  Run the following command to restart the Solaris host:

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

# 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 "Steps for installing the JNI adapter driver package" on page 55.

  For information about how to set the bindings, see "Steps for modifying JNI HBA settings" on page 56.
- Go to the following Web site to ensure that you have the most recent RDAC:

  www.pc.ibm.com/qtechinfo/MIGR-43839.html

  After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

Perform 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/SM82. Adjust the procedure as required for your specific installation location.

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

```
# pkgadd -d /cdrom/SM821/SUN_Sparc/SM8rdac-Sparc-filename.pkg
```

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 "Steps for modifying JNI HBA settings" on page 56.

**Attention:** Modifying failover settings in the JNI configuration file after installing RDAC requires the removal of the RDAC from the host. In this case, perform the following procedure, in which you remove RDAC and restart the host.

**Note:** Modification or addition of targets or WWPNs for the controllers does not require the removal of RDAC or host restart. New HBAs can bind to controllers without the removal of RDAC or host restart. To modify or add targets or WWPNs for controllers, do not perform the following procedure; 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, perform the following steps:

1. Uninstall the RDAC driver package using the following command:

```
#pkgrm RDAC_driver_pkg_name
```

2. Verify RDAC drive package removal using the following command:

```
#pkginfo RDAC_driver_pkg_name
```

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
```

When you have finished making changes, run the following command to save changes:

```
#:wq
```

5. Install the RDAC driver package using the following command:

```
#pkgadd -d RDAC_driver_pkg_name
```

6. Verify package installation using the following command:

```
#pkginfo RDAC_driver_pkg_name
```

7. Restart the Solaris host using the following command:

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

# Verifying external storage

After you install RDAC, complete the following procedure 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 on Solaris hosts" on page 50.

**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 FAStT 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 SMutils 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 the zones have been enabled.
- Recheck the targets and WWPNs.
- Check to see the FAStT Controllers and expansion drawers are powered on.
- Check to see the switch(s) are powered on.
- Check fibre channel cables.

# Chapter 5. Completing the software installation

This chapter describes how to complete the installation of Storage Manager 8.21 by performing these tasks:

- Failover protection
- Changing the host type
- Understanding the implications of using heterogeneous hosts in your storage subsystem
- Configuring the storage subsystem
- Configuring alert notifications
- Starting the Subsystem Management window

## Failover protection

Failover protection is available by using multipath drivers. A multipath driver is an I/O path failover driver that is installed on host computers that access the storage subsystem. AVT/ADT is a built-in feature of the controller firmware that allows logical-drive-level failover rather than controller-level failover.

When AVT/ADT is enabled and used with a host multipath driver, it ensures that an I/O data path is available for the storage subsystem logical drives. The AVT/ADT feature changes the ownership of the logical drive that is receiving the I/O to the alternate controller. After the I/O data path problem is corrected, the preferred controller reestablishes ownership of the logical drive as soon as the multipath driver detects that the path is working again.

## Changing the host type

The host type defines how the controllers in the storage subsystem work with the operating systems on the hosts that are connected to it.

When using the storage management software, you must set the correct host type by clicking **Mappings —> Change —> Host Type** in the Subsystem Management window.

If partitioning is enabled, click **Mappings —> Change —> Host Type**. Select the desired host port in the left window and click **Configure —> Topology —> Change Host Type**.

For more information, see the topic on changing the host type of a storage subsystem in the Subsystem Management window online help.

If the Storage Partitioning feature is enabled, you must change the host type that is associated with each host port in the Mappings window. (For more information, see the topic on changing the host type of an individual host port in the Subsystem Management window online help.)

When you have selected the host type, continue with "Configuring storage subsystems" on page 64.

# Heterogeneous hosts overview

The heterogeneous hosts feature enables hosts that are running different operating systems to access a single storage subsystem. In previous releases of Storage Manager, only hosts running the same operating system could access a single storage subsystem. Storage Manager 8.21 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 be running 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 a host type is specified in the Define New Host Port window, the heterogeneous hosts feature enables the controllers in the storage subsystem to tailor their behavior (such as LUN reporting and error conditions) to the needs of the operating system or variant of the host that is sending the information.

In a heterogeneous environment, you must set each host type to the appropriate operating system during host-port definition so that the firmware on each controller can respond correctly for the operating system for that host. Before you begin setting up your heterogeneous host's configuration, see the *IBM FAStT Storage Manager Concepts Guide* available on your installation CD or at the following Web site:

www.ibm.com/pc/support/

# Configuring storage subsystems

Use the following procedures to start the client software 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 client software to configure each attached storage subsystem.

**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.

# Starting the Enterprise Management window

Use this procedure to start the Enterprise Management window from the storage management station where you have installed the client software:

1.  Start the client software:

    A splash screen is displayed while the client software starts. When the client software has been loaded, the Enterprise Management window and the Initial Automatic Discovery window opens (see Figure 11 on page 65).

    **Note:**  The Enterprise Management window can take several minutes to open. No wait cursor, such as an hourglass, is displayed.
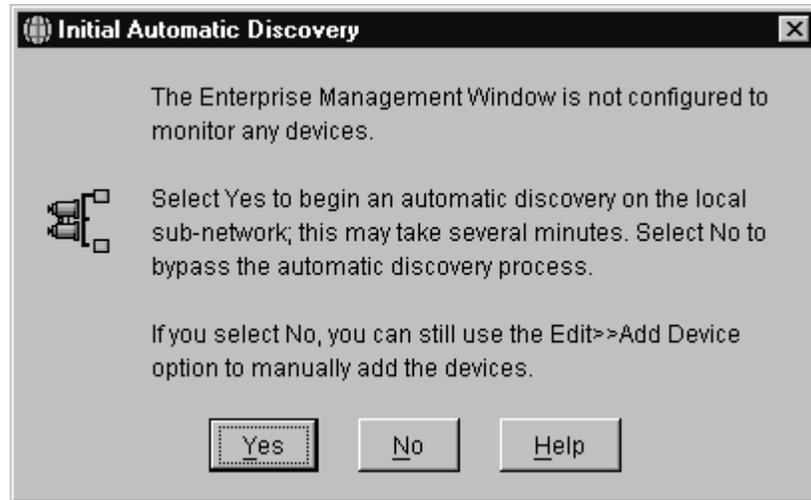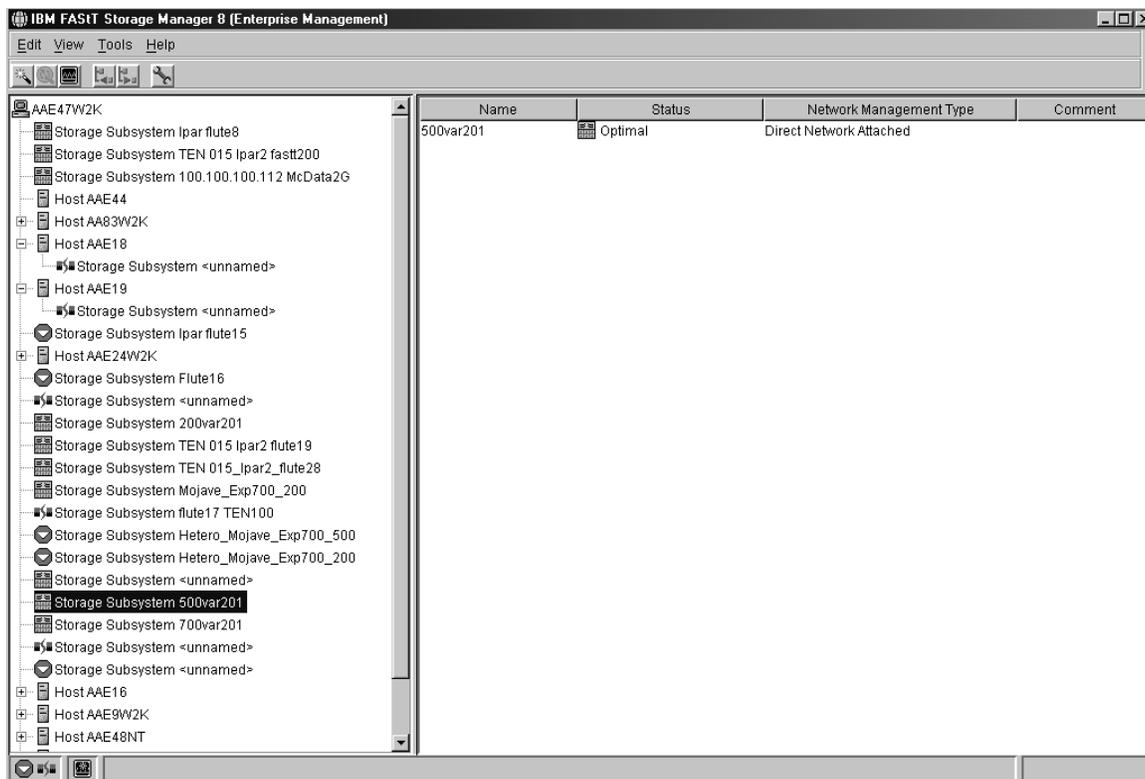
SJ000704

*Figure 11. Initial Automatic Discovery window*

2. If you are running the client software from AIX, change to the /SMclient directory and then type `SMclient`.

3. If you are running the client software from Solaris 8, type `SMclient`.

4. Click **Yes** to begin an initial automatic discovery of all attached hosts and storage subsystems that are attached.

   The software sends a broadcast message across the local subnetwork that is connected to the storage management station. It discovers host-agent-managed storage subsystems if the respective hosts respond to the broadcast. The software discovers directly managed storage subsystems if the controllers in the attached storage subsystems respond to the broadcast message.

   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 (see Figure 12 on page 66).

IBM FAStT Storage Manager 8 [Enterprise Management]

Edit   View   Tools   Help

| Name | Status | Network Management Type | Comment |
|------|--------|-------------------------|---------|
| 500var201 | Optimal | Direct Network Attached | |

AAE47W2K
  Storage Subsystem lpar flute8
  Storage Subsystem TEN 015 lpar2 fastt200
  Storage Subsystem 100.100.100.112 McData2G
  Host AAE44
  Host AA83W2K
  Host AAE18
    Storage Subsystem <unnamed>
  Host AAE19
    Storage Subsystem <unnamed>
  Storage Subsystem lpar flute15
  Host AAE24W2K
  Storage Subsystem Flute16
  Storage Subsystem <unnamed>
  Storage Subsystem 200var201
  Storage Subsystem TEN 015 lpar2 flute19
  Storage Subsystem TEN 015_lpar2_flute28
  Storage Subsystem Mojave_Exp700_200
  Storage Subsystem flute17 TEN100
  Storage Subsystem Hetero_Mojave_Exp700_500
  Storage Subsystem Hetero_Mojave_Exp700_200
  Storage Subsystem <unnamed>
  Storage Subsystem 500var201
  Storage Subsystem 700var201
  Storage Subsystem <unnamed>
  Storage Subsystem <unnamed>
  Host AAE16
  Host AAE9W2K
  Host AAE48NT

SJ000705

*Figure 12. Enterprise Management window*

5. Make sure that all the attached hosts and storage subsystems are displayed as expected. If not, do the following:

    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. Make sure 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.

    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.

6. Make sure 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 customer service representative.

7. 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 *IBM FAStT Storage Manager Concepts Guide*, available on your installation CD or at the following Web site:

www.ibm.com/pc/support/

Use the following procedure to set up alert notifications using SNMP traps. You need to set up the designated management station only once.

1. Make sure that the installation CD is inserted in the CD-ROM drive on your designated NMS.
2. From the installation CD, copy the SM8_21.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.
4. Go to "Starting the Subsystem Management window".

## Starting the Subsystem Management window

In the Enterprise Management window, select a storage subsystem in one of these ways:

- Click **Tools —> Manage Device**.
- Right-click the **storage subsystem** and click **Manage Device**.
- Double-click the **storage subsystem**.

The Subsystem Management window for the selected storage subsystem opens (see Figure 13 on page 68).

**Note:** You can manage one storage subsystem per Subsystem Management window. Open multiple windows to manage other storage subsystems.
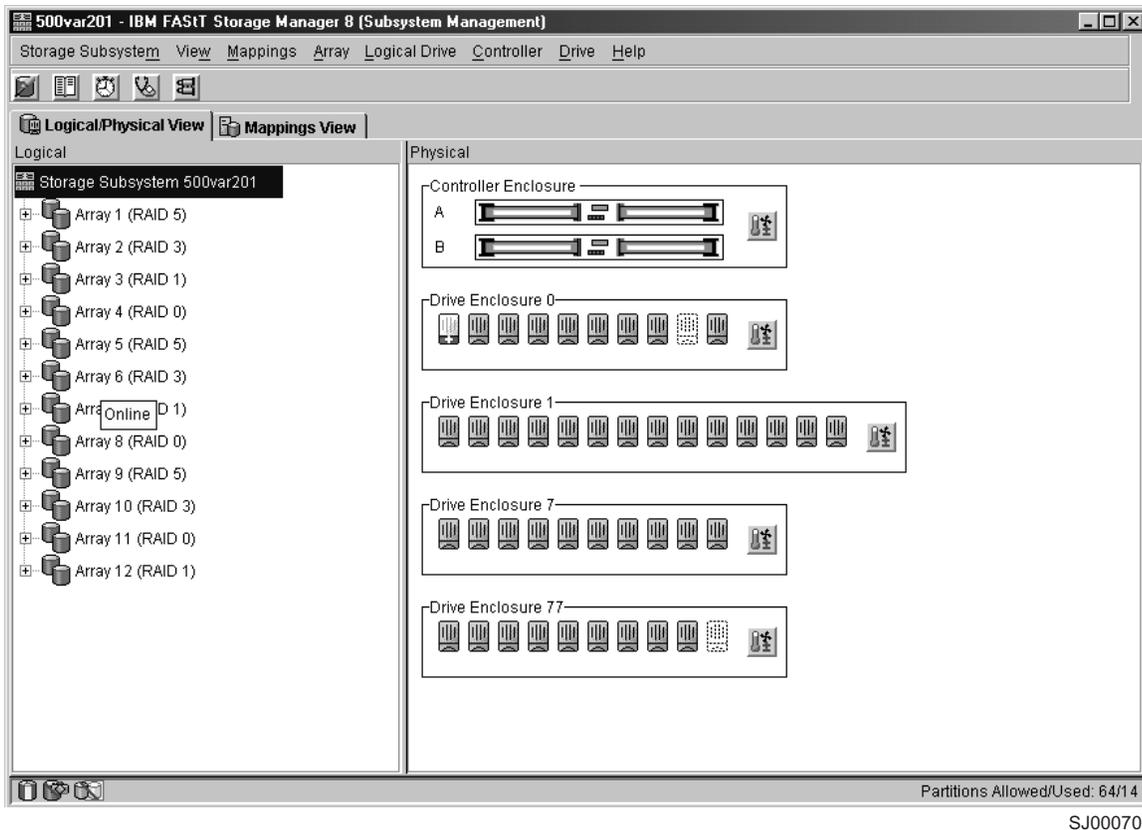
*Figure 13. Subsystem Management window*

## Renaming storage subsystems

When you start the storage management software for the first time, the storage subsystems are unnamed. Rename each storage subsystem from *unnamed* to a name that is appropriate for your network. In the Subsystem Management window, click **Storage Subsystem —> Rename**.

## Performing optional 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 applicable)

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 11, Chapter 3, "Installing storage management station software on HP-UX

systems", on page 33, or Chapter 4, "Installing storage management station software on Solaris systems", on page 45 for installation instructions.

# Chapter 6. Storage Manager 8.21 with high-availability cluster services

The high-availability clustering services provided by Storage Manager 8.21 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

Storage Manager 8.21 is certified for use with the following cluster services:
- MC/ServiceGuard versions A.11.09 and A.11.13 on HP-UX systems
- Veritas Cluster Server 1.3 and 2.0 on Solaris systems
- Veritas Volume Manager 3.2 on Solaris systems

This document does not describe how to install or configure cluster services. Refer to documentation provided with your cluster service products for this information.

## Prerequisites for HP-UX

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.

## Prerequisites for Solaris and Veritas Cluster Server

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.

### Veritas Volume Manager and Data Multipathing

If you are using the Veritas Volume Manager, you must disable Data Multipathing (DMP) either for all devices, or for just FAStT storage servers, depending on your version of the Veritas Volume Manager.

For Veritas Volume Manager 3.1 or earlier, follow these steps to disable DMP for all devices:

1. Open the /etc/system file in the vi text editor by typing the following command:

```
# vi /etc/system
```

2. Comment out the `forceload: drv/vxdmp` line.
3. Save and close the /etc/system file.

For Veritas Volume Manager 3.2 and later, you must disable DMP for FAStT storage servers only. Use option 17 and then option 5 of the submenu of the vxdiskadm utility to do so. Other devices can use DMP.

**Note:** If you are using the Veritas Cluster Server, you must change the stack size parameters. Open the `/etc/system` file in the vi test editor and make the following updates:

- Change the default value for `set lwp_default_stksize` to 0x8000
- Change the default value for `set rcpcmod:svc_default_stksize` to 0x8000

### 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.

## Storage Manager 8.21 with High Availability Cluster Management Program

This section contains general software requirements for the High Availability Cluster Management Program (HACMP).

## FAStT software and firmware requirements

See Appendix A, "AIX system requirements", on page 131 for hardware, software, firmware and RDAC requirements.

For the most current information about AIX and device driver versions for FAStT, see the aixreadme file at the following Web site:

www.pc.ibm.com/qtechinfo/MIGR-43839.html

After accepting the license agreement, go to the v8.21 link for the appropriate Operating System.

## Minimum HACMP software requirements

The following HACMP requirements are in addition to the requirements that are specified in Appendix A, "AIX system requirements", on page 131.

- For HACMP ES and ESCRM v4.4.1 with AIX 4.3.3 and AIX 5.1.0, the following HACMP APARs are required:
  - IY31483
  - IY31489
  - IY38234
- For HACMP ES and ESCRM v4.5 with AIX 5.1.0 and AIX 5.2.0, the following HACMP APARs are required:
  - IY32874
  - IY37247
- The following AIX 5.1.0 APAR is required:
  - IY37897
- The following AIX 5.2.0 APARs are required:
  - IY37746
  - IY36626

## Configuration limitations

Configuration limitations are:

- Switched fabric connection only, no direct connection is allowed between the host node and FAStT.
- HACMP C-SPOC cannot be used to add a FAStT disk to AIX using the "Add a Disk to the Cluster"facility.
- The HACMP C-SPOC facility does not support enhanced concurrent mode volume groups.
- Single Node Quorum is not supported in a two-node General Parallel File System (GPFS) cluster with FAStT disks in the configuration.
- pSeries™ and AIX clusters are not supported in a heterogeneous environment at this time.

## Other usage notes specific to HACMP environments

The following notations are specific to HACMP environments:

- Concurrent and non-concurrent modes are supported with HACMP v4.4.1 and v4.5 and FAStT running SM 8.21, including Hot Standby and Mutual Take-over.
- HACMP v4.4.1 and v4.5 is supported on Regatta LPAR clustered configurations.
- HACMP clusters can support from 2 to 32 servers per FAStT partition. In this environment be sure to read and understand the AIX device drivers queue depth settings as described in Chapter 2, "Installing storage management station software on AIX systems", on page 11.

- Non-clustered AIX hosts can be connected to the same FAStT that is attached to an HACMP cluster with HACMP version 4.4.1 and version 4.5, and FAStT running Storage Manager 8.21, but they must be configured on separate FAStT host partitions.

## Storage Manager 8.21 with Parallel System Support Programs and General Parallel File System

This section contains general software requirements for Parallel System Support Programs (PSSP) and General Parallel File System (GPFS) support with Storage Manager.

### Minimum AIX, PSSP, and GPFS software requirements

The following combinations of PSSP and GPFS are supported with FAStT500 or FAStT700:

- PSSP v3.4 with GPFS v1.5 requires APAR IY31786:
- PSSP v3.5 with GPFS v2.1 requires APARs IY37601 and IY37029:

### Configuration limitations

Limitations for HACMP cluster configurations are:

- The FAStT200 is not supported in PSSP or GPFS configurations.
- No direct connection is allowed between the host node and a FAStT. Only switched fabric connection is allowed.
- Each server must have two or four fibre-channel connections to each attached FAStT; one connection per FAStT controller host-side minihub; two connections per FAStT partition with each connection on different controllers. These connections must be made using two or four fibre channel host adapters. Multiple FAStT storage servers can be attached using these same host adapters (fan out) or by adding additional HBA pairs for each partition.
- A maximum of four partitions are allowed per FAStT.
- Recoverable Virtual Shared Disk (RVSD) Clusters can support a maximum of two IBM Virtual Shared Disk and RVSD servers per FAStT partition.
- HACMP and GPFS clusters can support from 2 to 32 servers per FAStT partition. In this environment be sure to read and understand the AIX device drivers queue depth settings as described in Chapter 2, "Installing storage management station software on AIX systems", on page 11.
- For maximum availability, distribute the HBA and FAStT connections across separate fibre-channel switches to minimize the effects of a SAN fabric failure.
- Single Node Quorum is not supported in a dual-node GPFS cluster with FAStT disks in the configuration.

### Other usage notes specific to PSSP and GPFS environments

In GPFS file systems, the following FAStT cache settings are supported:

- Read cache enabled or disabled
- Write cache enabled or disabled
- Cache mirroring disabled

The performance benefits of read or write caching is application-dependent.

# GPFS and PSSP logical configuration diagrams

The following diagrams show both preferred and failover paths from an HBA pair to a given volume or set of volumes. A preferred path to a volume is determined when the volume is created and distributed across a FAStT controller. The controller to which it is assigned determines which path is "preferred" or active for I/O transfer. Volumes can, and in most cases should, be assigned to both controllers, balancing the I/O load across HBAs and FAStT controllers.
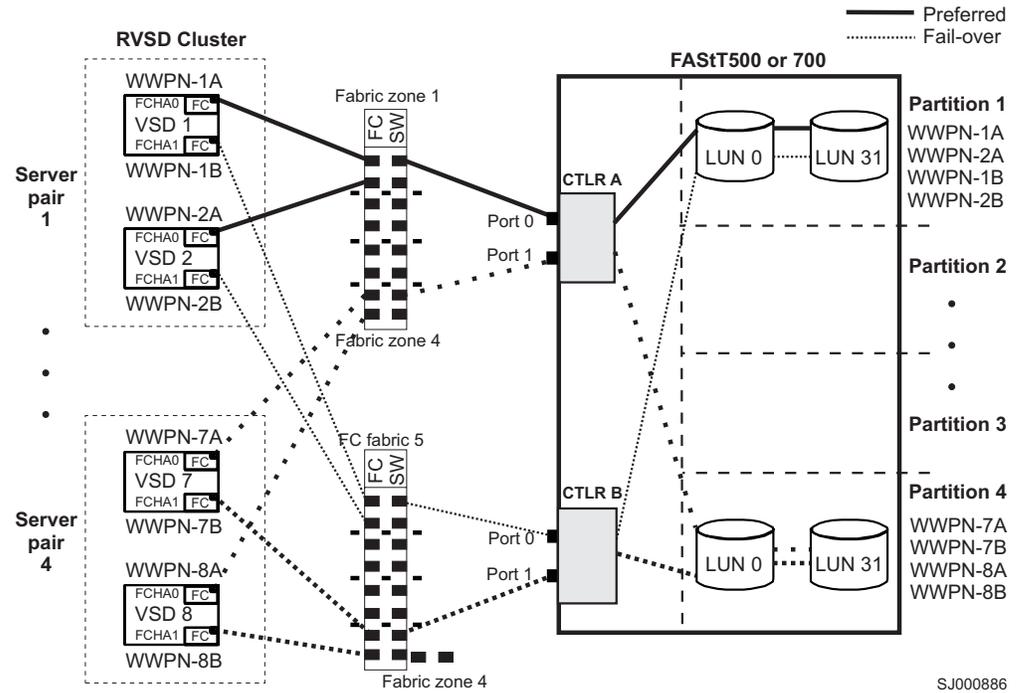


*Figure 14. RVSD cluster configuration example with a single FAStT500 or FAStT700, shown with two partitions (four maximum) per FAStT*
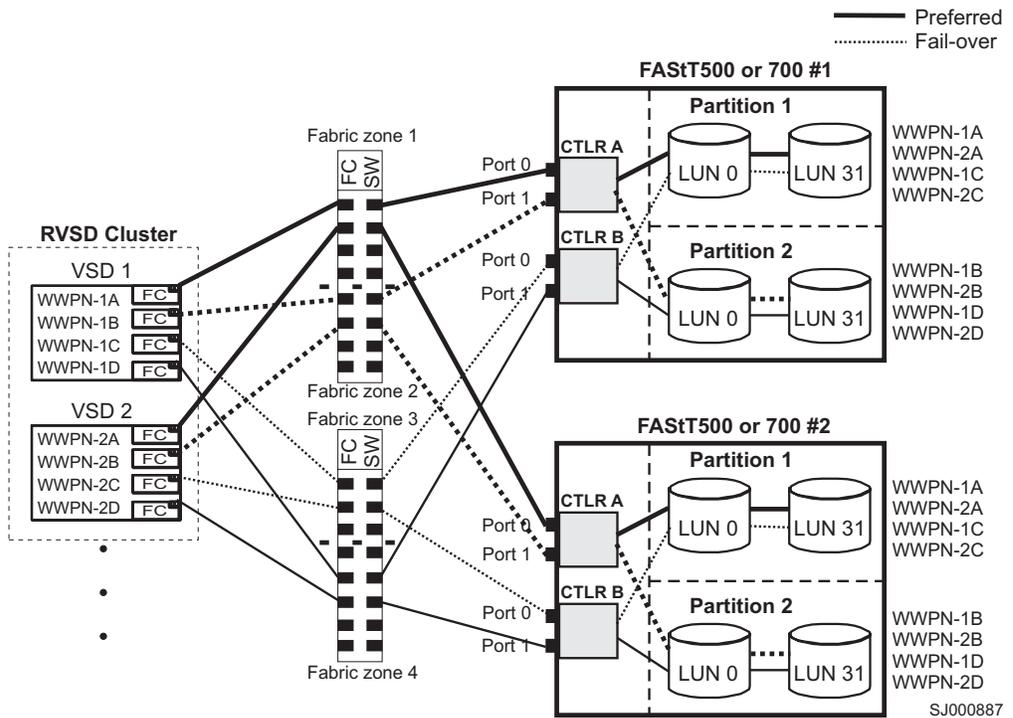
*Figure 15. RVSD cluster configuration example with multiple FAStT500 or FAStT700, shown with two partitions per FAStT*

Preferred
Fail-over

**FAStT500 or 700 #1**

**CTLR A**

**Partition 1**

Port 0
Port 1

**CTLR B**

Port 0
Port 1

LUN 0 — LUN 31

WWPN-1A
WWPN-2A
WWPN-1B
WWPN-2B

Fabric zone 1

FC SW

**RVSD Cluster**

WWPN-1A

FCHA0 FC

**VSD 1**

FCHA1 FC

WWPN-1B

WWPN-2A

FCHA0 FC

**VSD 2**

FCHA1 FC

WWPN-1B

Fabric zone 2

FC SW

**FAStT500 or 700 #2**

**CTLR A**

**Partition 1**

Port 0
Port 1

**CTLR B**

Port 0
Port 1

LUN 0 ...... LUN 31

WWPN-1A
WWPN-2A
WWPN-1B
WWPN-2B

**FAStT500 or 700 #3**

**CTLR A**

**Partition 1**

Port 0
Port 1

**CTLR B**

Port 0
Port 1

LUN 0 ...... LUN 31

WWPN-1A
WWPN-2A
WWPN-1B
WWPN-2B

SJ000888

*Figure 16. RVSD cluster configuration example with multiple FAStT500 or FAStT700, shown with one partition per FAStT*
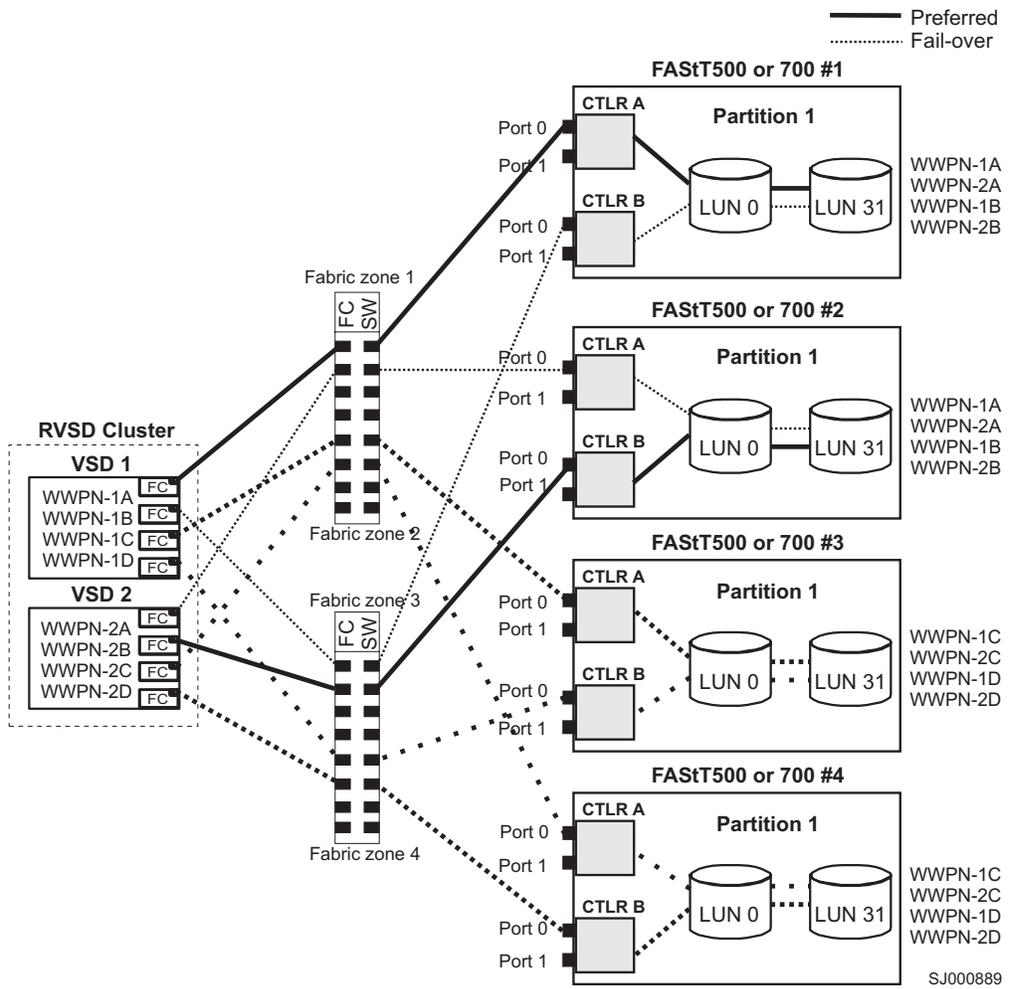
*Figure 17. Typical RVSD cluster configuration example with multiple FAStT500 or FAStT700, shown with one partition per FAStT*
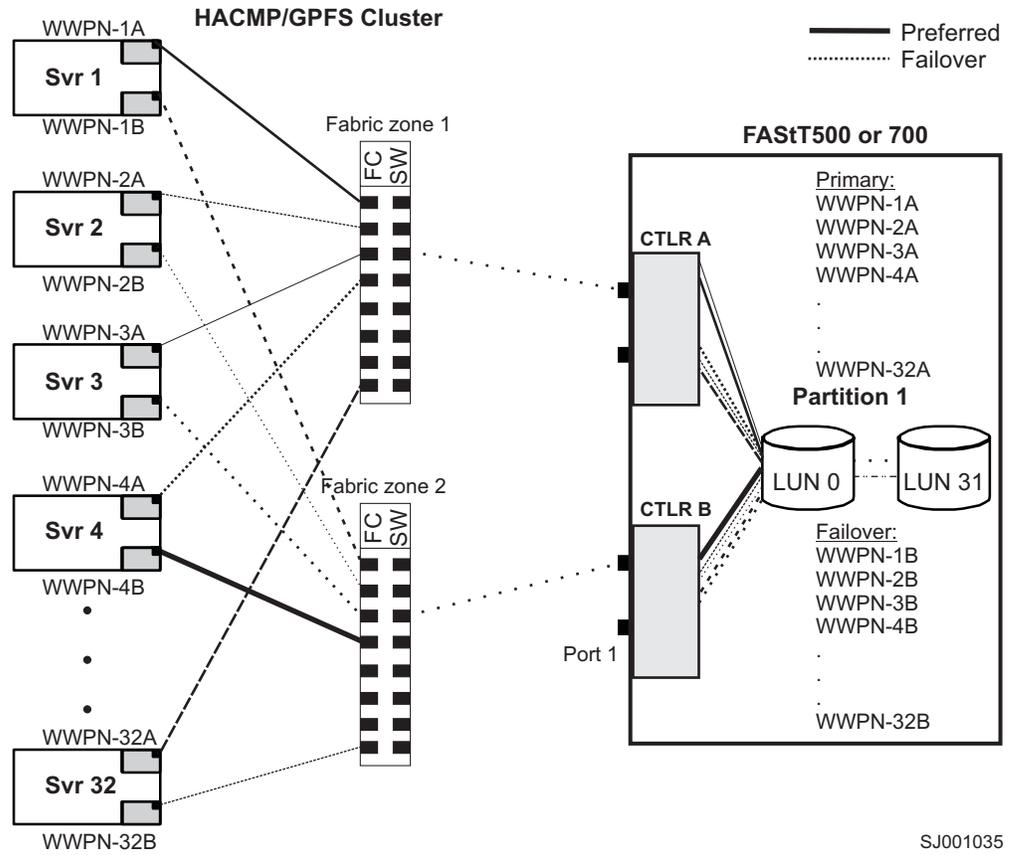
*Figure 18. HACMP or GPFS cluster configuration example with a single FAStT500 or FAStT700, shown with one partition per FAStT*
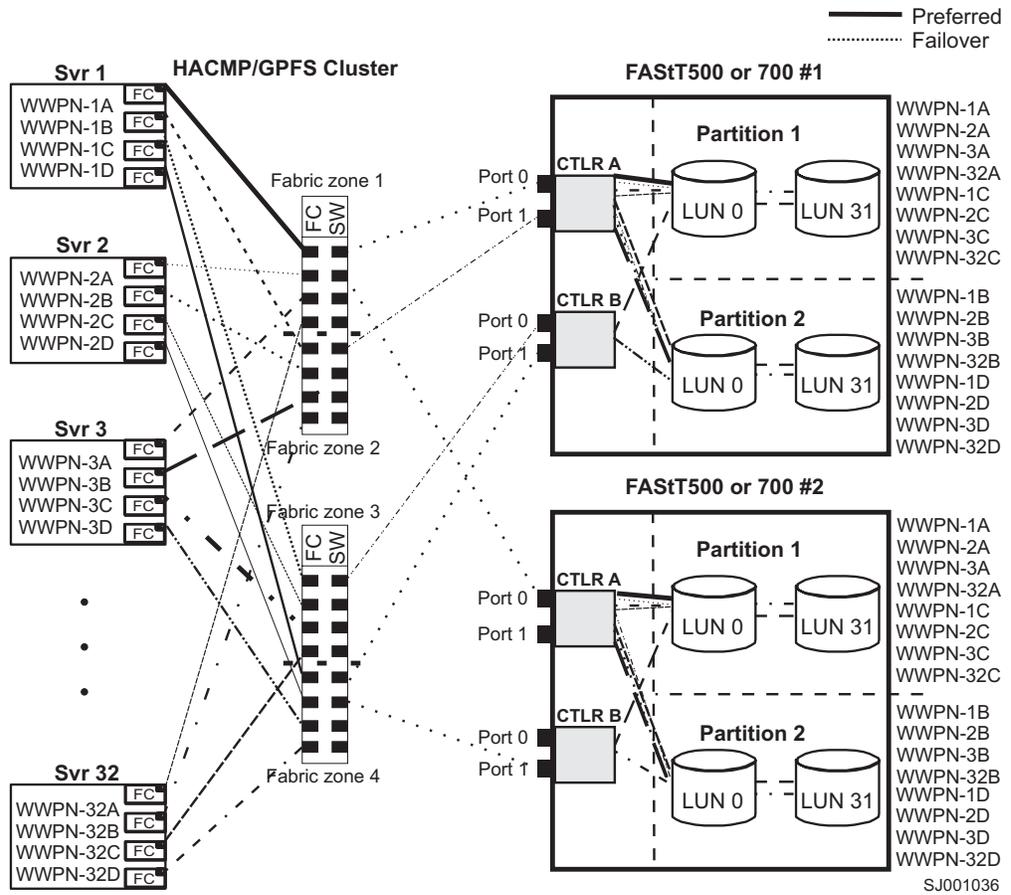
*Figure 19. HACMP or GPFS cluster configuration example with multiple FAStT500 or FAStT700, shown with two partitions per FAStT*

# Chapter 7. FlashCopy and the FAStT Storage Server

This chapter introduces FlashCopy, a premium feature of the FAStT Storage Manager 8.21. It describes its various components, what they do, and how to set them up. This is followed by a step-by-step guide to using several FlashCopy features.

The FlashCopy option is available for purchase separately from IBM or an IBM Business Partner. FlashCopy is available only with IBM FAStT Storage Manager Version 8.21 and above.

## Overview of FlashCopy

A FlashCopy logical drive is a point-in-time (PIT) image of a logical drive. It is the logical equivalent of a complete physical copy, but you create it much more quickly than a physical copy; it also requires less disk space. In FAStT Storage Manager 8.21, the logical drive from which you are basing the FlashCopy, called the *base logical drive*, must be a standard logical drive in your storage subsystem. FlashCopy can enable an application, for example a backup application, to access the FlashCopy and read the data while its base logical drive remains online and user-accessible. When the backup completes, the FlashCopy logical drive is no longer needed.

It is also possible to create several flash copies of a base logical drive and write data to the FlashCopy logical drives to perform testing and analysis. Before upgrading a database management system, for example, you might use FlashCopy logical drives to test different configurations. Then you can use the performance data that is provided by the storage management software to help you decide how best to configure your live database system.

When you make a FlashCopy, the controller suspends I/O to the base logical drive for a few seconds. Meanwhile, it creates a physical logical drive called the FlashCopy *repository logical drive* to store FlashCopy meta data and copy-on-write data. When the controller finishes creating the FlashCopy repository logical drive, I/O write requests to the base logical drive can continue. However, before a data block on the base logical drive is modified, a copy-on-write occurs. This copies the contents of blocks that are to be modified into the FlashCopy repository logical drive for safekeeping. Because the FlashCopy repository logical drive stores copies of the original data in those data blocks, further changes to those data blocks write directly to the base logical drive without another copy-on-write. And, because the only data blocks that are physically stored in the FlashCopy repository logical drive are those that have changed since the time of the FlashCopy, the FlashCopy technology uses less disk space than a full physical copy.

When you create a FlashCopy logical drive, you specify where to create the FlashCopy repository logical drive, its capacity, and other parameters. You can disable the FlashCopy when you are finished with it, for example, after a backup completes. Then, you can recreate the FlashCopy the next time you do a backup and reuse the same FlashCopy repository logical drive. Using the Disable FlashCopy and Recreate FlashCopy menu options provides a shortcut to create a new FlashCopy logical drive of a particular base logical drive. You do not need to create a new FlashCopy repository logical drive. You can also delete a FlashCopy logical drive, which also deletes an associated FlashCopy repository logical drive.

**81**

The storage management software provides a warning message when a FlashCopy repository logical drive nears a user-specified threshold (a percentage of its full capacity, the default is 50%). When this threshold is met, storage management software allows you to expand the capacity of a FlashCopy repository logical drive using free capacity on the array. If no free capacity is available on the array, you can optionally add unconfigured capacity to the array with which to expand the FlashCopy repository logical drive.

## Enabling FlashCopy

You enable the IBM FAStT Storage Manager Version 8.21 FlashCopy feature using its accompanying feature key CD. This CD contains a GenKey program that you must run to enable the FlashCopy feature.

**Note:** The GenKey program is licensed for use on only one storage subsystem. Purchase a FAStT FlashCopy Premium Feature key CD for each storage subsystem on which you want to enable the FAStT FlashCopy feature.

To enable FlashCopy you must perform the following tasks:
1. Obtain the feature enable identifier.
2. Generate the feature key file.
3. Use the feature key file to enable the premium feature.

## Obtaining the feature enable identifier

Each storage subsystem has its own unique feature enable identifier. This identifier ensures that a particular feature key file is applicable only to that storage subsystem. Complete the following steps to obtain the feature enable identifier:
1. Click **Start —> Programs —> FAStT Storage Manager 8.21 Client**. The Enterprise Management window opens.
2. In the left-hand pane, double-click the storage subsystem for which you want to enable the FlashCopy feature. The Subsystem Management window opens for the selected storage subsystem.
3. In the Subsystem Management window, click **Storage Subsystem —> Premium Features —> List**. The Premium Feature List window opens and displays the feature enable identifier.
4. Record the feature enable identifier.
5. Close the Premium Feature List window.

## Generating the feature key file

Complete the following steps to generate the feature key file:
1. Insert the IBM FAStT Storage Manager Version 8.21 FlashCopy Premium Feature Key CD into the CD-ROM drive.
2. From a command prompt, change to the root directory on the CD-ROM drive; then, type:

```
GenKey full pathname and filenamefeature enable identifier
```

where:
- *full pathname* is the location at which you want to create the feature key file
- *filename* is the feature key file name
- *feature enable identifier* is the feature enable identifier that you recorded in "Obtaining the feature enable identifier"

For example, if you want to create a feature key file named "flashcopy.key" on drive C, using the feature enable identifier 6789087543214567897654321234578, type:

```
GenKey c:/flashcopy.key 67890875432145678976543212345678
```

> **Note:** Always specify a feature key file name with the .key extension. The premium feature user interface uses this extension to filter the files in a directory.

3. Press Enter. A feature key file is created in the location that you specified in step 2 on page 82.

## Using the feature key file to enable FlashCopy

Complete the following steps to enable FlashCopy:

1. From the Subsystem Management window, click **Storage Subsystem —> Premium Features —> Enable**. The Select Feature Key File window opens.

> **Note:** The Select Feature Key File program filters files from the .key extension.

2. Select the directory in which you placed the generated key file.
3. Select the appropriate key file.
4. Click **OK**.
5. The Enable Feature window opens. Click **Yes**.
6. FlashCopy is now enabled. The icon in the Premium Feature status area no longer displays a red slash. To further verify the status of the option, click **Storage Subsystem —> Features —> List**.

Your system is now ready to use the FlashCopy feature.

## FlashCopy parameters

When you create a FlashCopy logical drive, you specify where to create the FlashCopy repository logical drive, its capacity, threshold level warning, and other parameters. The FlashCopy repository logical drive capacity is created as a percentage of the base logical drive and contains the copy-on-write data. The sorage mnagement software provides a warning message when your FlashCopy repository logical drive exceeds the threshold level.

The failure policy of the FlashCopy repository logical drive determines what happens when the FlashCopy repository logical drive becomes full (that is, all of its capacity has been used). The failure policy can be set to either fail the FlashCopy (default setting) or fail incoming I/O to the FlashCopy base logical drive.

**Attention:** Do not ignore the *If FlashCopy repository logical drive full* failure policy. The failure policy must always be set to the default policy of *Fail FlashCopy logical drive*. The *Fail writes to base logical driver* policy is not supported and causes data loss. In addition, the capacity of the FlashCopy repository logical drive must be monitored using the GUI. It is best never to let the FlashCopy repository fill up. Because the failure policy must be set to *Fail Flashcopy logical drive*, when the repository becomes full the data in the repository is not be recoverable and the FlashCopy cannot be accessed. You are still able to access the base logical drive.

The *FlashCopy repository logical drive full* mode must be set to the default *Fail FlashCopy Logical drive*. With this failure mode, the repository data is not recoverable when the driver becomes full and the FlashCopy cannot be accessed.

If this situation occurs, the only available option is to delete the FlashCopy logical drive or re-create the FlashCopy logical drive to create a new point-in-time image. Either way, the FlashCopy has been lost.

# Maintaining FlashCopy logical drives

The default FlashCopy repository logical drive capacity is initially set to 20% of the base logical drive, if enough free capacity exists to create a FlashCopy repository logical drive of this size. The default threshold level for the FlashCopy repository logical drive is initially set to 50%.

If you are not sure how large to make the FlashCopy repository logical drive or how high to set the *FlashCopy repository logical drive full* warning, accept the default settings. You can estimate later how quickly the repository capacity is being used. For more information, see "Estimating FlashCopy repository life" on page 87.

# Viewing FlashCopy logical drive failure settings

Complete the following steps to see the current FlashCopy logical drive failure settings:

1. Select a FlashCopy repository logical drive in the Logical view of the Subsystem Management window.
2. Click **Logical Drive —> Properties**, or right-click and select **Properties**. The FlashCopy Repository Logical Drive - Properties window opens. See Figure 20.



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*Figure 20. FlashCopy repository logical drive properties*

3. Click the **Capacity** tab to view the currently defined settings. See Figure 21.
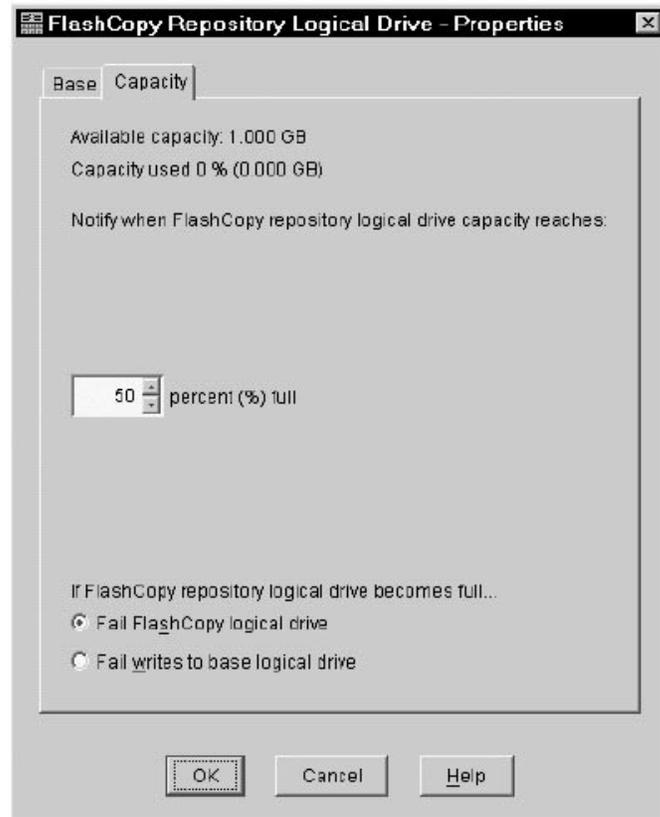


SJ000826

*Figure 21. Repository capacity settings*

If the FlashCopy repository logical drive is set to fail, the data is not recoverable when the drive becomes full and FlashCopy cannot be accessed. The only available option (if this situation occurs) is to delete the FlashCopy logical drive or re-create the FlashCopy logical drive to create a new point-in-time image.

If the FlashCopy repository logical drive is set to fail when writing to the base logical drive, the data is recoverable. But, the FlashCopy repository logical drive capacity must be increased before writes to the base logical drive are not rejected. See "Resizing a FlashCopy repository logical drive" on page 112.

Note the following points:
- Deleting a FlashCopy logical drive automatically deletes the associated FlashCopy repository logical drive.
- Deleting a FlashCopy repository logical drive automatically deletes the associated FlashCopy logical drive.
- Deleting a FlashCopy logical drive and then creating it again forces you to stop the host application and unmount the base logical drive while the FlashCopy is being created again.
- Recreating a FlashCopy logical drive alleviates the need to create a FlashCopy repository logical drive, as well as remap the assigned logical drive-to-LUN mappings between the FlashCopy logical drive and the host.

- After you recreate the FlashCopy logical drive, you can change parameters on the FlashCopy repository logical drive through the appropriate menu options.
- To avoid another *FlashCopy repository logical drive full* failure, increase the capacity of the FlashCopy repository logical drive. See "Resizing a FlashCopy repository logical drive" on page 112.

# Estimating FlashCopy repository logical drive capacity

When a FlashCopy logical drive is created, a physical logical drive called the *FlashCopy repository logical drive* is also created to store FlashCopy data and copy-on-write data. The default setting for the FlashCopy repository logical drive capacity is 20% of the base logical drive's capacity. In general, this capacity should be sufficient. Use the following information to help determine the appropriate capacity of the FlashCopy repository logical drive:

- A FlashCopy repository logical drive can be no smaller than 8 MB.
- The amount of write activity to the base logical drive after the FlashCopy logical drive has been created dictates the size of a FlashCopy repository logical drive. As the amount of write activity to the base logical drive increases, the number of original data blocks that need to be copied from the base logical drive to the FlashCopy repository logical drive also increases.
- The estimated life expectancy of the FlashCopy logical drive contributes to determining the capacity of the FlashCopy repository logical drive. The longer a FlashCopy logical drive remains enabled, the FlashCopy repository logical drive runs the increased risk of reaching its maximum capacity. For more information, see "Estimating FlashCopy repository life" on page 87.
- The amount of management overhead required on the FlashCopy repository logical drive to store FlashCopy logical drive data contributes to determining the capacity of the FlashCopy repository logical drive. The amount of management overhead actually required is fairly small and can be calculated using the simple formulas detailed in the following section.
- There is not necessarily a one-to-one correlation between the number of data blocks that change on the base logical drive and the amount of copy-on-write data that is stored on the FlashCopy repository logical drive. Depending on the location of data blocks that need to be copied, for performance reasons, the controller might copy over a full set of 32 blocks, even if only one set of blocks has changed. Keep this in mind when determining the percentage of the capacity of the base logical drive that can be copied to the FlashCopy repository logical drive.

## Calculating expected overhead

Use the following formula to calculate the amount of management overhead that is required to store FlashCopy data on the FlashCopy repository logical drive. This formula should be used merely as a guide, and FlashCopy repository logical drive capacity should be re-estimated periodically.

**Note:** For this formula, you must convert bytes to kilobytes, and then convert kilobytes to megabytes.

The formula to calculate the amount of management overhead required is:

```
192 KB +(X /2000)
```

Where *X* is the capacity of the base logical drive in bytes.

### Example

For a 5 GB base logical drive, where 30%of the data blocks are expected to change on the base logical drive, the estimated FlashCopy repository logical drive capacity can be calculated as follows:

1. Convert the capacity of the base logical drive to bytes.

   When converted, 5 GB equals 5 368 709 120 bytes.

2. Divide the capacity of the base logical drive (in bytes) by 2000.

   When divided, the result is 2 684 354.56 bytes.

3. Convert the result from step 2 (in bytes) to kilobytes (KB).

   When converted, the result is 2621.44 KB.

4. Add 192 KB to the results from step 3.

   ```
   192 KB +2621.44 KB = 2813.44 KB
   ```

5. Convert the result from step 4 to megabytes (MB).

   When converted, the amount of management overhead required is 2.75 MB (or 0.002686 GB).

6. In this example, 30% of the data blocks on the base logical drive are expected to change. To accurately calculate the FlashCopy repository logical drive capacity, sufficient space needs to be allocated for the copy-on-write data as well as the management overhead (calculated in step 5).

   To calculate the copy-on-write space required, calculate the percentage of the base logical drive expected change:

   ```
   30% of 5 GB = 1.5 GB
   ```

   The final estimated FlashCopy repository logical drive capacity for this example is:

   ```
   1.5 GB +0.002686 GB = 1.502686 GB
   ```

7. In the Create FlashCopy Logical Drive Wizard: Specify Repository Capacity window, use the **percent (%) full** field to set the estimated FlashCopy repository logical drive capacity. See Figure 21 on page 85.

   **Note:** The **percent (%) full** field sets the FlashCopy repository logical drive capacity as a percentage of the base logical drive. Using the **percent (%) full** field, increase or decrease the percentage until the FlashCopy Repository Logical Drive Capacity value matches the estimated capacity calculated in step 6. (Some rounding up might be required.)

## Estimating FlashCopy repository life

When you create a FlashCopy logical drive, you are asked to define various properties for the FlashCopy repository logical drive, including the name of the FlashCopy repository logical drive, its capacity, a logical drive-to-LUN mapping, and the repository full condition. When defining the properties of the FlashCopy repository logical drive, keep in mind the kind of usage you have planned for the FlashCopy logical drive. Understanding how the FlashCopy logical drive will be used can help you to estimate the life expectancy of the FlashCopy repository logical drive.

If numerous I/O requests are written to the base logical drive, the FlashCopy repository logical drive (containing the FlashCopy data and copy-on-write data) could eventually exceed the base logical drive capacity if all the original data blocks are changed. The default setting suggests 20% of the base logical drive capacity, but this is a setting that can be adjusted after some usage data becomes available.

The following procedure describes how to estimate the life expectancy of a FlashCopy repository logical drive. Use it merely as a guide. Note that the life expectancy of a FlashCopy repository logical drive should be carefully re-estimated periodically.

1. Select the FlashCopy repository logical drive in the Logical view. Click **Logical Drive —> Properties** and click the **Capacity** tab. Alternately, you can right-click the FlashCopy repository logical drive, select **Properties**, and click the **Capacity** tab.

2. Select the FlashCopy repository logical drive in the Logical view. Click **View —> GoTo —> FlashCopy Logical Drive**. Alternately, right-click the FlashCopy repository logical drive and select **Go To FlashCopy Logical Drive**.

3. Record the creation timestamp day and time.

4. Record the capacity used (GB) and the available capacity (GB).

5. Determine the elapsed time (t) by subtracting the creation time from the current time, expressing the elapsed time in either minutes, hours, or days.

6. The total time (Tr) that the repository is available for copy-on-write data can now be estimated (based on the current usage) by multiplying the elapsed time (t) by the available capacity (Ct), and then dividing the resultant number by the capacity used (Cu).

   The formula you need to use is:

   ```
   Tr =(t *Ct)/Cu
   ```

   Where:

   **Tr**    Total time available

   **t**    Elapsed time

   **Ct**    Available capacity

   **Cu**    Capacity used

   **Note:** The total time available (Tr) indicates the total usage time for the FlashCopy repository logical drive.

Using the result of these calculations, you should now be able to make an informed decision about whether you should increase the capacity of the FlashCopy repository logical drive. If the repository capacity becomes 100% full during the expected lifetime of the FlashCopy, then you should increase the capacity of the FlashCopy repository logical drive. For more information, see "Resizing a FlashCopy repository logical drive" on page 112.

## Using FlashCopy

This section presents an easy-to-follow, step-by-step procedural guide to common administration tasks for a FAStT FlashCopy solution. The tasks that are covered include:

- Checking the status of the Flash Copy premium feature
- Creating a FlashCopy drive
- Mapping a FlashCopy drive to a host
- Viewing FlashCopy drive status
- Disabling a FlashCopy a drive
- Recreating a FlashCopy drive
- Resizing a FlashCopy repository drive
- Deleting a FlashCopy drive

# Checking the status of the FlashCopy premium feature

Use this procedure to view a list of premium features on the storage subsystem and to verify that the FlashCopy feature has been enabled. It requires you to:

1. Check the premium options list.
2. View the FlashCopy icon to verify that the feature has been enabled.

## Checking the premium option

Perform the following steps to check the premium option:

1. From the Subsystem Management window, click **Storage Subsystem —> Premium Features —> List**. Alternately, right-click and click **Premium Features —> List** (see Figure 22).
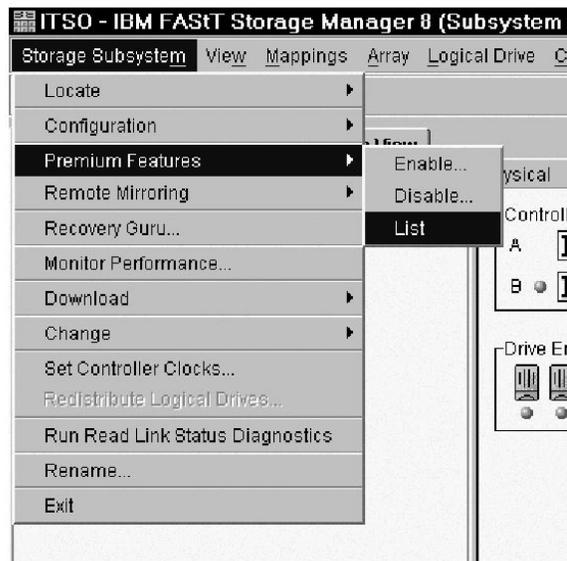


SJ000827

*Figure 22. Listing premium features*

The List Premium Features window opens. It lists the following items:

- The Premium features that are enabled on the storage subsystem
- The Feature enable identifier

2. Verify that **FlashCopy Logical Drives:** indicates *Enabled* as shown in Figure 23.
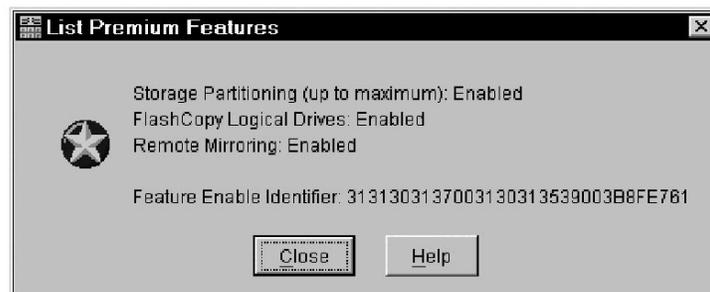


SJ000828

*Figure 23. Feature list showing FlashCopy enabled*

Figure 24 shows an example where the FlashCopy copy feature is not enabled.



SJ000829
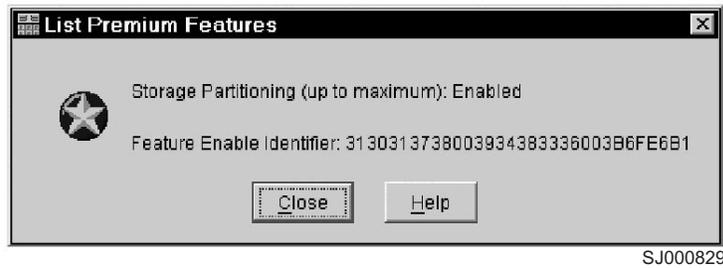
*Figure 24. Feature list showing FlashCopy not enabled*

See "Enabling FlashCopy" on page 82 for the procedure to enable FlashCopy.

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

> **Note:** If you receive a `Premium Features - Out of Compliance` error message during a management session, use the `Recovery Guru` to resolve the problem.

### Viewing the FlashCopy icon

Check the status of the FlashCopy feature icon at the bottom left of the device management GUI, as shown in Figure 25.



SJ000830
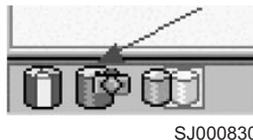
*Figure 25. FlashCopy feature icon*

The example in Figure 26 shows a disabled FlashCopy feature icon.



SJ000831
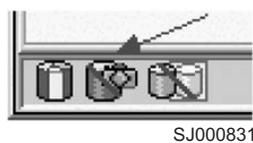
*Figure 26. FlashCopy feature icon disabled*

## Creating a FlashCopy logical drive

Use this procedure to create a FlashCopy logical drive from a base volume.

**Note:**

- See the Create a FlashCopy Logical Drive Wizard online help for additional instructions for the operating-system-specific procedures. Failure to complete the additional steps that are required for your host operating system can result in an inaccurate point-in-time image of the base logical drive.
- You cannot create a FlashCopy logical drive of a base logical drive that is the secondary logical drive in a Remote Volume Mirror.

Perform the following steps to create a FlashCopy logical drive:

1. Place the application into backup mode:

   a. Stop the host application that is accessing the base logical drive, sync file system. Unmount the base logical drive if possible. This enables a valid consistent copy to be taken.

   It might not be convenient to stop database applications. However, in this case, it is required to place the application into a backup mode or place it in an acquiesced state while you create the FlashCopy.

   b. It is important to back up application recovery files, such as role back and redo logs, because these files might be located in different physical disk storage or on different logical drives.

2. Launch the Create a FlashCopy Logical Drive Wizard:

   a. Select a base logical drive from the Logical view.

   b. Click **Logical Drive —> FlashCopy —> Create**. Alternately, right-click and select **Create FlashCopy Logical Drive**. See Figure 27.
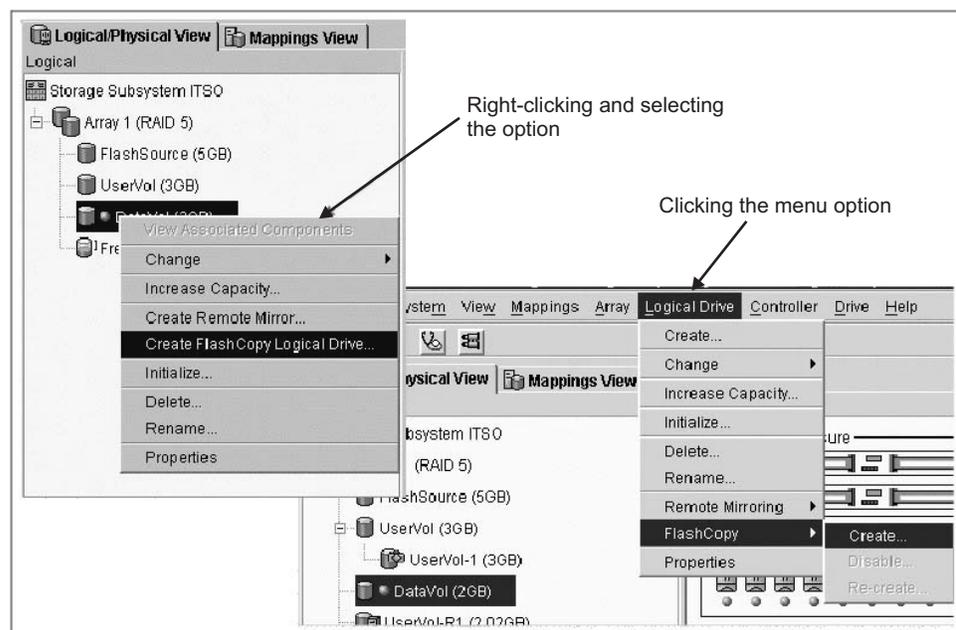


SJ000832

*Figure 27. Create FlashCopy menu options*

The Create a FlashCopy Logical Drive Wizard opens as shown in Figure 28 on page 92.
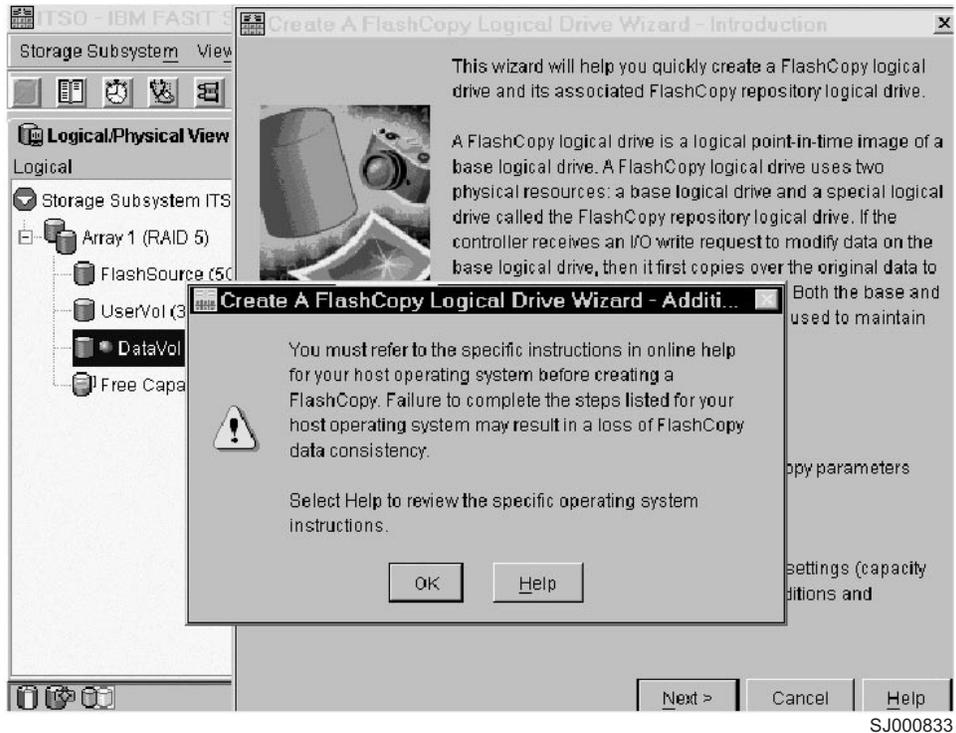
Figure 28. Create a FlashCopy Logical Drive Wizard startup

> **Note:** If the FlashCopy logical drive is to be based on the root disk of the host operating system, the final point-in-time image might not be completely consistent with the base logical drive.

3. Create the FlashCopy logical drive:

   a. Review the information in the initial window as shown in Figure 28. Click **OK** to proceed to the wizard introduction window.

      Follow the instructions on each wizard panel, and click the **Next** button when you are ready to continue to the next panel.

      > **Note:** Each wizard panel has context-sensitive help. Click the **Help** button on a particular panel to receive help for that panel.

   b. The Introduction window (Figure 29 on page 93) defines what a FlashCopy logical drive is and the physical components that are associated with a FlashCopy logical drive. It enables you to select either the Simple or Advanced path through the Create FlashCopy Logical Drive Wizard:

      • **Simple Path**: Proceeds to the *Specify Name* panel, which provides a preview of the FlashCopy and repository default names. You can also change the defaults on this panel.

      • **Advanced Path**: Proceeds to the *Allocate Capacity* panel. There you select the Free Capacity or Unconfigured Capacity node on which to place the FlashCopy repository logical drive.

         If no free capacity exists or the available free capacity is unusable, a warning message displays.
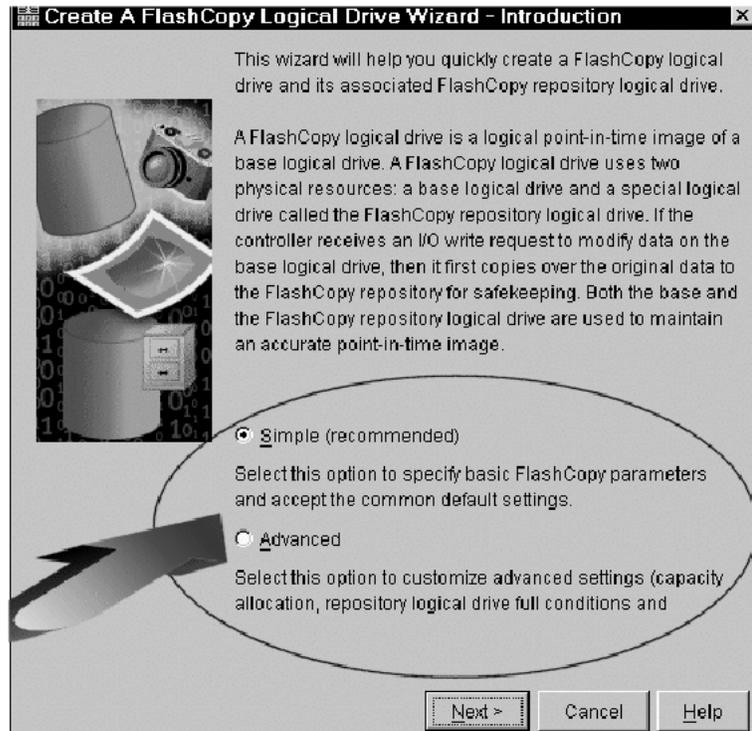
Figure 29. Wizard Introduction window

    c. If you want to use the Advanced path, select **Advanced** and click **Next**. The Allocate Capacity window (Figure 30 on page 94) opens. From this window you can choose free capacity or unconfigured capacity. A description of each option follows.
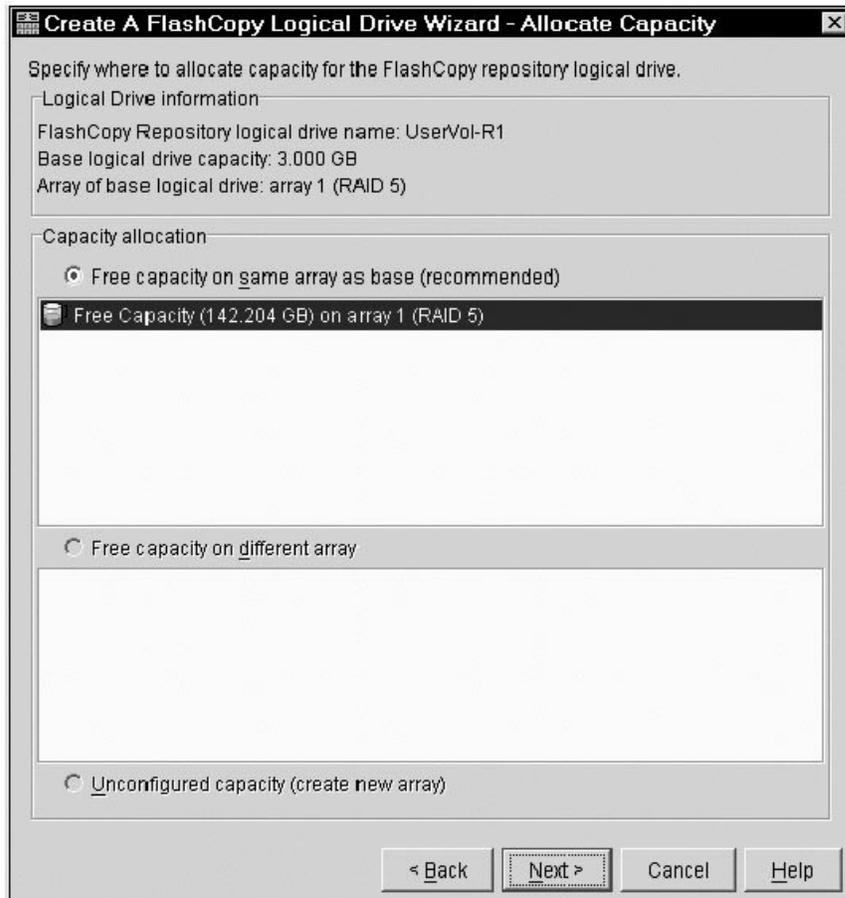
Figure 30. Allocate Capacity window

- **Free Capacity**:

  If you select **Free Capacity** and click **Next**, the Specify Logical Drive Parameters window (Figure 31 on page 95) opens. Define the FlashCopy logical drive-to-LUN mapping parameter and the FlashCopy repository logical drive full conditions. Click **Next**.
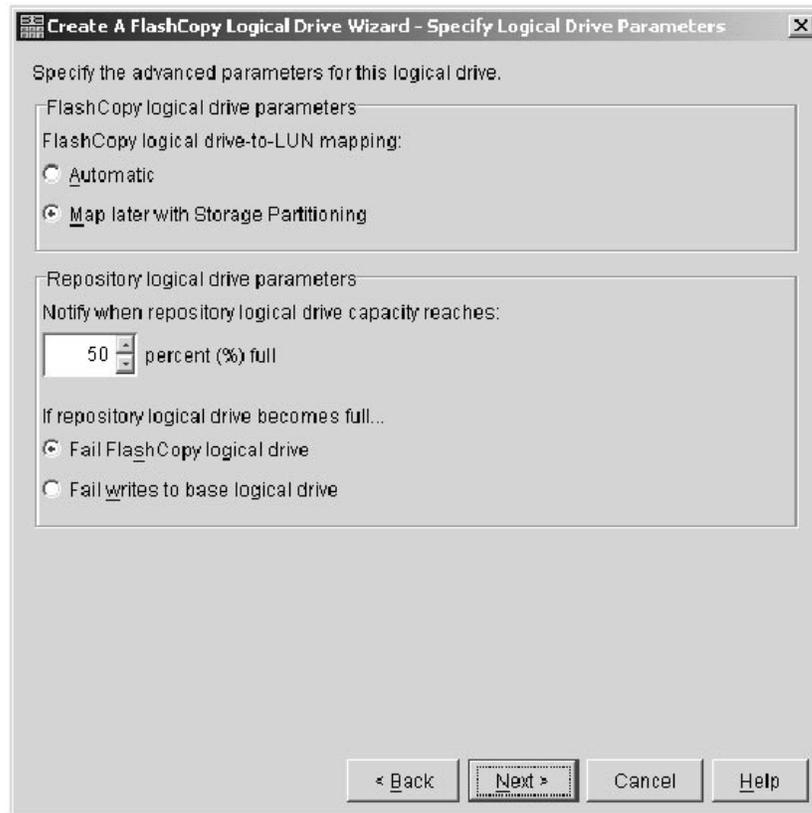
SJ000836

*Figure 31. Specify Logical Drive Parameters*

The Preview window (Figure 32 on page 96) opens and displays the FlashCopy and repository parameters. You can click **Back** to return to the previous windows and edit the parameters or click **Finish** and continue.

```
Create A FlashCopy Logical Drive Wizard - Preview                    [x]

A FlashCopy logical drive and associated repository logical drive will be created with the
following parameters. Select Finish to create the logical drives.

    [icon] FlashCopy Logical Drive Parameters

Name: Drive 2-1
FlashCopy logical drive capacity: 15.000GB
Logical Drive-to-LUN Mapping: Map later with Storage Partitioning

    [icon] Repository Logical Drive Parameters

Name: Drive 2-R1
Repository logical drive capacity: 3.000GB (20% of base logical drive capacity)
Capacity used from: Free Capacity 18.823GB on array 2
Notify when repository capacity reaches: 50% full
If repository becomes full: Fail FlashCopy logical drive


                         < Back     Finish     Cancel     Help
```

SJ000837

*Figure 32. Preview window*

- **Unconfigured Capacity**:

  In the Allocate Capacity window (Figure 30 on page 94), if you select
  **Unconfigured Capacity** and click **Next**, the Specify Array Parameters
  window (Figure 33 on page 97) opens. Here you can specify a new array
  on which the repository resides. You can also specify the RAID level of
  the array that meets the FlashCopy repository logical drive data storage
  and protection requirements.
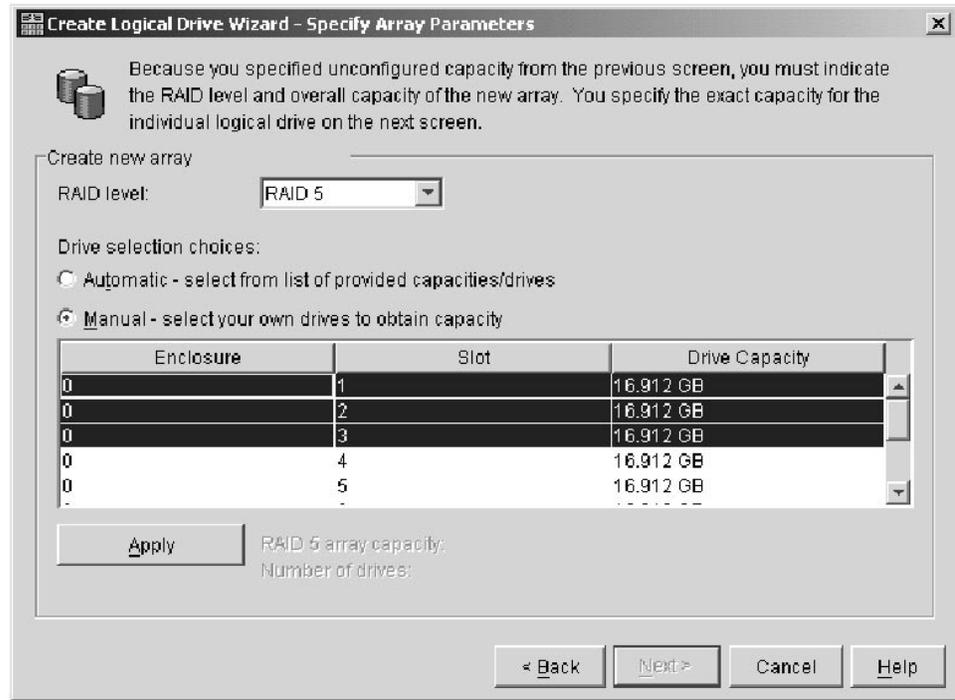
*Figure 33. Specify Array Parameters window*

After you select where you are placing the volume, same array, and free capacity on another array, or you create a new array, the steps for defining the FlashCopy logical drive parameters are the same as for the Free Capacity option.

On the Specify Logical Drive Parameters window (Figure 31 on page 95), define the FlashCopy logical drive-to-LUN mapping parameter, the threshold percentage full parameter, and the FlashCopy repository logical drive full conditions.

The Preview window (Figure 32 on page 96) provides a preview of the FlashCopy and repository parameters. You can click **Back** and return to the previous windows to edit the repository parameters, or click **Finish** and continue.

d. On the Specify Names window (Figure 34 on page 98), define the FlashCopy logical drive name and the name of its associated FlashCopy repository logical drive.

The default naming convention for the first FlashCopy uses the base volume name and adds a suffix of "-1" for the logical drive and "-R1" for the repository drive. The second FlashCopy increments this number to 2, and so on, up to the four volumes.

For example, if you are creating the first FlashCopy logical drive for a base logical drive called *DataVol*, then the default FlashCopy logical drive name is DataVol-1, and the associated FlashCopy repository logical drive default name is DataVol-R1. The default name of the next FlashCopy logical drive you create based on DataVol is DataVol-2, with the corresponding FlashCopy repository logical drive named DataVol-R2, by default.

Change the default names if required.

Click **Next** to continue.
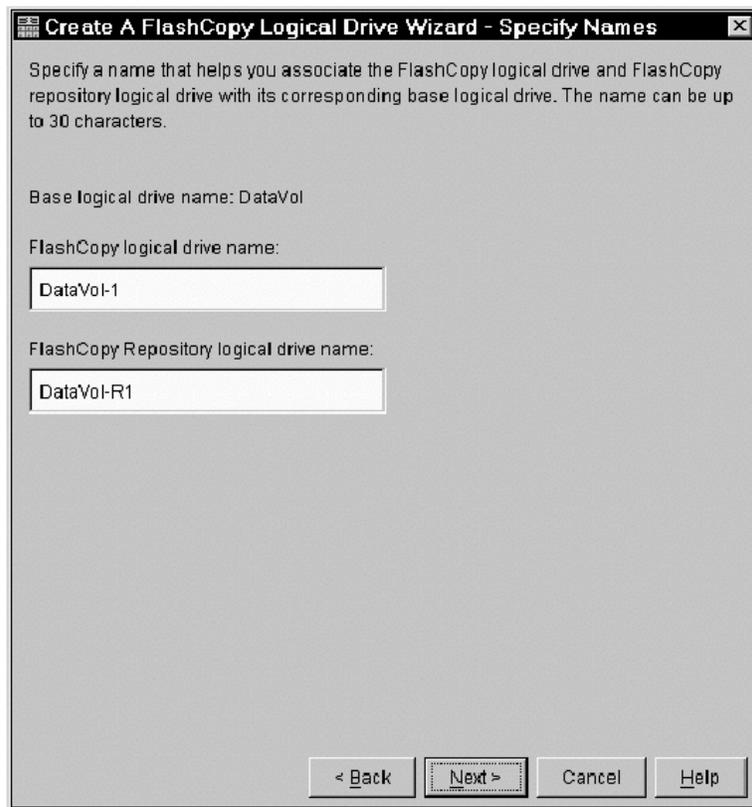


SJ000839

*Figure 34. Specify Names window*

**Tips about names**:

- Regardless of whether you use the software-supplied sequence number that (by default) populates the **FlashCopy logical drive name** or **FlashCopy repository logical drive name** field, the next default name for a FlashCopy or FlashCopy repository logical drive still receives a sequence number determined by the software. For example, you might name the first FlashCopy of base logical drive DataVol *DataVolMay28*, without using the software-supplied sequence number of 1. Regardless, the software assigns a default name for the next FlashCopy as *DataVol-2*.

- The next available sequence number is based on the number of existing FlashCopies of a base logical drive. If you delete a FlashCopy logical drive, its sequence number becomes available again.

- You must choose a unique name for the FlashCopy and FlashCopy repository logical drives. Otherwise, the system displays an error message.

- Names have a 30-character limit. When you reach this limit in either the **FlashCopy logical drive name** or **FlashCopy repository logical drive name** field, it no longer accepts input. If the base logical drive name contains 30 characters, the default names for the FlashCopy and its associated FlashCopy repository logical drive use the base logical drive name truncated just enough to add the sequence string. For example, for "Host Software Engineering Group GR-1", the default FlashCopy name would be "Host Software Engineering GR-1". The default repository name would be "Host Software Engineering G-R1".

e. On the Specify FlashCopy Repository Logical Drive's Capacity window (Figure 35), set the repository drive capacity as a percentage of the capacity of the base logical drive.
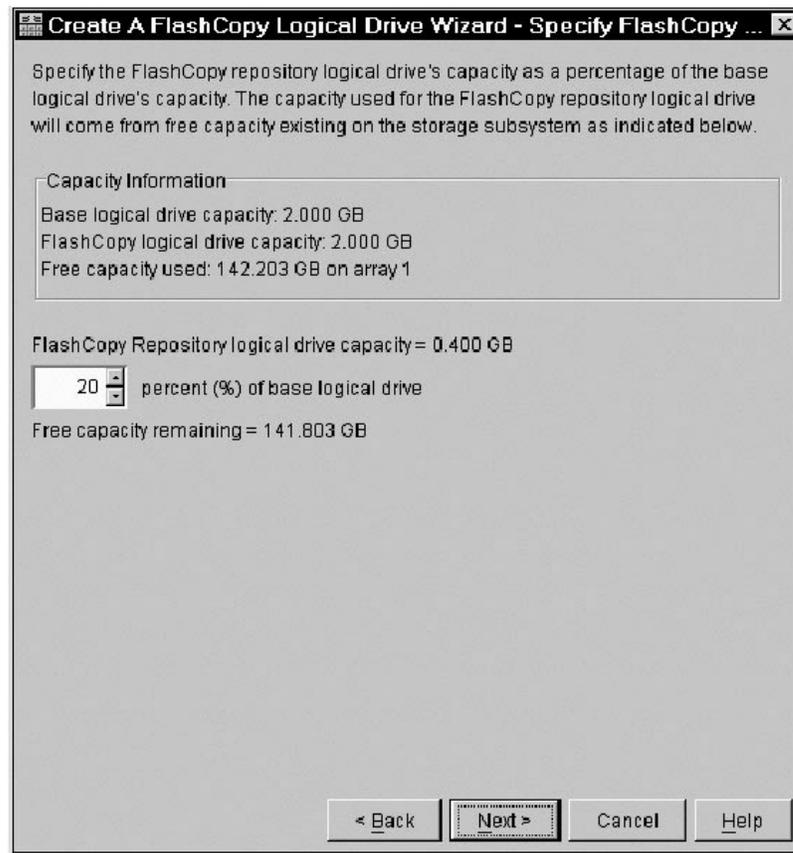


SJ000840

*Figure 35. Specify Repository Drive Capacity*

Use the **percent (%) of base logical drive** field to set the desired capacity. Click **Next** to continue.

The capacity requirement varies, depending on the frequency and size of I/O writes to the base logical drive and the length of time that you need to retain the FlashCopy logical drive. In general, you should choose a larger capacity for the repository if you intend to keep the FlashCopy logical drive for a long period of time. You should choose a larger capacity if a large percentage of data blocks will change on the base logical drive during the life of the FlashCopy logical drive due to a high level of I/O activity. Use historical performance monitor data or other operating system utilities to help you determine typical I/O activity levels on the base logical drive.

**Note:** In most situations, the 20% default value should be sufficient capacity for your FlashCopy repository logical drive. For information about determining the optimal size, see "Estimating FlashCopy repository logical drive capacity" on page 86, and "Estimating FlashCopy repository life" on page 87.

f. The Create FlashCopy Logical Drive Wizard - Preview window opens. It displays components that are associated with the FlashCopy. Review the information and click **Next**.

g. The Create FlashCopy Logical Drive Wizard - Completed window (Figure 36) opens. It displays the associated logical drives and components that make up the FlashCopy relationship. Click **Finish** to continue.
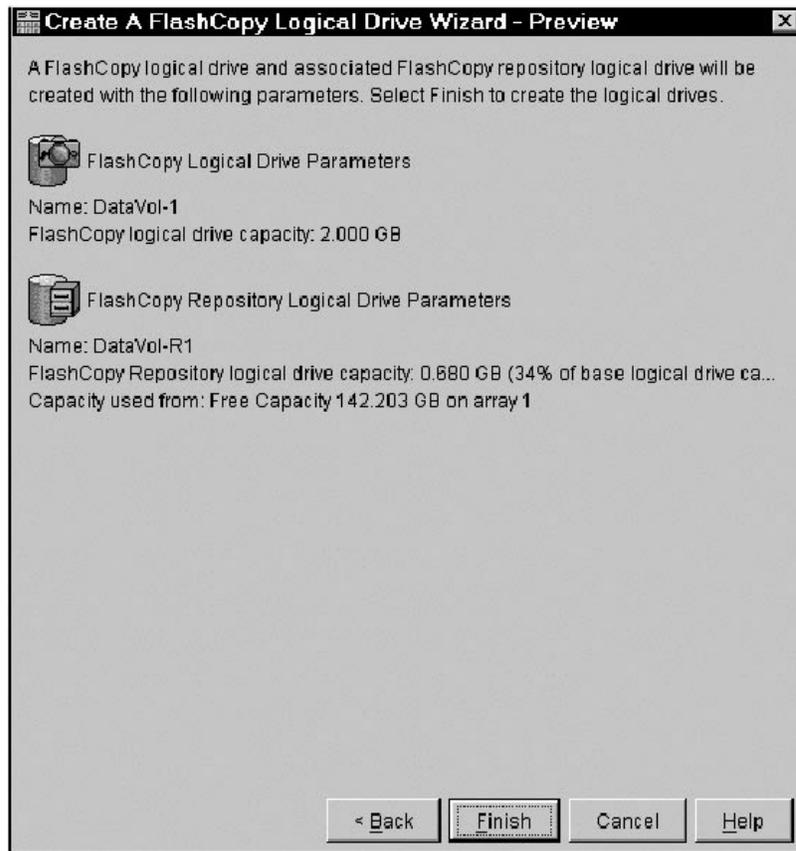


SJ000841

*Figure 36. Preview window*

The FlashCopy drives are now displayed in the device management GUI, as shown in Figure 37 on page 101. See "Viewing the FlashCopy icon" on page 90 for information about interpreting the display icons.

Logical/Physical View | Mappings View

Logical

Storage Subsystem ITSO

    Array 1 (RAID 5)

        FlashSource (5GB)

        UserVol (3GB)

        DataVol (2GB)

            DataVol-1 (2GB)

        DataVol-1 (0.68GB)

        Free Capacity (141.524GB)
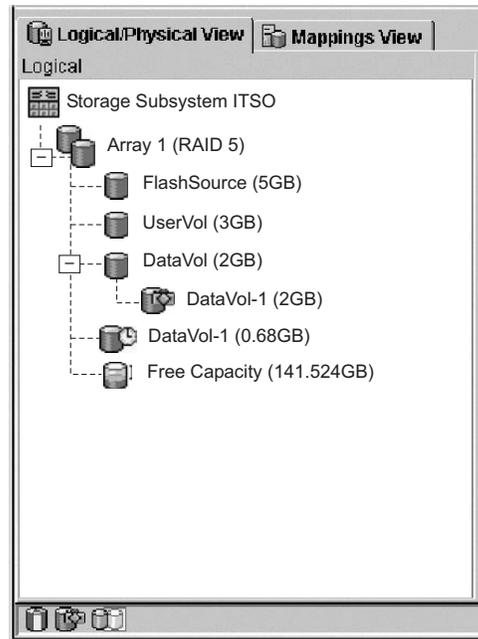
SJ000842

*Figure 37. FlashCopy volumes*

4. Restart the host application. After you create one or more FlashCopy logical drives, mount the base logical drive and restart the host application using that base logical drive.

# Mapping a FlashCopy drive to a host

Assign logical drive-to-LUN mappings between the FlashCopy logical drive and the host that will access the FlashCopy logical drive using the Mappings view of the Subsystem Management window. In some cases, depending on the host operating system and if any logical drive manager software is in use, mapping the same host to both a base logical drive and its associated FlashCopy logical drive can result in conflicts. For operating-system-specific instructions, see "Instructions for Solaris" on page 116 or "Instructions for HP-UX: Logical Volume Manager" on page 118.

Perform the following steps to map the FlashCopy logical drive to a host:

1. Open the Mappings view of the Management window. See Figure 38 on page 102. The newly-created FlashCopy logical drive displays in the undefined mapping section.
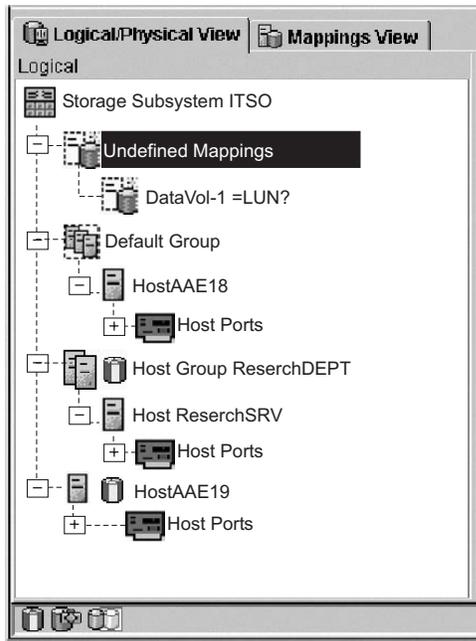
SJ000843

*Figure 38. Undefined FlashCopy disk*

2. Select the host or host group that you want to map the drive.
3. Right-click and select **Define Additional Mapping**, as shown in Figure 39.
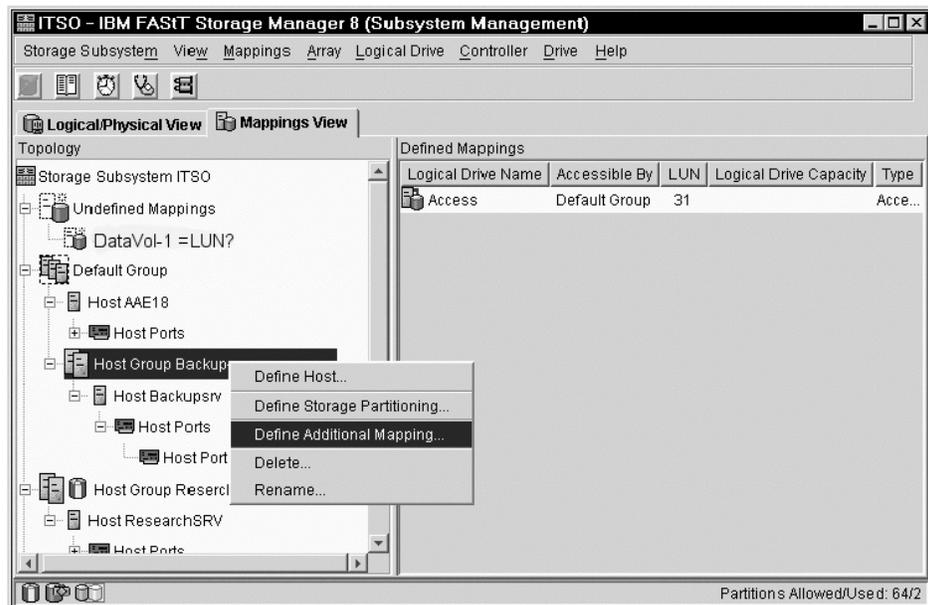


SJ000844

*Figure 39. Define Additional Mapping*

4. The Define Additional Mapping window (Figure 40 on page 103) opens:
   a. Select the FlashCopy drive.
   b. Select the host or host group.
   c. Set the LUN number.

d.  Click **Add**.
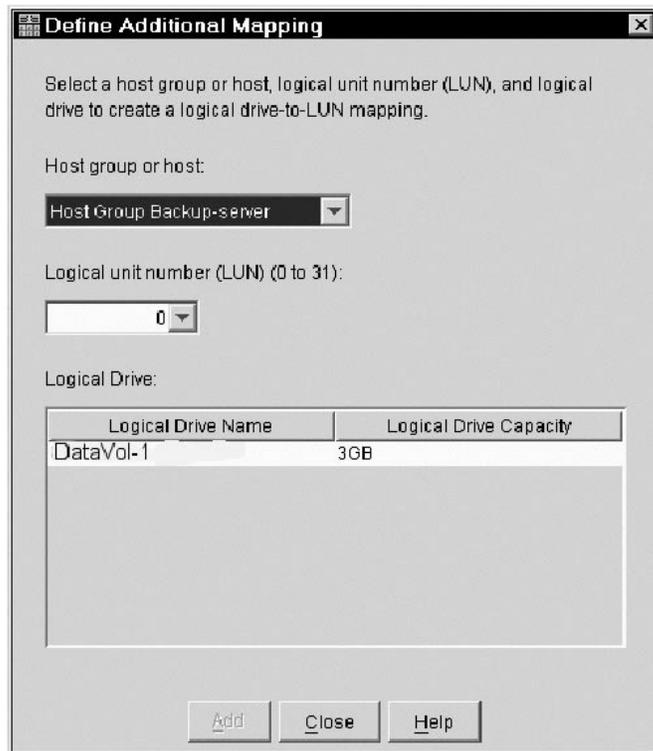


SJ000845

*Figure 40. Define Additional Mapping window*

In the example shown in Figure 39 on page 102 and Figure 40, the FlashCopy logical disk DataVol-1 is made available to the backup server host group. This enables the backup server to access and mount the disk as part of its own file system. It also allows a local backup to be performed by the backup application software.

It is possible to map the FlashCopy logical disk to the same server that owns the base logical disk. However, immediately after creating the FlashCopy, the two logical disks appear exactly the same (a block-by-block copy). Many operating systems do not tolerate seeing an exact duplicate volume. You might need to complete other steps before you can access it. The mapping is shown in Figure 41 on page 104.

**Note:**  If you use this FlashCopy on a regular basis (for example, for backup purposes), use the Disable FlashCopy and Re-create FlashCopy options to reuse the FlashCopy. Using these options preserves the existing mappings to the FlashCopy logical drive. For more information, see "Disabling a FlashCopy logical drive" on page 109 and "Re-creating a FlashCopy logical drive" on page 111.
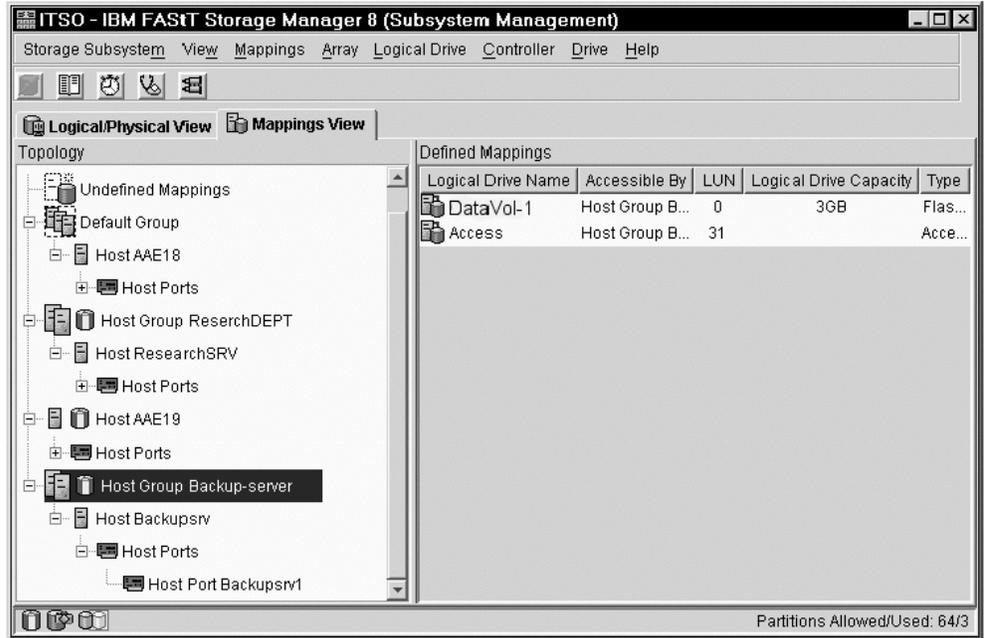
SJ000846

*Figure 41. Mapped FlashCopy logical disk*

Finally, use specific operating-system and host utilities to mount and use the mapped FlashCopy drive.

1. Run the host-based hot_add utility to register the FlashCopy logical drive with the host operating system.

2. Run the host-based SMdevices utility to associate the mapping between the physical device name and the logical drive name.

3. Mount the logical drive to the host.

For information about specific host operating-system procedures, see "Instructions for Solaris" on page 116 or "Instructions for HP-UX: Logical Volume Manager" on page 118.

# Viewing the FlashCopy logical drive status

You can determine the status of the FlashCopy logical drive by viewing the icons that change depending of the state of the drive. The logical drive component property display is also useful in determining the state of the logical drives.

Use the FlashCopy Repository Logical Drive - Properties window to view the FlashCopy repository logical drive base and capacity properties. You can also use this window to specify the capacity percentage full and the action to be taken if the FlashCopy repository logical drive becomes full.

The progress of modification operations displays at the bottom of the window.

## FlashCopy icon states

To view the FlashCopy icon, open the Storage Management Device Manager GUI Physical/Logical view. The icon states are shown in Figure 42 on page 105.

| FlashCopy status representation in logical view | | |
|---|---|---|
| **Logical drive status icon** | **Mirror status** | **Icon** |
| **FlashCopy** | Optimal | |
| | Disabled | |
| | Failed | |
| | Offline | |
| **Repository** | Optimal | |
| | Degraded | |
| | Failed | |
| | Full | |
| | Offline | |
| | Warning | |
| | | |
| **Free capacity** | Spare capacity | |

SJ000847

*Figure 42. FlashCopy icon states*

## FlashCopy repository properties

Perform the following steps to view the FlashCopy repository properties:

1. Select a FlashCopy repository logical drive in the Logical view of the Subsystem Management window.

2. Click **Logical Drive —> Properties**, or right-click and select **Properties**, as shown in Figure 43 on page 106.
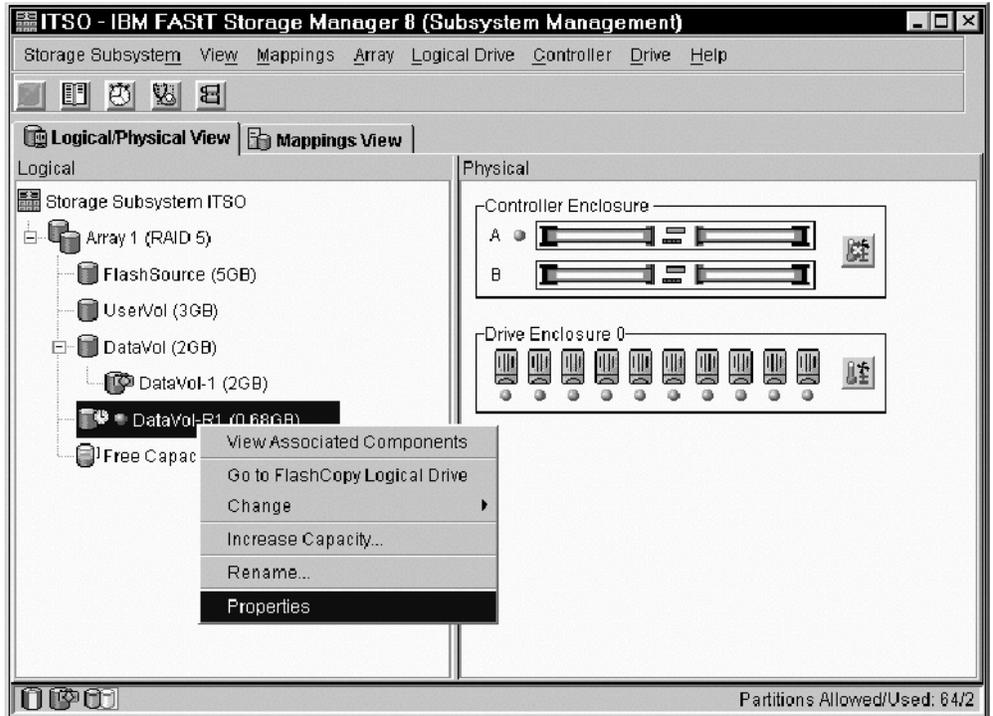
SJ000848

*Figure 43. Repository Logical Drive Properties*

The FlashCopy Repository Logical Drive - Properties window opens, as shown in Figure 44 on page 107.

```
FlashCopy Repository Logical Drive - Properties                    ×

Base  Capacity

    Logical Drive name: DataVol-R1
    World-wide name: 600A0B80000CD466000000EC3CF4EC0B
    Subsystem ID (SSID): 3
    Status: Optimal {1}
    Owned by controller in slot: A
    Capacity: 0.68GB
    RAID level: 5
    Segment size: 64 KB
    Modification priority: High
    Associated array: 1
    Read cache: Enabled
    Write cache: Enabled
    Write cache with mirroring: Enabled
    Write cache without batteries: Disabled
    Flush write cache after (in seconds): 10.00
    Cache read ahead multiplier: 0
    Enable background media scan: Disabled
    Media scan with redundancy check: Disabled
    Associated base logical drive: DataVol
    Associated FlashCopy logical drive: DataVol-1

            OK         Cancel        Help
```

SJ000849

*Figure 44. Base Repository Logical Drive Properties*

The **Base** tab of the FlashCopy Repository Logical Drive - Properties window displays the following information for the selected FlashCopy repository logical drive:

- Logical drive name
- Worldwide name
- Status
- Controller ownership
- Capacity
- RAID level
- Modification priority
- Associated base logical drive
- Associated FlashCopy logical drive

3. Click the **Capacity** tab (Figure 45 on page 108) to view or set the following FlashCopy repository logical drive capacity properties:

- **FlashCopy repository logical drive percentage full**

  Allows a threshold level to be set for the FlashCopy repository logical drive capacity. When the defined percentage is reached, a warning is issued indicating that the repository is nearing its capacity. The default percentage setting is 50% of the maximum capacity of the FlashCopy repository logical drive.

  Use the **percent (%) full** field to define the percentage at which a warning is issued.
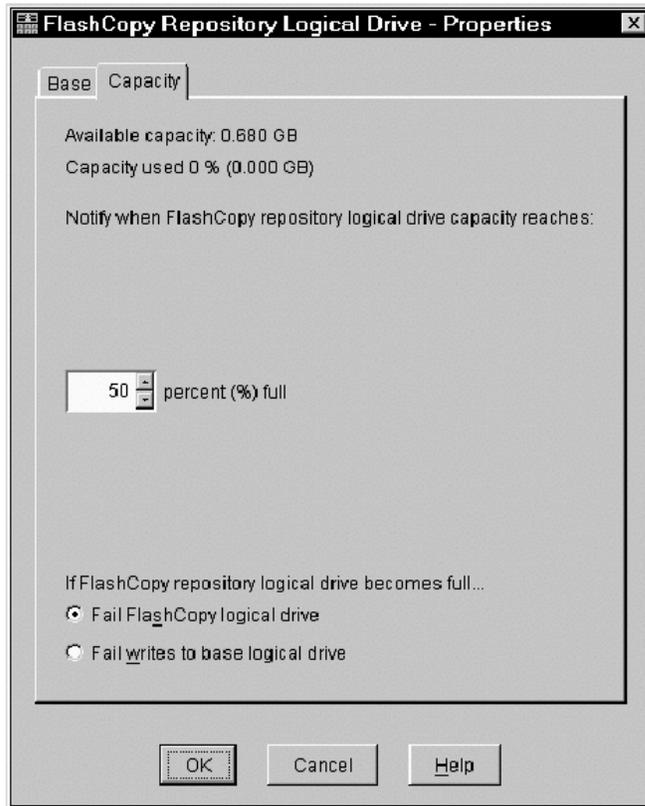
SJ000850

Figure 45. Repository drive warning threshold

- **Repository full policy**

  When a FlashCopy repository logical drive reaches its capacity and becomes full, one of the following actions occurs:

  – Fail FlashCopy logical drive

  – Fail writes to base logical drive

  If the FlashCopy repository logical drive is set to *Fail FlashCopy logical drive* (as shown in Figure 45) when it becomes full, its data is not recoverable and the FlashCopy cannot be accessed. In this case, the only available option is to delete the FlashCopy logical drive or recreate the FlashCopy logical drive to create a new point-in-time image.

  If the FlashCopy repository logical drive is set to *Fail writes to the base logical drive*, the data is recoverable. However, the FlashCopy repository logical drive capacity must be increased so writes to the base logical drive are not rejected. For more information, see "Resizing a FlashCopy repository logical drive" on page 112.

## Viewing the progress of a modification operation

The progress bar at the bottom of the FlashCopy Repository Logical Drive Properties window displays the progress of an operation. You can view the progress of the following operations:

- Copyback
- Reconstruction
- Initialization
- RAID level change

- Dynamic logical drive expansion
- Capacity increase
- Defragmentation
- Segment size change

> **Note:** The storage management software cannot obtain progress information from the storage subsystem controllers if the network management connection to the controllers is down or if the storage subsystem is partially managed. For more information about a partially managed storage subsystem or an unresponsive controller or storage subsystem condition, see the Enterprise Management window online help.

## Disabling a FlashCopy logical drive

If you no longer need a FlashCopy logical drive, you might want to disable it. As long as a FlashCopy logical drive is enabled, your storage subsystem performance can be impacted by copy-on-write activity thst is directed to the associated FlashCopy repository logical drive. The copy-on-write activity concludes when you disable a FlashCopy logical drive.

If you disable a FlashCopy logical drive instead of deleting it, you can retain it and its associated repository for future use. When you need to create a different FlashCopy of the same base logical drive, you can use the Recreate option to reenable the previously disabled FlashCopy. This takes less time than creating a new FlashCopy.

When you disable a FlashCopy logical drive, note the following points:
- You cannot use that FlashCopy logical drive again until you use the Recreate option on that logical drive.
- Only that FlashCopy logical drive is disabled. All other FlashCopy logical drives remain functional.

If you do not intend to recreate a FlashCopy, you can delete that FlashCopy logical drive instead of disabling it.

Perform the following steps to disable a FlashCopy logical drive:
1. Select the FlashCopy logical drive. Right-click and select **Disable**, as shown in Figure 46 on page 110.

SJ000851
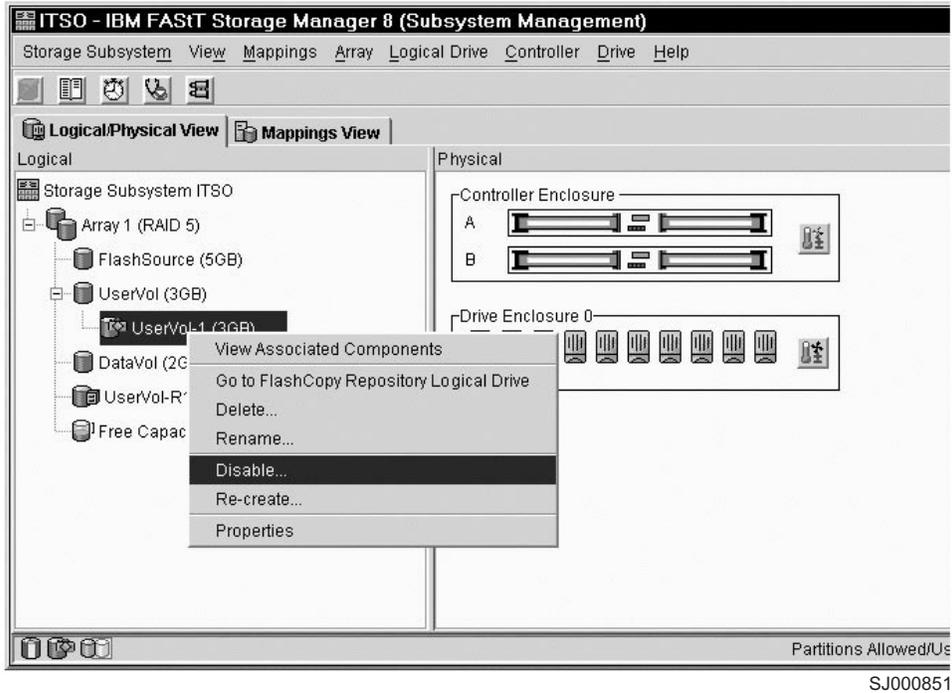
Figure 46. Choosing to disable the FlashCopy drive

2. The Disable FlashCopy Logical Drive confirmation window opens. See
Figure 47. On this window, type Yes and click **OK** to begin the disable operation.



SJ000852
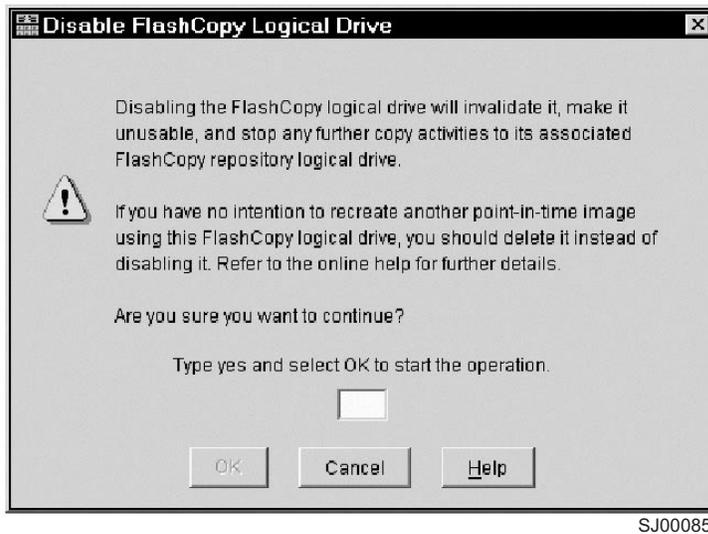
Figure 47. Disable FlashCopy confirmation window

The FlashCopy icon in the Physical/Logical View now displays as disabled, as
shown in Figure 48 on page 111.

SJ000853
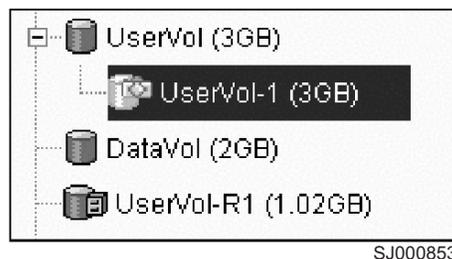
*Figure 48. Icon showing the disabled FlashCopy logical drive*

# Re-creating a FlashCopy logical drive

Re-creating a FlashCopy logical drive takes less time than creating a new one. If you have a FlashCopy logical drive that you no longer need, instead of deleting it, you can reuse it (and its associated FlashCopy repository logical drive) to create a different FlashCopy logical drive of the same base logical drive.

When you re-create a FlashCopy logical drive, note the following points:

- The FlashCopy logical drive must be in either an optimal or a disabled state.
- All copy-on-write data on the FlashCopy repository logical drive is deleted.
- FlashCopy and FlashCopy repository logical drive parameters remain the same as the previously disabled FlashCopy logical drive and its associated FlashCopy repository logical drive. After you re-create a FlashCopy logical drive, you can change parameters on its associated FlashCopy repository logical drive through the appropriate menu options.
- The system retains the original names for the FlashCopy and FlashCopy repository logical drives. You can change these names, however, after the Re-create option completes.
- When using this option, the previously-configured FlashCopy name, parameters, and FlashCopy repository logical drive are used.

Perform the following steps to re-create a FlashCopy drive:

1. Select the FlashCopy logical drive. Right-click and select **Re-Create**, as shown in Figure 49 on page 112.
2. The Re-create FlashCopy Logical Drive window opens. Type `Yes` and click **OK**.

This command disables and re-creates the FlashCopy logical drive (if it had not been previously disabled) and displays in the Logical view in an Optimal state. The creation timestamp shown on the FlashCopy Logical Drive Properties window is updated to reflect the new point-in-time image. Copy-on-write activity resumes to the associated FlashCopy repository logical drive.
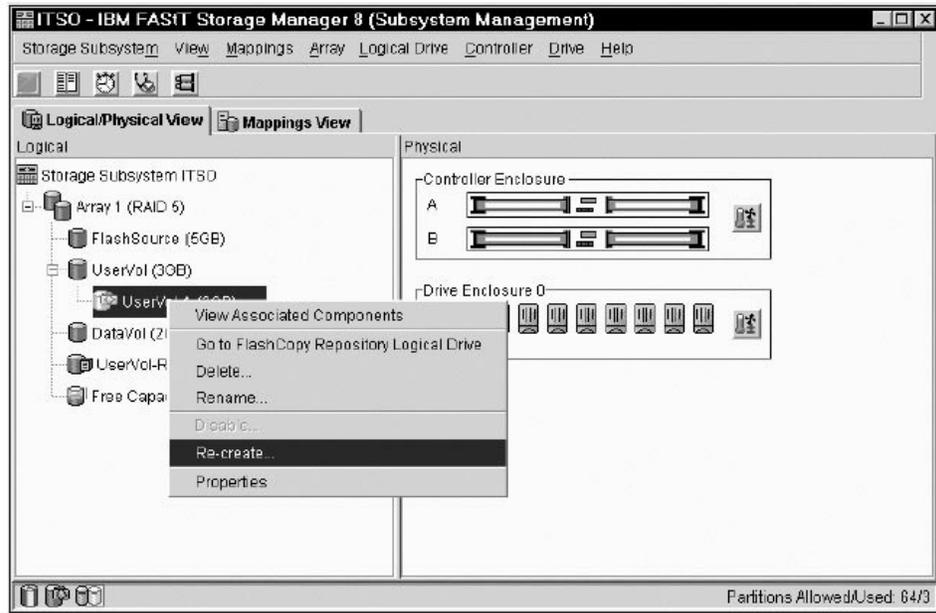
SJ000854

*Figure 49. Re-creating a FlashCopy*

**Note:**

- To use the Re-create option, the FlashCopy logical drive must be in either an optimal state or a disabled state.
- If the FlashCopy logical drive is in an optimal state, the process first disables and then recreates the FlashCopy logical drive. This process invalidates the current FlashCopy.

## Resizing a FlashCopy repository logical drive

Use this option to increase the storage capacity of an existing FlashCopy repository logical drive. Typically, this option is used when a warning is received that the FlashCopy repository logical drive is in danger of becoming full.

You can achieve an increase in storage capacity by:

- Using free capacity available on the array of the FlashCopy repository logical drive.
- Adding unconfigured capacity (in the form of unused drives) to the array of the FlashCopy repository logical drive. Use this option when no free capacity exists on the array.

  **Note:** A maximum of two drives can be added at one time to increase FlashCopy repository logical drive capacity.

The storage capacity of a FlashCopy repository logical drive cannot be increased if:

- One or more hot spare drives are in use in the logical drive.
- The logical drive has a `non-optimal` status.
- Any logical drive in the array is in any state of modification.
- The controller that owns this logical drive is in the process of adding capacity to another logical drive. Each controller can add capacity to only one logical drive at a time.
- No free capacity exists in the array.

- No unconfigured capacity (in the form of drives) is available to add to the array.

Perform the following steps to resize a FlashCopy repository drive:

1. Select a FlashCopy repository logical drive in the Logical view of the Subsystem Management window.

2. Click **Logical Drive —> Increase Capacity**, or right-click and select **Increase Capacity**.

   **Note:** If no free capacity or unconfigured capacity is available, the Increase Capacity option is not available.

   The Increase Repository Capacity window opens. You can see the FlashCopy repository logical drive name, the associated FlashCopy logical drive name, the associated base logical drive name, the current capacity, and the amount of free capacity that is available for the selected repository.

   If free capacity is available, the maximum free space is shown in the **Increase Capacity by** field. If there is no free capacity on the array, the free space that is shown in the **Increase Capacity by** field is 0. Add drives to create free capacity on the array of the standard logical drive.

3. Use one of the following two methods to increase capacity:

   - Increase FlashCopy repository logical drive capacity using free capacity on the array of the FlashCopy repository logical drive:

     a. Accept the final capacity increase or use the **Increase Capacity by** field to adjust the capacity. Click **OK**.

     b. A confirmation window displays. Type Yes and click **OK** to continue.

        The Logical view is updated. The FlashCopy repository logical drive with its capacity increased shows a status of Operation in Progress, together with its original capacity and the total capacity being added.

     c. In addition, the Free Capacity node involved shows a reduction in capacity. If all of the free capacity is used to increase the logical drive size, then the Free Capacity node involved is removed from the Logical view.

   - Increase FlashCopy repository logical drive capacity by adding unconfigured capacity (drives) to the array of the FlashCopy repository logical drive:

     a. If no unassigned drives are available and empty slots in the drive enclosures are available, insert new drives.

        If no unassigned drives are available, and there are no empty slots available in the drive enclosures, install another drive enclosure and additional drives.

     b. Select **Add Drives**.

        The Increase Repository Capacity - Add Free Capacity window opens. Enclosure, slot, and usable capacity details for the available free drives are displayed.

        **Note:** The drives that are displayed have a capacity that is either equivalent to or larger than those that are already employed by the array.

     c. Select a single drive, or two drives, to be added:
        – Press Ctrl and click **Enter** to select the nonadjacent drives.
        – Press Shift and click **Enter** to select the adjacent drives.

     d. Click **Add**.

The Add Free Capacity window closes. Check the **Drives to add [enclosure, slot]** field to ensure that the correct drives are added.

e. Accept the final capacity or use the **Increase Capacity by** field to adjust the capacity.

f. Click **OK**.

g. A confirmation window opens. Type `Yes` to confirm the operation, and click **OK** to continue.

The Logical view is updated. The FlashCopy repository logical drive having its capacity increased shows a status of `Operation in Progress`, together with its original capacity and the total capacity being added. In addition, the Free Capacity node involved in the increase shows a reduction in capacity.

If all of the free capacity is used to increase the logical drives size, then the Free Capacity node involved is removed from the Logical view.

If a Free Capacity node did not exist before you added capacity and not all of the capacity that is added will be used to increase the FlashCopy repository logical drives capacity, a new Free Capacity node is created and displayed in the Logical view.

Unassigned drives (unconfigured capacity) that are added to increase the FlashCopy repository logical drives capacity change in the Physical view to assigned drives, and become associated to the array of the FlashCopy repository logical drive.

4. View the progress of the capacity increase process. Select the FlashCopy repository logical drive. Click **Logical Drive —> Properties**, or right-click and select **Properties**.

The FlashCopy Repository Logical Drive - Properties window opens. A progress bar at the bottom of the window indicates the status of the capacity increase.

## Deleting a FlashCopy drive

Use this option to delete a FlashCopy logical drive that is no longer needed for backup or application testing purposes. This option results in an increase of free capacity in the array or additional unconfigured capacity.

**Note:**

- Deleting a logical drive causes loss of all data on the logical drive. Back up the data and stop all I/O before performing this operation, if necessary.
- If a file system is mounted on the logical drive, unmount it before you perform this operation.
- Deleting a base logical drive automatically deletes the associated FlashCopy logical drive and FlashCopy repository logical drive.
- Deleting a FlashCopy logical drive automatically deletes the associated FlashCopy repository logical drive.
- You cannot delete a FlashCopy repository logical drive using the Delete Logical Drive option, but you can by using the **delete** command in the script editor or CLI. See the Enterprise Management window online help system for more information about using the **delete** command.

Perform the following steps to delete a FlashCopy drive:

1. Select the FlashCopy logical drive in the Logical view.

2. Click **Logical Drive —> Delete**, or right-click and select **Delete**, as shown in Figure 50.



SJ000855
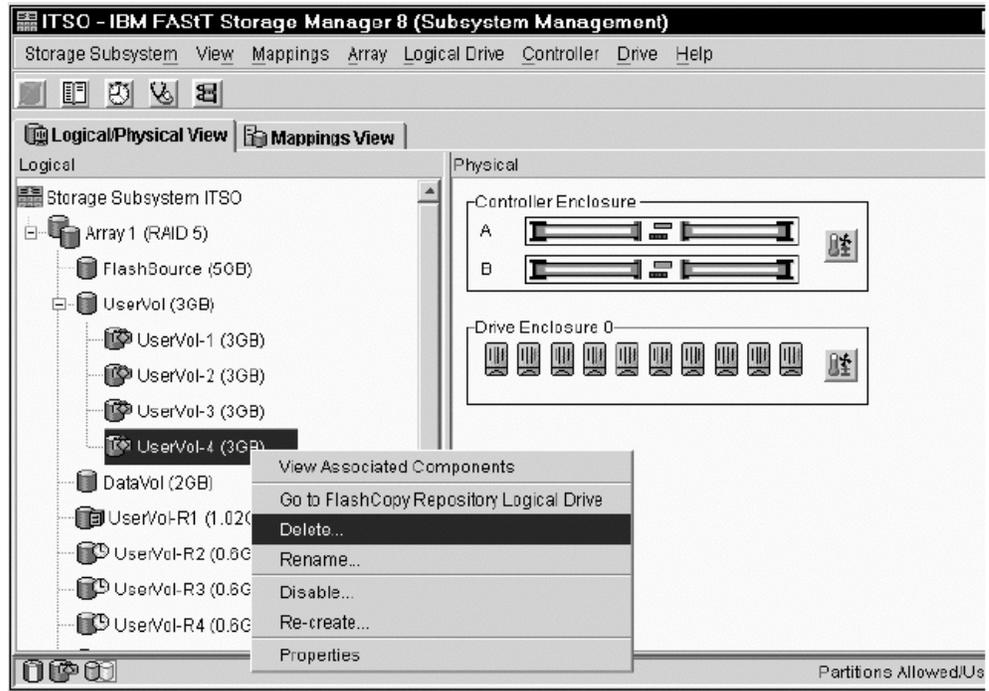
*Figure 50. Deleting the FlashCopy logical drive*

3. The Delete FlashCopy Logical Drive window opens, as shown in Figure 51. Type Yes and click **OK**.
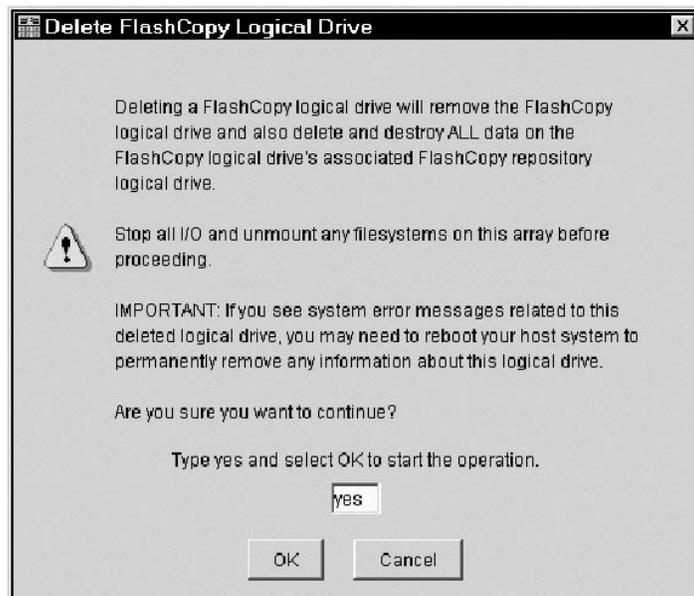


SJ000856

*Figure 51. Delete FlashCopy Logical Drive Dialog window*

The FlashCopy logical drive and FlashCopy repository logical drive are deleted, destroying any data that they might have contained.

# Using FlashCopy with UNIX disks

This section explains the procedures for using FlashCopy with UNIX disks (LVM, FAStT, and RAID arrays). It outlines the key steps that are required to create and reuse a FlashCopy logical drive on the following UNIX-based operating systems, using disks:

- Solaris 2.6, 2.7 (Solaris 7), and 2.8 (Solaris 8)
- HP-UX 11.0 (or higher)
- AIX 4.3.3 (or higher)

# Instructions for Solaris

Use the following procedures to create and reuse a FlashCopy logical drive using disks on Solaris 2.6, 2.7 (Solaris 7), and 2.8 (Solaris 8). Failure to complete the steps listed can result in an inaccurate point-in-time image of the base logical drive.

FlashCopy logical drives can either be created for reuse (frequent or nightly backups) or for one-time use (speculative change or upgrade testing).

## Creating a FlashCopy logical drive

Before you create a FlashCopy logical drive, consider the following questions:

- Are you creating the FlashCopy logical drive for immediate use?

  If you plan to use the FlashCopy logical drive immediately, stop all I/O activity to the base logical drive. Also, unmount the base logical drives from the host to which they are currently mounted. This ensures that it will capture an accurate point-in-time image of the data on the base logical drive.

- Are you creating the FlashCopy logical drive for use at a later date?

  If you plan to use the FlashCopy logical drive at a later date, do not unmount or stop I/O activity to the base logical drive at this time. You must perform these activities immediately before you use the FlashCopy logical drive for the first time.

Perform the following steps to create a FlashCopy logical drive:

1. Start the storage management software. The Enterprise Management window opens.

2. In the Logical view of the Subsystem Management window, select a standard logical drive and create a FlashCopy logical drive using one of the following methods:

   - Use the Create FlashCopy Logical Drive Wizard. This is accessed using a Subsystem Management window.

   - Create a FlashCopy logical drive using either the script editor or a command-line shell on the host operating system. Type the following command and press Enter.

   ```
   create FlashCopylogicaldrive
   ```

3. If supported by the operating system, run the hot_add utility (or operating system-specific utility), or restart the host on which the FlashCopy will be used. This ensures that the host operating system recognizes the FlashCopy logical drive.

After you have created logical drives and defined logical drive-to-LUN mappings, run the hot_add utility to ensure that the operating system is aware of the newly-created logical drives, without having to restart the host. For information about which operating systems support the hot_add utility, see the Storage Manager software installation guide for your specific operating system, which is shipped on a CD with the product. You can also download it from the Web site at:

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

For the Solaris operating system, at the host prompt, type the following command and press Enter.

```
/etc/raid/bin/hot_add
```

After logical drives are created and logical drive-to-LUN mappings are defined, this step ensures that the operating system is aware of the newly-created logical drives, without having to restart the host.

4. Run the SMdevices utility to associate the LUN with a host operating system device and to ensure that the FlashCopy logical drive is recognized by the host.

   After you have created logical drives and defined logical drive-to-LUN mappings, run the SMdevices utility to ensure that the logical drive name and the operating system device name (assigned by the operating system) correlate.

5. If you plan to use the FlashCopy logical drive immediately, go to step 6. If you plan to use the FlashCopy logical drive at a later date, disable the FlashCopy logical drive now using one of the following methods:

   - Click **Logical Drive —> FlashCopy —> Disable** in the Subsystem Management window.
   - Disable a FlashCopy logical drive using the script editor or a command-line shell on the host operating system. Type the following command and press Enter:

```
disable FlashCopylogicaldrive
```

   **Note:** If I/O activity to the base logical drive was stopped or data transfer was suspended, resume I/O activity to the base logical drive or re-enable data transfer at this time.

6. Mount the FlashCopy logical drive to its intended host.

7. Use the FlashCopy logical drive with your backup application, for speculative testing, or with another application.

8. Unmount the FlashCopy logical drive.

9. After the FlashCopy logical drive is no longer needed, disable or delete the FlashCopy logical drive.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can recreate the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and avoids any reduction in performance that might occur if the FlashCopy logical drive remains available.

## Reusing FlashCopy logical drives

Typically, after a FlashCopy logical drive is created, it is disabled until a new point-in-time image of the same base logical drive is needed.

Perform the following steps to create a new point-in-time image of the same base logical drive:

**Note:** Stop all I/O activity to the base logical drive at this point (or suspend data transfer). This ensures that an accurate point-in-time image of the base logical drive is captured.

1. Unmount the base logical drive.
2. In the storage management software, re-create the FlashCopy logical drive using one of the following methods:
   - Click **Logical Drive —> FlashCopy —> Re-create** from the menus in the Subsystem Management window.
   - Re-create a FlashCopy logical drive using the script editor or a command-line shell on the host operating system. Type the following command and press Enter.

```
create FlashCopylogicaldrive
```

3. Remount the base logical drive to its original host.
4. Mount the FlashCopy logical drive to its intended host.

   **Note:** If you stopped I/O activity to the base logical drive or suspended data transfer, resume I/O activity to the base logical drive or re-enable data transfer at this time.

5. Use the FlashCopy logical drive with your backup application or with another application.
6. Unmount the FlashCopy logical drive.
7. When the FlashCopy logical drive is no longer needed, disable the FlashCopy logical drive.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can recreate the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any reduction in performance that might occur if the FlashCopy logical drive remains available.

# Instructions for HP-UX: Logical Volume Manager

Use the following procedures to create FlashCopy logical drives on a host running HP-UX 11.0 (or higher) using Logical Volume Manager (LVM). Failure to complete the steps listed can result in an inaccurate point-in-time image of the base logical drive.

FlashCopy logical drives can either be created for repeated reuse (frequent or nightly backups) or for one-time use (speculative change or upgrade testing).

## Creating a FlashCopy logical drive
Perform the following steps to create a FlashCopy logical drive:

1. Start the storage management software. The Enterprise Management window opens.
2. Launch a Subsystem Management window, using one of the following methods:
   - Select the storage subsystem in the Device Tree view or from the Device Table. Then, click the **Manage Device** toolbar button, or click **Tools —> Manage Device**.

- Right-click the storage subsystem in the Device Tree view or from the Device Table and select **Manage Device**.
- Double-click a storage subsystem node in the Device Table.
- Select the storage subsystem in the Device Tree view or from the Device Table and press Enter.

The Subsystem Management window opens in a separate window.

**Note:** Stop the host application that is accessing the base logical drive and unmount the base logical drive. Unmounting the base logical drive does not apply when the base logical drive is the root disk of the host operating system.

3. When creating a FlashCopy logical drive based on a mounted file system, always use a **sync** command to flush the file system cache immediately before you create a FlashCopy logical drive.

   At the host prompt, type the following command and press Enter.

```
sync
```

   All unwritten file system buffers are flushed.

4. Within the Logical view of the Subsystem Management window, select a standard logical drive, and create a FlashCopy logical drive using one of the following methods:
   - Use the Create a FlashCopy Logical Drive Wizard. This is accessed using a Subsystem Management window.
   - Create a FlashCopy logical drive using either the script editor or a command-line shell on the host operating system. Type the following command and press Enter.

```
create FlashCopylogicaldrive
```

5. Assign a logical drive-to-LUN mapping between the FlashCopy logical drive and the host that will access the FlashCopy logical drive. Logical drive-to-LUN mappings can be defined using one of the following methods:
   - Use the Storage Partitioning Wizard to quickly define a single storage partition. It guides you through the major steps to specify which host will access a logical drive, and the associated LUNs.
   - Create a logical drive-to-LUN mapping using the script editor or a command-line shell on the host operating system. Type the following command and press Enter.

```
create mapping logical drive
```

6. At the host prompt, type the following command and press Enter.

```
ioscan -fn
```

   A list of the mapped devices that are recognized by the host is displayed.

   **Note:** If the required device names are not displayed using this command, at the host prompt, type the following command and then press Enter.

```
insf
```

7. Remount the base logical drive to its original host.

   **Note:** If I/O activity to the base logical drive was stopped or data transfer was suspended, resume I/O activity to the base logical drive or reenable data transfer at this time.

8. Perform the following steps to import the FlashCopy logical drives into the Logical Volume Manager:

   a. Create a new directory for the new array, as shown in the following example.

```
mkdir /dev/vg02
```

   b. Create a group node for the new array, as shown in the following example.

```
mknod /dev/vg02/group c 64 -0x020000
```

   c. Import the FlashCopy logical drive LUNs. At the host prompt, type the following command and press `Enter`.

```
vgimport /dev/vg02 FlashCopy-block-node-1 FlashCopy-block-node-2
```

   The following example addresses how to handle redundancy with multiple paths. The two paths or nodes represent the primary and alternate paths of the FlashCopy volume. Consider the following example:

```
vgimport /dev/vg02 /dev/dsk/c66t0d1 /dev/dsk/c69t0d1
```

   **Note:** You must verify that the */dev/dsk* device files exist on the FlashCopy logical drive. Use the SMdevices utility or the HP-UX ioscan utility to do the verification.

   The system displays a warning indicating that a backup of the array being imported might not exist on the host. This message is only a warning and requires no response. The import continues and completes successfully.

   The backup for this array is created later, when it is exported.

   d. Activate the new array as shown in the following example:

```
vgchange -a y /dev/vg02
```

9. If a file system existed on the base logical drive, then it also exists on the FlashCopy logical drive. Before you mount the FlashCopy logical drive, however, perform a file system check to ensure that the file system is consistent, for example:

```
fsck /dev/vg02/lvol01
```

10. Mount the FlashCopy logical drive to its intended host.
11. Use the FlashCopy logical drive with your backup application, for speculative testing, or with another application.
12. Unmount the FlashCopy logical drive.
13. Disable the FlashCopy logical drive using one of the following methods:
    - Click **Logical Drive —> FlashCopy —> Disable** in the Subsystem Management window.

- Disable a FlashCopy logical drive using the script editor or a command line shell on the host operating system. Type the following command and press Enter.

```
disable FlashCopylogicaldrive
```

Disable the FlashCopy logical drive after it is no longer needed.

If you disable a FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can recreate the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and avoids any reduction in performance that might result by retaining the availability of an unused FlashCopy logical drive.

## Reusing FlashCopy logical drives

Typically, after a FlashCopy logical drive is created it is disabled until a new point-in-time image of the same base logical drive is needed. Perform the following steps to create a new point-in-time image of the same base logical drive:

**Note:** Stop all I/O activity to the base logical drive (or suspend data transfer). This ensures that an accurate point-in-time image of the base logical drive is captured.

Complete the following steps to create a FlashCopy logical drive:

1. Start the storage management software. The Enterprise Management window opens.
2. Launch a Subsystem Management window using one of the following methods:
   - Select the storage subsystem in either the Device Tree view or from the Device Table. Then, click the **Manage Device** toolbar button or click **Tools—> Manage Device**.
   - Right-click the storage subsystem in the Device Tree view or from the Device Table, and select **Manage Device**.
   - Double-click a storage subsystem node in the Device Table.
   - Select the storage subsystem in the Device Tree View or from the Device Table, and then press Enter.

   The Subsystem Management window opens in a separate window.
3. Unmount the base logical drive.
4. In the storage management software, re-create the FlashCopy logical drive using one of the following methods:
   - Click **Logical Drive —> FlashCopy —> Re-create** in the Subsystem Management window.
   - Re-create a FlashCopy logical drive using the script editor or a command-line shell on the host operating system. Type the following command and press Enter.

```
recreate FlashCopylogicaldrive
```

5. Remount the base logical drive to its original host.

**Note:** If you stopped I/O activity to the base logical drive or suspended a data transfer, resume I/O activity to the base logical drive or re-enable data transfer at this time.

6. Perform the following steps to import the FlashCopy logical drives into the Logical Volume Manager:

   a. Create a new directory for the new array as shown in the following example:

   ```
   mkdir /dev/vg02
   ```

   b. Create a group node for the new array as shown in the following example:

   ```
   mknod /dev/vg02/group c 64 -0x020000
   ```

   c. Import the FlashCopy logical drive LUNs. At the host prompt, type the following command and press `Enter`.

   ```
   vgimport /dev/vg02 FlashCopy-block-node-1 FlashCopy-block-node-2 ...
   ```

   An alternate command can be used as shown in the following example:

   ```
   vgimport /dev/vg02 /dev/dsk/c66t0d1 /dev/dsk/c69t0d1
   ```

   **Note:** You must verify that the */dev/dsk* device files exist on the FlashCopy logical drive. Use the SMdevices utility or the HP-UX ioscan utility to do this verification.

   A warning is displayed indicating that a backup of the array being imported might not exist on the host. This message is only a warning and can be ignored. The import continues and completes successfully.

   The backup for this array is created when it is exported later.

   d. Activate the new array, as shown in the following example:

   ```
   vgchange -a y /dev/vg02
   ```

7. If a file system existed on the base logical drive, then it also exists on the FlashCopy logical drive. However, before the FlashCopy logical drive can be mounted, submit it to a file system check.

   Perform a file system check to ensure that the file system is consistent, for example:

   ```
   fsck /dev/vg02/lvol01
   ```

8. Mount the FlashCopy logical drive to its intended host.

9. Use the FlashCopy logical drive with your backup application or other application.

10. Unmount the FlashCopy logical drive.

11. If the FlashCopy logical drive is no longer needed, disable the FlashCopy logical drive.

   If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base

logical drive, you can recreate the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any reduction in performance that might occur if the FlashCopy logical drive remains available.

# Instructions for AIX: Logical Volume Manager

Use the following procedure to create FlashCopy logical drives on a host running AIX versions 4.3.3 or higher, using Logical Volume Manager (LVM).

You can create FlashCopy logical drives for repeated reuse (frequent or nightly backups) or for one-time use (speculative change or upgrade testing).

**Attention:** Regarding the Repository Volume: The failure policy for the Repository Volume, which can occur when it becomes full, can be set to either fail the FlashCopy logical drive (default setting) or fail writes to the base logical drive of the FlashCopy. On AIX hosts, the failure policy must ALWAYS be set to the default policy of *Fail FlashCopy logical drive*. The *Fail writes to base logical drive* policy is not supported on AIX, as data could be lost to the base logical drive.

In addition, the capacity of the FlashCopy repository logical drive must be monitored using the GUI. It is best to never to let the FlashCopy repository fill up. Because the failure policy must be set to *Fail FlashCopy logical drive*, when the repository becomes full, the data in the repository is not recoverable and the FlashCopy cannot be accessed. However, you can still access the base logical drive data.

Failure to complete the steps listed in the following procedure can result in an inaccurate point-in-time image of the base logical drive.

## Creating a FlashCopy logical drive

**Before you begin:** Stop all I/O activity to the base logical drive, or suspend data transfer. This ensures that an accurate point-in-time image of the base logical drive is captured.

**Restriction:** FlashCopy logical drives can be created only for AIX arrays. If an array has more than one logical drive, you must create a FlashCopy logical drive for each logical drive in the array.

Perform the following steps to create a FlashCopy logical drive:

1. Locate the array on which the FlashCopy logical drive is to be based, and unmount each of its associated filesystems using the following command:

```
umount mount-point
```

   where *mount-point* is the name of the filesystem that is being unmounted.
2. Start the storage management software. The Enterprise Management window opens.
3. Launch a Subsystem Management window, using one of the following methods:
   - Select the storage subsystem in the Device Tree view or from the Device Table. Then, click the **Manage Device** toolbar button, or click **Tools —> Manage Device**.
   - Right-click the storage subsystem in the Device Tree view or from the Device Table and select **Manage Device**.
   - Double-click a storage subsystem node in the Device Table.

- Select the storage subsystem in either the Device Tree view or from the Device Table and press Enter.

  The Subsystem Management window opens in a separate window.

4. Within the Logical view of the Subsystem Management window, select a standard logical drive, and create a FlashCopy logical drive using one of the following methods:

   **Important:** If an AIX array has more than one logical drive, create FlashCopy logical drives for each logical drive in the array.

   - Use the Create a FlashCopy Logical Drive wizard. This is accessed from the Subsystem Management window.
   - Create a FlashCopy logical drive using either the script editor or a command-line shell on the host operating system. Type the following command and press Enter.

```
create FlashCopylogicaldrive
```

   **Important:** If an AIX array has more than one logical drive, you must create a FlashCopy logical drive for each logical drive in the array.

5. Assign a logical drive-to-LUN mapping between the FlashCopy logical drive and the host that will access the FlashCopy logical drive. Logical drive-to-LUN mappings can be defined using one of the following methods:

   - Use the Storage Partitioning wizard to quickly define a single storage partition. It guides you through the major steps to specify which host will access a logical drive, and the associated LUNs.
   - Create a logical drive-to-LUN mapping using the script editor or a command-line shell on the host operating system. Type the following command and press Enter.

```
create mapping logical drive
```

6. Log in to the host as `root`.
7. Run the hot_add utility (or an operating-system specific utility) to ensure that the host operating system recognizes the FlashCopy logical drives. At the host prompt, type the following command and press Enter.

```
hot_add
```

   Several minutes might pass while the operating system accesses the drives. When the operation completes, a window opens with the following message:

```
Device nodes have been updated
```

   The new logical drives are now available from the operating system.

8. Run the SMdevices utility to associate the LUNs with a host operating system device, and to ensure the correlation between the logical drive name and the operating system device name (assigned by the operating system).

   Look for the newly-created FlashCopy logical drive names and note the names of the associated operating system device name. If you do not see the newly-created logical drive names, continue to the next step. Use the **lspv** command to list the new drives.

   If you do not see the newly created drive names, continue to Step 9 on page 125.

9. At the host prompt, type the following command and press Enter.

```
lspv
```

A list of the physical drives recognized by the operating system is displayed.

10. Look for the operating system device name of your FlashCopy logical drive in the list. The list shows a physical logical drive ID (PVID) for the FlashCopy logical drive that is the same as the PVID for the associated base logical drive. This is because the FlashCopy logical drive contains the same array data structures as the base logical drive.

11. Clear the PVID for the FlashCopy logical drives. At the host prompt, type the following command and press Enter.

```
chdev -l os_device_name -a pv=clear
```

where *os_device_name* is the operating system device name of the FlashCopy logical drive.

Repeat this step for each FlashCopy logical drive in the AIX array.

12. Re-create a new array. Use the **recreatevg** command, in `/usr/sbin`, to read or reconstruct the array data structure inside a logical drive. The command allocates new physical logical drive identifiers (PIDs) to the FlashCopy logical drives and enables access to the FlashCopy logical drive for the selected host.

At the host prompt, type the following command and press Enter.

```
recreatevg -y logical drivegroupname -l /directoryname os_device_name
```

where:

- *logical drivegroupname* is the name that you want to assign to the FlashCopy array.

- *directoryname* is the name of the directory where you want to mount the FlashCopy logical drive.

- *os_device_name* is the operating system device name of the FlashCopy logical drive. If your AIX array contains more than one FlashCopy logical drive, add an *os_device_name* for each logical drive.

The array is re-created, and contains the FlashCopy logical drive or drives.

13. Mount the FlashCopy logical drive to its intended host. At the host prompt, type the following command and press Enter.

```
mount mount-point
```

where *mount-point* is the name of the filesystem that is being mounted. Include the *directoryname* that was used in step 12.

14. Ensure that the logical drives are back online. At the host prompt, type the following command and press Enter.

```
df -k
```

A list of the mounted disks displays.

15. Use the FlashCopy logical drive with your backup application, for speculative testing, or with another application.

16. When the FlashCopy logical drive is no longer required, unmount the filesystem. At the host prompt, type the following command and press Enter.

```
umount mount-point
```

17. Delete the array, created in step 12, that contains the Flashcopy logical drives. At the host prompt, type the following commands and press Enter.

```
varyoffvg logical drivegroupname
exportvg logical drivegroupname
```

where *logical drivegroupname* is the name of the FlashCopy array.

**Note:** If this command is not available in AIX 4.3.3, install the AIX 4330-06 maintenance package.

18. Disable the FlashCopy logical drive using one of the following methods:
    *   Click **Logical Drive —> FlashCopy —> Disable** in the Subsystem Management window.
    *   Disable a FlashCopy logical drive using the Script Editor or a command line shell on the host operating system. Type the following command and press Enter.

```
disable FlashCopylogicaldrive
```

If you disable a FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and avoids any reduction in performance that might result by retaining the availability of an unused FlashCopy logical drive.

## Reusing FlashCopy logical drives

Typically, after a FlashCopy logical drive is created, it is disabled until a new point-in-time image of the same base logical drive is needed.

**Before you begin:** Stop all I/O activity to the base logical drive or suspend data transfer. This ensures that an accurate point-in-time image of the base logical drive is captured.

Perform the following steps to create a new point-in-time image of the same base logical drive:

1. Unmount the filesystems in the array on which the FlashCopy logical drive is to be based. At the host prompt, type the following command and press Enter.

```
umount mount-point
```

where *mount-point* is the name of the filesystem that is being unmounted.

2. Run the hot_add utility (or an operating system-specific utility) to ensure that the host operating system recognizes the FlashCopy logical drive. At the host prompt, type the following command and press Enter.

```
hot_add
```

Several minutes might pass while the operating system accesses the drives. When the operation completes, a window opens that contains the following message:

```
Device nodes have been updated
```

The new logical drives are now available from the operating system.

3. Start the Storage Management software. The Enterprise Management window opens.

4. Launch a Subsystem Management window using one of the following methods:

   - Select the storage subsystem in either the Device Tree view or from the Device Table. Then, click the Manage Device toolbar button or click **Tools —> Manage Device**.

   - Right-click the storage subsystem in the Device Tree view or from the Device Table, and select **Manage Device**.

   - Double-click a storage subsystem node in the Device Table.

   - Select the storage subsystem in the Device Tree view or from the Device Table, and then press Enter.

   The Subsystem Management window opens in a separate window.

5. In the storage management software, re-create the FlashCopy logical drive using one of the following methods:

   - Click **Logical Drive —> FlashCopy —> Re-create** in the Subsystem Management window.

   - Re-create a FlashCopy logical drive using the script editor or a command-line shell on the host operating system. Type the following command and press Enter.

```
recreateFlashCopy logical drive
```

6. Clear the PVID for the FlashCopy logical drives. At the host prompt, type the following command and press Enter.

```
chdev -l os_device_name -a pv=clear
```

where *os_device_name* is the operating system device name of the FlashCopy logical drive.

Repeat this step for each FlashCopy logical drive in the AIX array.

7. Re-create a new array. At the host prompt, type the following command and press Enter.

```
recreatevg -y logical drivegroupname -l /directoryname os_device_name
```

where:

- *logical drivegroupname* is the name that you want to assign to the FlashCopy array.

- *directoryname* is the name of the directory where you want to mount the FlashCopy logical drive.

- *os_device_name* is the operating system device name of the FlashCopy logical drive. If your AIX array contains more than one FlashCopy logical drive, add an *os_device_name* for each logical drive.

The array is re-created and contains the FlashCopy logical drive or drives.

8. Mount the filesystem to its intended host. At the host prompt, type the following command and press Enter.

```
mount mount-point
```

where *mount-point* is the name of the filesystem that is being mounted. Include the *directoryname* that was used in step 7.

9. Ensure that the logical drives are back online. At the host prompt, type the following command and press Enter.

```
df -k
```

A list of the mounted disks displays.

10. Use the FlashCopy logical drive with your backup application or other application.

11. After the FlashCopy logical drive is no longer needed, disable the FlashCopy logical drive.

If you disable the FlashCopy logical drive instead of deleting it, you can retain the FlashCopy logical drive and its associated FlashCopy repository logical drive. Then, when you need to create a different FlashCopy of the same base logical drive, you can re-create the disabled FlashCopy logical drive. This takes less time than creating a new FlashCopy logical drive and stops any reduction in performance that might occur if the FlashCopy logical drive remains available.

# Script editor and command-line interface

Many storage management options that are available through the Subsystem Management window can be sent to the storage subsystem using statements in scripts. You can use the script editor to create or edit a script file, save a script file to the local disk of the Storage Management station, or load a script file from disk. You can also use the command-line interface (CLI) to issue individual commands to the scripting engine from the host operating system command shell or to call complete prewritten scripts.

# Missing logical drives

A missing logical drive is a placeholder node that is displayed in the Logical view. It indicates that the storage subsystem has detected inaccessible drives that are associated with a logical drive. Typically, this results when drives that are associated with an array are removed, or when one or more drive enclosures lose power.

Missing logical drives are only displayed in the Logical view if they are standard logical drives or repository logical drives. In addition, one of the following conditions must exist:

- The logical drive has an existing logical drive-to-LUN mapping, and drives that are associated with the logical drive are no longer accessible.
- The logical drive is participating in a Remote Volume Mirror as either a primary logical drive or a secondary logical drive, and drives that are associated with the logical drive are no longer accessible.
- The logical drive is a mirror repository logical drive, and drives that are associated with the logical drive are no longer accessible. The `Recovery Guru` has a special recovery procedure for this case. Two mirror repository logical drives are created together on the same array when the Remote Volume Mirroring premium feature is activated and one is used for each controller in the storage subsystem. If drives that are associated with the array are no longer accessible, then both mirror repository logical drives are missing, and all Remote Volume Mirrors are in an Unsynchronized state.

- The logical drive is a base logical drive with associated FlashCopy logical drives, and drives that are associated with the logical drive are no longer accessible.
- The logical drive is a FlashCopy repository logical drive, and drives that are associated with the logical drive are no longer accessible.

If missing logical drives are detected by the storage subsystem, a Missing Logical Drives group is created in the Logical view of the Subsystem Management window. Each missing logical drive is shown and identified by its worldwide name and logical drive type. Missing logical drives are identified as being either a standard logical drive, base logical drive, FlashCopy repository logical drive, primary logical drive, secondary logical drive, or mirror repository logical drive.

Missing logical drives, in most cases, are recoverable. Do not delete missing logical drives without confirming that the logical drives are no longer needed, because they will be permanently removed from the configuration.

If the storage subsystem detects that logical drives are missing because they have either been accidentally removed or their drive enclosures have sustained a power loss, you can recover these logical drives by using either of the following methods:
- Reinsert the drives back into the drive enclosure.
- Ensure that the power supplies of the drive enclosure are properly connected to an operating power source and have an optimal status.

# 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 FAStT200, FAStT500, or FASTtT700 storage subsystem that is managed by Storage Manager 8.21. A readme file that contains the latest installation and user information about the storage management software, AIX filesets, and hardware components located in the AIX subdirectory on the FAStT Installation CD. The most recent copy, which supercedes this document, is maintained on the following Web site:

www.pc.ibm.com/qtechinfo/MIGR-43839.html

After accepting the license agreement, go to the v8.21 link for the appropriate operating system.

## Hardware requirements

The following hardware is required at a minimum:
- Any RS/6000®, @server, pSeries™ server that supports FC 6227 or FC 6228 host bus adapters
- Two host bus adapters (HBAs)

## Software requirements

The following software must be at the specified versions:
- AIX 4.3.3, AIX 5.1, or AIX 5.2
- Filesets associated with IBM RDAC driver installations listed in Table 15, Table 16, or Table 17 on page 132.

## RDAC installation requirements

The following filesets must be at the specified versions or later.
- For AIX 4.3.3:

*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 | 4.3.3.83 |
| devices.common.IBM.fc.rte | 4.3.3.75 |
| devices.pci.df1000f7.com | 4.3.3.83 |
| devices.pci.df1000f7.rte | 4.3.3.75 |
| devices.pci.df1000f9.rte | 4.3.3.75 |
| devices.scsi.scarray.rte | 4.3.3.50 |

- For AIX 5.1:

*Table 16. Filesets required for AIX 5.1 RDAC*

| PTF filesets | Version |
|---|---|
| devices.fcp.disk.array.diag | 5.1.0.0 |
| devices.fcp.disk.array.rte | 5.1.0.37 |

*Table 16. Filesets required for AIX 5.1 RDAC (continued)*

| PTF filesets | Version |
|---|---|
| devices.common.IBM.fc.rte | 5.1.0.10 |
| devices.pci.df1000f7.com | 5.1.0.28 |
| devices.pci.df1000f7.rte | 5.1.0.15 |
| devices.pci.df1000f9.rte | 5.1.0.15 |
| devices.scsi.scarray.rte | 5.1.0.0 |

- For AIX 5.2, you need APAR IY35693 and the following filesets:

*Table 17. Filesets required for AIX 5.2 RDAC*

| PTF filesets | Version |
|---|---|
| devices.fcp.disk.array | 5.2.0.1 |

**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 directly from the following Web site:

www.techsupport.services.ibm.com/server/fixes

For downloading instructions, see "Installing host RDAC software on AIX hosts" on page 14.

# 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 FAStT200, FAStT500, or FASTtT700 storage subsystem that is managed by Storage Manager 8.21.

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

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 (32 bit or 64 bit) with the following patches:
    - B.11.00.53.2
    - B.11.00.53.8
    - PHKL_23939, version 1.0
    - PHKL_24004, version 1.0
    - PHKL_24027, version 1.0
    - PHKL_24612, 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 11.11 and HP-UX 11i with the following patches:
    - B.11.11.09
    - PHKL_25304
    - PHKL_25375
    - PHKL_25896
    - PHKL_26519
- For high-availability clusters of HP 9000/Series 800 computers, install the HP MC/ServiceGuard software package

Ensure that the following maximum kernel parameters are configured, as shown in Table 18.

*Table 18. HP-UX kernel parameter configuration requirements*

| Parameter | Description | Configuration |
|---|---|---|
| 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 FAStT200, FAStT500, or FAStT700 storage subsystem that is managed with Storage Manager 8.21.

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

Ensure that the Solaris 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.
- Solaris 2.6 with the following patches:
  - 105181-32
  - 105356-19
  - 106429-02
- Solaris 7 with the following patches:
  - 106541-21
  - 107544-03
  - 108376-38
- Solaris 8 with the following patches:
  - 108528-15
  - 111111-03
  - 111310-01
  - 111293-04
- For high-availability clusters of Sparc S20 systems, install the Veritas Cluster Server software package. Check the Vertitas Cluster Server (VCS) documentation for the latest patches.

# Appendix D. MC/ServiceGuard 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
```

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*.

Use the following procedure 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
```

   On node *B*:

```
#vgdisplay -v volume_group_name
```

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 table detail settings for the various host bus adapter (HBA) cards for Sun Solaris. These cards are not plug-and-play with auto-configuration. Instead, you might need to change the settings or bindings.

*Table 19. Configuration file name: /kernel/drv/fca-pci.conf*

| 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/genjniconf* reconfigure script from the Solaris shell.

```
# /etc/raid/bin/genjniconf
```

*Table 20. Configuration file name: /kernel/drv/jnic146x.conf*

| 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. |

*Table 20. Configuration file name: /kernel/drv/jnic146x.conf (continued)*

| Original value | New value | Comments |
|---|---|---|
| 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/genjniconf* reconfigure script from the Solaris shell.

```
# /etc/raid/bin/genjniconf
```

*Table 21. Configuration file name: /kernel/drv/jnic.conf*

| Original value | New value | Comment |
|---|---|---|
| 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"; | |
| Add | target0_wwpn = "<controller wwpn>" | |
| Add | target1_hba = "jnic146x1"; | |
| Add | target1_wwpn = "<controller wwpn>" | |

**Note:**

- You might need to run the */etc/raid/bin/genjniconf* reconfigure script from the Solaris shell.

```
# /etc/raid/bin/genjniconf
```

- Set *portEnabled = 1;* only when you see JNI cards entering non-participating mode in the */var/adm/messages* file. Under that condition:
  1. Set *FcPortCfgEnabled = 1;*
  2. Restart the host.
  3. Set *FcPortCfgEnabled = 0;*
  4. 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 file name: /kernel/drv/fcaw.conf*

| Original value | New value | Comments |
|---|---|---|
| fca_nport = 0; | fca_nport =1; | |

*Table 22. Configuration file name: /kernel/drv/fcaw.conf  (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
```

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1. Form Z125-4144

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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

This glossary also includes terms and definitions from:

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- *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 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 (I/Os) between the internal bus of the host system and the external Fibre Channel link and vice versa. Also called an I/O adapter, host adapter, or FC adapter.

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

**agent.**   A server program that receives virtual connections from the network manager (the client program) in an 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 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 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 IP address and other network information such as server address and default gateway.

**bridge.** A SAN device that provides physical and transport conversion, such as Fibre Channel to SCSI bridge.

**bridge group.** A bridge and the collection of devices connected to it. Bridge Groups are discovered by the SANavigator tool and displayed with a gray background on the Physical and Data Path Maps.

**broadcast.** A method of sending an 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 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 PCs. 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 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) 1) A redundancy check in which the check key is generated by a cyclic algorithm. (2) 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*.

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

**direct access storage device (DASD).** IBM mainframe terminology for a data storage device by which information can be accessed directly, instead of by-passing 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 controller*.

**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 N_Port Identifier for the FC device. It is not used in the 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 random access memory (DRAM).** A storage in which the cells require repetitive application of control signals to retain stored data.

**E_Port.** An expansion port that connects the switches for two fabrics (also used for McData ES-1000 B ports).

**ECC.** See *error correction coding*.

**EEPROM.** See *Electrically Erasable Programmable Read-Only Memory*.

**EGA.** See *enhanced graphics adapter*.

**electrically eErasable 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 disk 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 disk interface*.

**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.**   A port that supports an N_Port on a Fibre Channel switch.

**fabric group.**   A collection of interconnected SAN devices discovered by the SANavigator tool and displayed with a blue background on the Physical and Data Path Maps.

**Fibre Channel.**   A bi-directional, 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 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 SCSI, in FC frames.

**Fibre Channel Protocol for SCSI (FCP).**   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*.

**general purpose interface bus (GPIB).**   An 8-bit parallel bus developed for the exchange of information between computers and industrial automation equipment.

**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 representing a logical unit number (LUN) on an array.

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

**host bus adapter (HBA).**   An interface between the Fibre Channel network and a workstation or server.

**host computer.**   See *host*.

**host group.**   The collection of HBAs and NASs in a fabric discovered by the SANavigator tool and displayed with a yellow background on the Physical and Data Path Maps.

**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.

**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).** Also known as a *chip*. 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.

**integrated drive electronics (IDE).** Also known as an Advanced Technology Attachment Interface (ATA). A disk drive interface based on the 16-bit IBM PC 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 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 SAN but discovered by the SANavigator tool. The Isolated Group displays with a gray background near the bottom of the Physical and Data Path Maps.

**Java Runtime Environment (JRE).** A subset of the Java Development Kit (JDK) for end users and developers who want to redistribute the Java Runtime

Environment (JRE). The JRE consists of the Java virtual machine, the Java Core Classes, and supporting files.

**JRE.** See *Java Runtime Environment*.

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

**LAN.** See *local area network*.

**LBA.** See *logical block 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 SCSI hard disks and on ATA-2 conforming 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 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).** An N-Port or 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 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 DOS or OS/2 systems to support one or more network adapters and protocol stacks. NDIS is a 16-bit, Ring O (for the OS/2 operating system) 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.

**N_Port.**  A node 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.

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

**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 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 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.

**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 changed stored data except under special conditions.

**recoverable virtual shared disk (RVSD).** A virtual shared disk on a server node configured to provide continuous acces 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 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 ports (SL_Ports).** SL_Ports allow 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.

**serial storage architecture (SSA).** An interface specification from IBM in which devices are arranged in a ring topology. SSA, which is compatible with SCSI devices, allows full-duplex packet multiplexed serial data transfers at rates of 20Mb/sec 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.

**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 ports*.

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

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

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

**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.** 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 I/O path.

**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 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 IP addresses of the 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_Ports.**  See *translated loop port*.

**translated loop ports (TL_Ports).**  Each 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 SNMP trap. Specifically, a trap receiver is defined by an 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*.

**user action events.**  Actions that the user takes, such as changes in the 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 RAM (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.

# Index

creating a SAN-attached configuration   54

# D

dac attributes   19, 22
dar attributes   18, 21
default partitioning, Solaris devices   53
devices
   identification   24
   names and bus numbers, identifying   25, 43
   Solaris, default partitioning for   53
diagnostics, controller   2
direct (out-of-band) management method   7
direct-attached configuration   3, 12, 53
documentation
   documents   1
   FAStT Storage Manager Version 8.21   xvii
   FAStT200   xvi
   FAStT500   xv
   FAStT700   xiii
   files   1
   online help   1, 66, 68
   related   xviii
   Web sites   1
drives, AIX, identifying by operating system device
  names   28

# E

e-mail address   xix, 67
edition notice   ii
enabling multipath I/O with PV-links   40
Enterprise Management window
   description   4
   online help   1
   starting   64
event monitoring   2

# F

failover protection   3
failure support
   cluster services   3, 71
   RDAC driver   3, 5
   redistributing volumes   31
FAStT configuration limitations   73
FAStT Storage Manager
   related documents   xviii
   Version 8.21 library   xvii
FAStT, introduction to   9
FAStT200 Storage Server library   xvi
FAStT500 Storage Server library   xv
FAStT700 Storage Server library   xiii
features of Storage Manager 8.21   2
fget_config command   27
filesets   131
firmware
   AIX
      requirements   11
      upgrading   16
      verifying   15

firmware *(continued)*
   description   1
   HP-UX
      requirements   33
      upgrading   39
   Solaris
      requirements   45
      upgrading   52
   versions   38, 51
FlashCopy   3, 81
   AIX instructions   123
   command line interface   128
   create drive   90
   delete drive   114
   disabling logical drive   109
   estimate repository life   87
   estimate repository logical drive capacity   86
   HP-UX instructions   118
   mapping drive to host   101
   missing logical drives   128
   paremeters   83
   premium features   89
   progress of modification operation   108
   re-create logical drive   111
   re-size repository drive   112
   script editor   128
   script scenarios   81
   step-by-step guide   88
   UNIX regular disks   116
   view status   104

# G

GPFS   74

# H

HACMP   72, 74
HACMP usage notes   73
hardware requirements
   AIX   11, 131
   HP-UX   33, 133
   Solaris   45, 135
hdisk attributes   20, 22, 23
help   1, 66, 68
heterogeneous environment   2, 64
high-availability cluster services   3, 71, 72, 74
host software
   AIX   14
   AIX installing   13
   packages   3
   Solaris   49
host type   63
host-agent (in-band) management method   6
how this document is organized   xi
how to send your comments   xix
HP-UX
   client software
      installing   36
      procedure   35
      requirements   34

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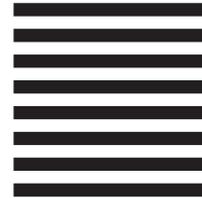_____

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