IBM TotalStorage DS4000

Hard Drive and Storage Expansion Enclosure Installation and Migration Guide

GC26-7663-00

IBM TotalStorage DS4000

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GC26-7663-00

Note:
Before using this information and the product it supports, be sure to read the general information in “Notices” on page 73.

First Edition (October 2004)

Safety

The caution and danger statements that this document contains can be referenced in the multilingual *IBM Safety Information* document that is provided with every IBM TotalStorage DS4000 Storage Server. Each caution and danger statement is numbered for easy reference to the corresponding statements in the translated document.

- **Danger:** These statements indicate situations that can be potentially lethal or extremely hazardous to you. A danger statement is placed just before the description of a potentially lethal or extremely hazardous procedure, step, or situation.
- **Caution:** These statements indicate situations that can be potentially hazardous to you. A caution statement is placed just before the description of a potentially hazardous procedure step or situation.
- **Attention:** These notices indicate possible damage to programs, devices, or data. An attention notice is placed just before the instruction or situation in which damage could occur.

Before installing this product, read the following danger and caution notices.

Statement 1:

DANGER

Electrical current from power, telephone, and communication cables is hazardous.

To avoid a shock hazard:

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

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

Statement 3:

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

- **Do not remove the covers. Removing the covers of the laser product could result in exposure to hazardous laser radiation. There are no serviceable parts inside the device.**
- **Use of controls or adjustments or performance of procedures other than those specified herein might result in hazardous radiation exposure.**

DANGER

Some laser products contain an embedded Class 3A or Class 3B laser diode. Note the following.

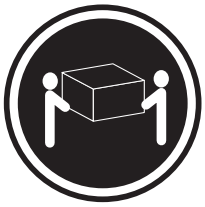
Laser radiation when open. Do not stare into the beam, do not view directly with optical instruments, and avoid direct exposure to the beam.

Class 1 Laser statement

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

IEC 825-11993 CENELEC EN 60 825

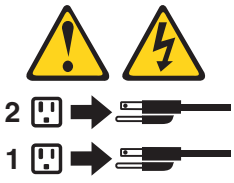
Statement 4:

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

CAUTION:
Use safe practices when lifting.

Statement 5:

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



Statement 8:

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

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

Contents

Figures

Tables

About this document

This document describes procedures for adding new Fibre Channel or SATA hard drives or new IBM TotalStorage DS4000 drive expansion enclosures containing new Fibre Channel or SATA hard drives to an existing IBM DS4000 Storage Server configuration. This document also describes the procedure for migrating either Fibre Channel hard drives or IBM TotalStorage DS4000 storage expansion enclosures containing Fibre Channel hard drives from one DS4000 storage subsystem to another.

Who should read this document

This document is intended for system administrators who are familiar with the IBM TotalStorage DS4000 storage subsystem components, terminology, and DS4000 Storage Server administrative tasks.

Illustrations

Illustrations contained in this document depict general visual characteristics of the DS4000 Storage Server, storage expansion unit, and fibre channel drive hardware cited. They are not intended for use as detailed DS4000 storage hardware images.

Using this document

Before you proceed to complete any storage addition or migration procedures detailed in this publication, familiarize yourself with the principles, prerequisite instructions at Chapter 2, “Prerequisites to adding capacity and hard drive migration,” on page 23, as well as the following storage addition or migration procedures applicable to your specific need.

- Chapter 3, “Adding one or more new hard drives,” on page 31
- Chapter 4, “Adding expansion units containing new hard drives,” on page 37
- Chapter 5, “Migrating one or more hard drives,” on page 47
- Chapter 6, “Migrating expansion units containing hard drives,” on page 55
- Chapter 7, “Upgrading a storage server in a functioning configuration,” on page 63

Your familiarity with the principles, preliminary procedures, and detailed steps described in this document is critical to prevent loss of data availability, and in some cases, loss of data. If you have questions about the procedures described in this document, please contact the IBM Help Center in your geography for assistance.

Important:

1. Do not mix SATA and Fibre Channel drives in the same enclosure.
2. Do not place SATA drives in a fibre channel enclosure.
3. Do not place fibre channel drives in a SATA enclosure.
4. Do not mix SATA drive expansion enclosures (EXP100) and Fibre channel drive enclosures (EXP710 and EXP500) in the same drive loop or DS4000 Storage Server.

DS4000 installation process overview

The following flow chart gives an overview of the DS4000 hardware and the DS4000 Storage Manager software installation process. Lined arrows in the flow chart indicate consecutive steps in the hardware and software installation process. Labeled arrows indicate which current documents provide detailed information about those steps.

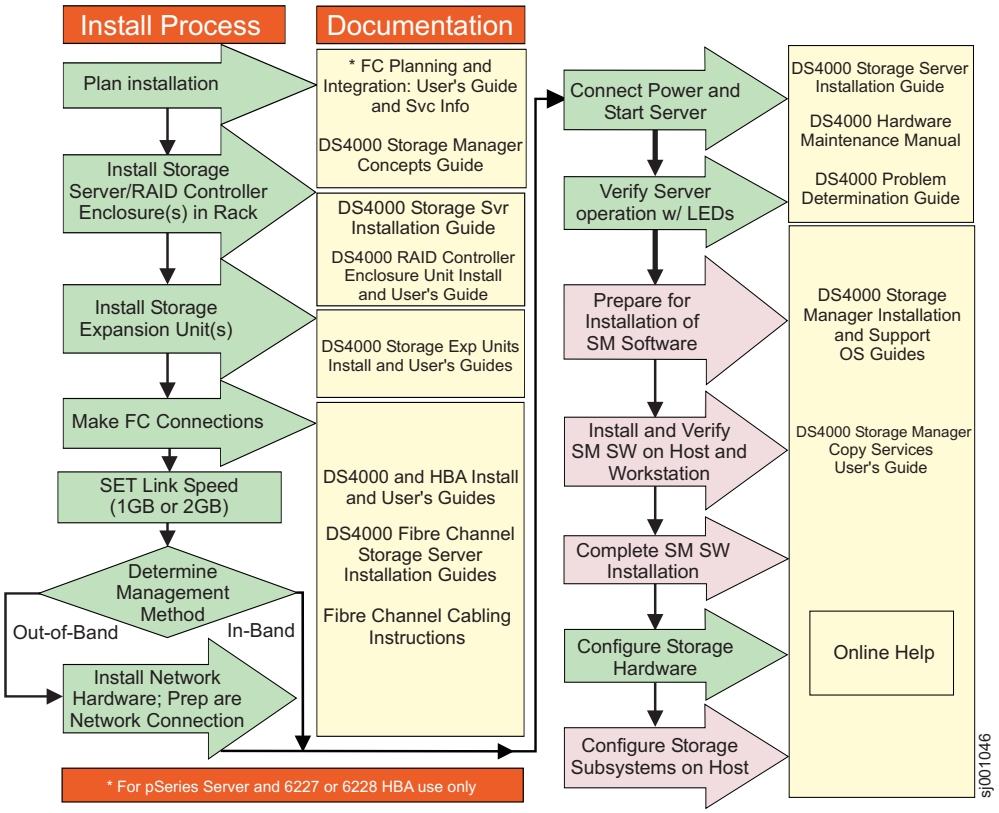


Figure 1. Installation process flow by current publications

DS4000 Storage Server publications

The following tables present an overview of the DS4500, DS4400, DS4300 Fibre Channel, and DS4100 SATA Storage Server product libraries, as well as other related documents. Each table lists documents that are included in the libraries and what common tasks they address. Click on active links in the tables to access those documents currently available on the Internet. You can access documentation for the other DS4000 products at the following Web site:

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

DS4500 Fibre Channel Storage Server library

Table 1 on page xvii associates each document in the DS4500 Fibre Channel Storage Server library with its related common user tasks.

Table 1. TotalStorage DS4500 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4500 Installation and Support Guide, GC26-7530	✓	✓		✓		
IBM TotalStorage DS4500 Fibre Channel Cabling Instructions, 24P8135	✓	✓				
IBM TotalStorage DS4500 Storage Server User's Guide, GC26-7534				✓	✓	✓
IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7532		✓			✓	
IBM DS4000 FC2-133 Host Bus Adapter Installation and User's Guide, 48P9823		✓			✓	
IBM TotalStorage DS4500 Rack Mounting Instructions, 19K0900	✓	✓				
IBM Fibre Channel Planning and Integration: User's Guide and Service Information, SC23-4329	✓	✓			✓	✓
IBM DS4000 Management Suite Java User's Guide, 32P0081					✓	✓
IBM TotalStorage DS4000 Hardware Maintenance Manual, GC26-7640						✓
IBM TotalStorage DS4000 Problem Determination Guide, GC26-7642						✓

DS4400 Fibre Channel Storage Server library

Table 2 associates each document in the DS4400 Fibre Channel Storage Server library with its related common user tasks.

Table 2. TotalStorage DS4400 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM DS4400 Fibre Channel Cabling Instructions, 32P0343	✓	✓				
IBM DS4400 Fibre Channel Storage Server User's Guide, 32P0341				✓	✓	✓
IBM DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7532		✓			✓	
IBM TotalStorage DS4000 FC2-133 Host Bus Adapter Installation and User's Guide, 48P9823		✓			✓	
IBM DS4000 Management Suite Java User's Guide, 32P0081					✓	✓
IBM TotalStorage DS4000 Hardware Maintenance Manual, GC26-7640						✓
IBM TotalStorage DS4000 Problem Determination Guide, GC26-7642						✓

DS4300 Fibre Channel Storage Server library

Table 3 associates each document in the DS4300 Fibre Channel Storage Server library with its related common user tasks.

Table 3. TotalStorage DS4300 Fibre Channel Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4300 Fibre Channel Storage Server Installation and User's Guide, GC26-7531	✓	✓		✓		
IBM TotalStorage DS4000 Hardware Maintenance Manual, GC26-7640						✓
IBM TotalStorage DS4000 Problem Determination Guide, GC26-7642						✓
IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7532		✓			✓	
IBM TotalStorage DS4300 Rack Mounting Instructions, 24P8125	✓	✓				
IBM TotalStorage DS4300 Fibre Channel Cabling Instructions, 24P8126	✓	✓				

DS4100 Storage Server library

Table 4 associates each document in the DS4100 Storage Server library with its related common user tasks.

Table 4. TotalStorage DS4100 Storage Server document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4100 Installation, User's, and Maintenance Guide, GC26-7641	✓	✓		✓		✓

Table 4. TotalStorage DS4100 Storage Server document titles by user tasks (continued)

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4100 Cabling Guide, 24P8973	✓	✓				
IBM TotalStorage DS4000 FC2-133 Dual Port Host Bus Adapter Installation and User's Guide, GC26-7532		✓			✓	
IBM DS4000 FC2-133 Host Bus Adapter Installation and User's Guide, 48P9823		✓			✓	
IBM TotalStorage DS4000 Hardware Maintenance Manual, GC26-7640						✓
IBM TotalStorage DS4000 Problem Determination Guide, GC26-7642						✓

DS4000-related hardware publications

Table 5 associates each of the following documents related to DS4000 operations with its related common user tasks.

Table 5. TotalStorage DS4000-related document titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM Safety Information, P48P9741					✓	
IBM TotalStorage DS4000 Quick Start Guide, GC26-7662	✓	✓				
IBM TotalStorage DS4000 EXP100 Storage Expansion Unit Release Notes, GC26-7619	✓	✓				
IBM TotalStorage DS4000 EXP100 Storage Expansion Unit Installation and Users Guide, GC26-7601	✓	✓		✓	✓	✓
Fibre Channel Solutions - IBM DS4000 EXP500 Installation and User's Guide, 59P5637	✓	✓		✓	✓	✓
IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Units Installation, User's, and Maintenance Guide, GC26-7647	✓	✓		✓	✓	✓
IBM TotalStorage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide, GC26-7639	✓	✓				
IBM Netfinity® Fibre Channel Cabling Instructions, 19K0906		✓				
IBM Fibre Channel SAN Configuration Setup Guide, 25P2509	✓		✓	✓	✓	

DS4000 Storage Manager Version 9 publications

Table 6 associates each document in the DS4000 Storage Manager library with its related common user tasks.

Table 6. TotalStorage DS4000 Storage Manager Version 9 titles by user tasks

Title	User Tasks					
	Planning	**Hardware Installation**	**Software Installation**	**Configuration**	**Operation and Administration**	**Diagnosis and Maintenance**
IBM TotalStorage DS4000 Storage Manager Version 9 Installation and Support Guide for Windows 2000/Server 2003, NetWare, ESX Server, and Linux, GC26-7649	✓		✓	✓		
IBM TotalStorage DS4000 Storage Manager Version 9 Installation and Support Guide for AIX, UNIX, Solaris and Linux on Power, GC26-7648	✓		✓	✓		
IBM TotalStorage DS4000 Storage Manager Version 9 Copy Services User's Guide, GC26-7660	✓		✓	✓	✓	
IBM TotalStorage DS4000 Storage Manager Version 9 Concepts Guide, GC26-7661	✓	✓	✓	✓	✓	✓

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Chapter 1. Introduction

Scalability is a primary attribute of the IBM TotalStorage DS4000 Storage Server family. Whenever the need arises, you can expand a DS4000 Storage Server from its minimum to its maximum capacity configuration. To expand DS4000 Storage Server configurations you can purchase additional equipment or migrate equipment from DS4000 Storage Server configurations previously deployed.

The typical DS4000 Storage Server drive connects to both Controller A and Controller B. Taken together, these connections represent a dual drive loop or a redundant drive loop pair. You must connect drive loops in pairs to enable redundant drive loop configurations (two data paths per drive enclosure).

Table 7 provides a list of the maximum allowable number of drives and drive loop pairs for each DS4000 Storage Server by machine type and model number. It also specifies storage expansion enclosure license requirements.

Important:
Do not intermix fibre channel and SATA devices (DS4100 and EXP100) in the same storage subsystem environment.

Table 7. Maximum allowable drives and drive loop pairs in DS4000 storage servers

Product name	Machine type	Model number	Maximum number of drives	Maximum number of drive loop pairs	License requirement to add storage expansion units
IBM TotalStorage DS4100 Storage Server	1724	100	56	1	None
IBM TotalStorage FAStT200 Fibre Channel Storage Server	3542	1RU 1RX	38	1	None
IBM TotalStorage FAStT200 High Availability (HA) Fibre Channel Storage Server		2RU 2RX	66	1	None
IBM TotalStorage FAStT500 Fibre Channel Storage Server	3552	1RU 1RX	224	2	None

Table 7. Maximum allowable drives and drive loop pairs in DS4000 storage servers (continued)

Product name	Machine type	Model number	Maximum number of drives	Maximum number of drive loop pairs	License requirement to add storage expansion units
IBM TotalStorage DS4300 Fibre Channel Storage Server	1722	60X 60U	56	1	Purchase storage expansion unit entitlements in increments up to three storage expansion units per DS4300 Storage Server.
IBM TotalStorage DS4300 Turbo Fibre Channel Storage Server			112	1	None. The DS4300 Turbo option includes a seven storage expansion unit entitlement.
IBM TotalStorage DS4300 Single Controller Fibre Channel Storage Server		6LU 6LX	14	0	None. The DS4300 Single Controller Storage Server does not support storage expansion enclosure attachment.
IBM TotalStorage DS4400 Fibre Channel Storage Server	1742	1RU 1RX	224	2	None
IBM TotalStorage DS4500 Fibre Channel Storage Server	1742	90X 90U	224	2	None

Notes:

1. The maximum number of drives supported by the FAStT200 HA Storage Server (models 2RU and 2RX) assumes attachment to 4 14-drive storage expansion enclosures containing 56 fibre channel drives.
2. The maximum number of drives supported by FAStT500, DS4400, and DS4500 storage servers assumes their attachment to 16 14-drive storage expansion enclosures.

Intermixing Enclosures

For hardware compatibility, ensure that the environmental service module (ESM) firmware for each storage expansion enclosure and the storage server controller firmware are either at or above the levels that are recommended in Table 16 on page 24 and Table 17 on page 26.

You can mix DS4000 TotalStorage EXP500 (which operates only at 1 Gbps) and DS4000 TotalStorage EXP700 (which operates at either 1 Gbps or 2 Gbps) storage expansion enclosures in the same redundant drive loop pair in all DS4000 Storage Server configurations with one exception. You cannot mix these enclosures in the same redundant drive loop pair in DS4300 Storage Server configurations. The DS4300 Storage Server (models 60X and 60U) supports only DS4000 EXP700 and DS4000 EXP710 (which operates only at 2 Gbps) storage expansion enclosures. There is no restriction to the physical sequence of mixed EXP700 and EXP500 expansion units in the same redundant drive loop pair. See “Intermixing EXP700 and EXP710 storage expansion enclosures” on page 6 additional information.

Although the EXP700 storage expansion enclosure is capable of operating at 2 Gbps, you must set the fibre channel speed of drive loops in a mixed storage expansion enclosure environment to the lowest fibre channel speed supported by all hardware in the loop, which is 1 Gbps. If one of the drive loops in a DS4000 storage configuration is set to 1 Gbps, you must set all of the drives' loops to 1 Gbps. This speed restriction applies to all four drive loops in either the DS4400 or DS4500 storage subsystem configuration, even where some of the drive loops consist only of EXP700 storage expansion enclosures that might otherwise operate at 2 Gbps. Although you can mix DS4000 TotalStorage EXP700 and DS4000 TotalStorage EXP710 storage expansion enclosures in the same redundant drive loop pair in any DS4000 Storage Server configuration, you cannot intermix the sequence of these enclosure models in a drive loop. See “Intermixing EXP700 and EXP710 storage expansion enclosures” on page 6 additional information.

Do not mix DS4000 TotalStorage EXP500 (which operates only at 1 Gbps) and DS4000 TotalStorage EXP710 (which operates only at 2 Gbps) storage expansion enclosures in the same redundant drive loop pair. Also, do not attach these storage expansion enclosures to the same controller.

Do not intermix DS4000 TotalStorage EXP100 storage expansion enclosures with any other storage expansion enclosure model in the same redundant drive loop pair.

You can intermix DS4000 EXP700s and DS4000 EXP710s in the same drive loop, but all DS4000 EXP710s in the redundant drive loop must be grouped together.

Important: Even though IBM supports intermixing different drive expansion enclosure models in the same redundant drive loop, we recommend use of a single drive expansion enclosure model in given redundant drive loop. This is the best practice.

Table 8 indicates what DS4000 expansion enclosures may coexist in the same redundant drive loop of a DS4000 storage subsystem by model.

Table 8. Mixed DS4000 expansion enclosure compatibility in storage subsystems by model

DS4000 expansion enclosure	**DS4000 EXP100** (SATA)	**DS4000 EXP500** (Fibre Channel)	**DS4000 EXP700** (Fibre Channel)	**DS4000 EXP710** (Fibre Channel)
IBM TotalStorage DS4000 EXP100 (SATA)	✓			
IBM TotalStorage DS4000 EXP500 (Fibre Channel)		✓ (1 Gbps only)	✓ (1 Gbps only)	

Table 8. Mixed DS4000 expansion enclosure compatibility in storage subsystems by model (continued)

IBM TotalStorage DS4000 EXP700(Fibre Channel)		✓ (1 Gbps only)	✓	✓
IBM TotalStorage DS4000 EXP710 (Fibre Channel)			✓	✓

Table 9 indicates what DS4000 expansion enclosures may attach to DS4000 storage servers by model.

Table 9. DS4000 expansion enclosure compatibility with DS4000 storage servers by model

DS4000 storage device	**DS4000 EXP100** (SATA)	**DS4000 EXP500** (Fibre Channel)	**DS4000 EXP700** (Fibre Channel)	**DS4000 EXP710** (Fibre Channel)
DS4100 Storage Server (SATA)	✓			
FAStT200 Storage Server (Fibre Channel)		✓ (1 Gbps only)	✓ (1 Gbps only)	
FAStT500 Storage Server (Fibre Channel)		✓ (1 Gbps only)	✓ (1 Gbps only)	
FAStT500 Storage Server (Fibre Channel)			✓	
DS4300 Storage Server (Single Controller, Fibre Channel)				
DS4300 Turbo Storage Server (Fibre Channel)	✓ 1 2		✓	✓
DS4400 Storage Server (Fibre Channel)	✓ 2	✓ (1 Gbps only)	✓	✓
DS4500 Storage Server (Fibre Channel)	✓ 2	✓ (1 Gbps only)	✓	✓

1 While the DS4300 Turbo Storage Server will support fibre channel or SATA drives, it will not support both in a mixed environment. It will support SATA drives only in an attached storage enclosure, never in the DS4300 Turbo Storage Server.

2 DS4000 storage servers require the following firmware to manage EXP100 expansion enclosures.

DS4300 Turbo and DS4500
05.41.5x.xx or 06.10.xx.xx (recommended)

DS4400
06.10.xx.xx

Important: Do not change the speed of a drive loop while the DS4000 Storage Server is powered on. Such a speed change will cause unpredictable results. To change the speed of a drive loop:

__ Step 1. Prepare applications for DS4000 Storage Server shutdown.

__ Step 2. Shutdown the DS4000 Storage Server.
__ Step 3. Shutdown the DS4000 storage expansion enclosures.
__ Step 4. Change the fibre channel speed settings.
__ Step 5. Power on the DS4000 storage expansion enclosures.
__ Step 6. Power on the DS4000 Storage Server.
__ Step 7. Restore DS4000 Storage Server host application operations.

Note: For additional information on turning a storage server on and off, see the appropriate *DS4000 Storage Server installation and user's guide*. For more information on these guides, see the following Web site:

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

Intermixing EXP500 and EXP700 storage expansion enclosures

Figure 2 illustrates cabling of DS4000 TotalStorage EXP500 and EXP700 storage expansion enclosures in a mixed configuration.

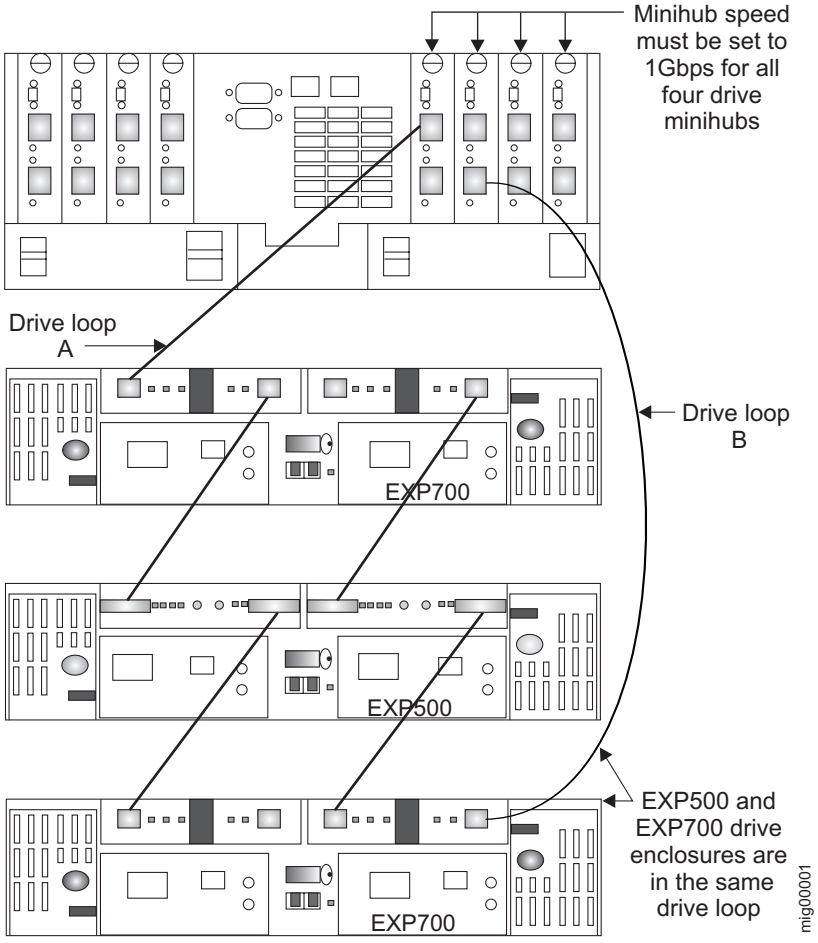

Figure 2. DS4000 EXP500 and EXP700 cabling in a mixed configuration

There are maximum limits to the number of fibre channel hard drives that you can configure in redundant drive loop pairs. Table 10 on page 6 lists the numbers of EXP500 and EXP700 storage expansion enclosures that you can combine for use in a single redundant drive loop pair. Table 10 on page 6 assumes that a DS4000

Storage Server is generally capable of addressing the maximum of 112 fibre channel hard drives for each redundant drive loop pair.

Important: IBM supports only those EXP500 and EXP700 Storage Expansion Unit combinations listed in Table 10.

Table 10. Supported EXP500 and EXP700 combinations per maximum redundant drive loop pair drives

Total number of EXP500 enclosures per redundant drive loop pair	Total number of EXP700 enclosures per redundant drive loop pair	Maximum number of storage expansion units per redundant drive loop pair	Maximum number of drives per redundant drive loop pair
11	0	11	110
10	0	10	100
9	1	10	104
8	2	10	108
7	3	10	112
6	3	9	102
5	4	9	106
4	5	9	110
3	6	9	114
2	6	8	104
1	7	8	108
0	8	8	112

Note: The combination of three EXP500 and six EXP700 storage expansion enclosures has the maximum number of 114 drives per redundant drive loop pair. You can have this maximum number of hard drives per drive loop pair only in this mixed EXP500 and EXP700 configuration.

Intermixing EXP700 and EXP710 storage expansion enclosures

It is possible to intermix EXP700 and EXP710 storage expansion enclosures in the same drive loop. To do so, however, you must group all of the EXP710 storage expansion enclosures together. Figure 3 on page 8 though Figure 4 on page 9 illustrate two acceptable EXP700 and EXP710 intermixing cabling configurations in which all EXP710 storage expansion enclosures are grouped together. Figure 5 on page 10 shows an acceptable configuration that is not recommended because it may later present cabling problems when you may choose to add new EXP710 drive enclosures to a redundant drive loop that is already configured. Figure 6 on page 11 and Figure 7 on page 12 show two unacceptable intermixed configurations in which all EXP710 storage expansion enclosures are not grouped together.

These intermixing requirements must also be met if you are upgrading some (but not all) of the EXP700 storage expansion enclosures in a drive loop with the EXP700 Models 1RU/1RX Switched-ESM Option Upgrade Kit (P/N 25R0166).

Important:

Failure to follow these intermixing requirements for drive loops that include both EXP700 and EXP710 storage expansion enclosures may result in drive loop performance degradation that could cause loss of data access and possibly loss of data.

Figure 3 on page 8 though Figure 5 on page 10 show three acceptable EXP700 and EXP710 intermixing cabling configurations in which all EXP710 storage expansion enclosures are grouped together. Note that in Figure 5 on page 10, the EXP710 storage expansion enclosures are grouped together, even though the EXP700 storage expansion enclosures are not grouped together.

Although illustrations Figure 3 on page 8 through Figure 7 on page 12 incorporate the DS4000 DS4300 Storage Server for the sake of example, other DS4000 storage servers may be acceptable replacements.

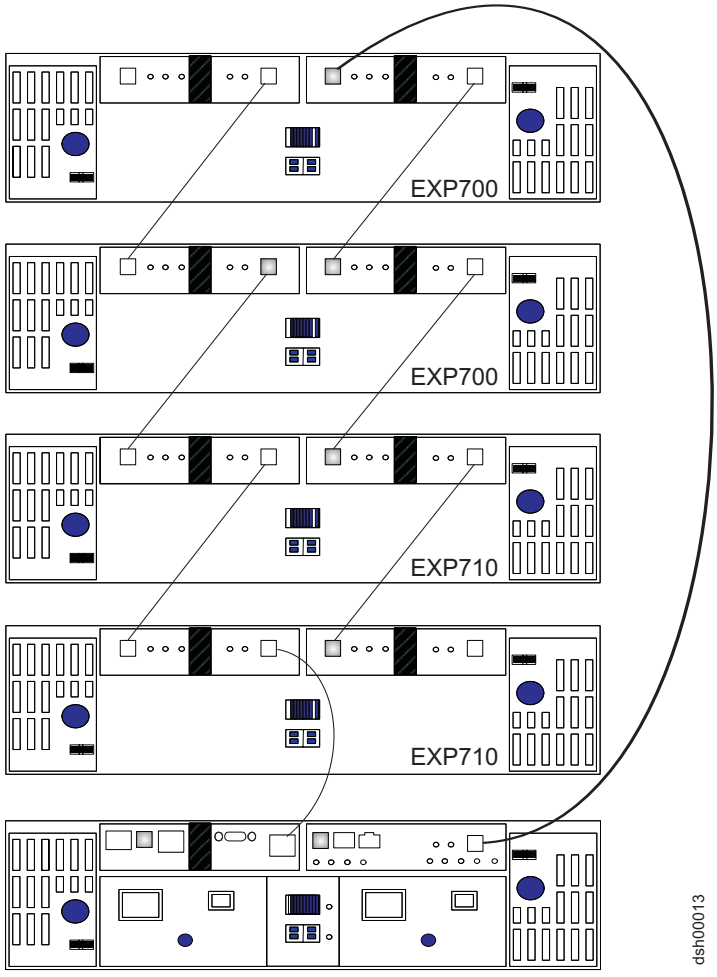

Figure 3. Acceptable intermixed EXP700 and EXP710 loop configuration (1 of 3)

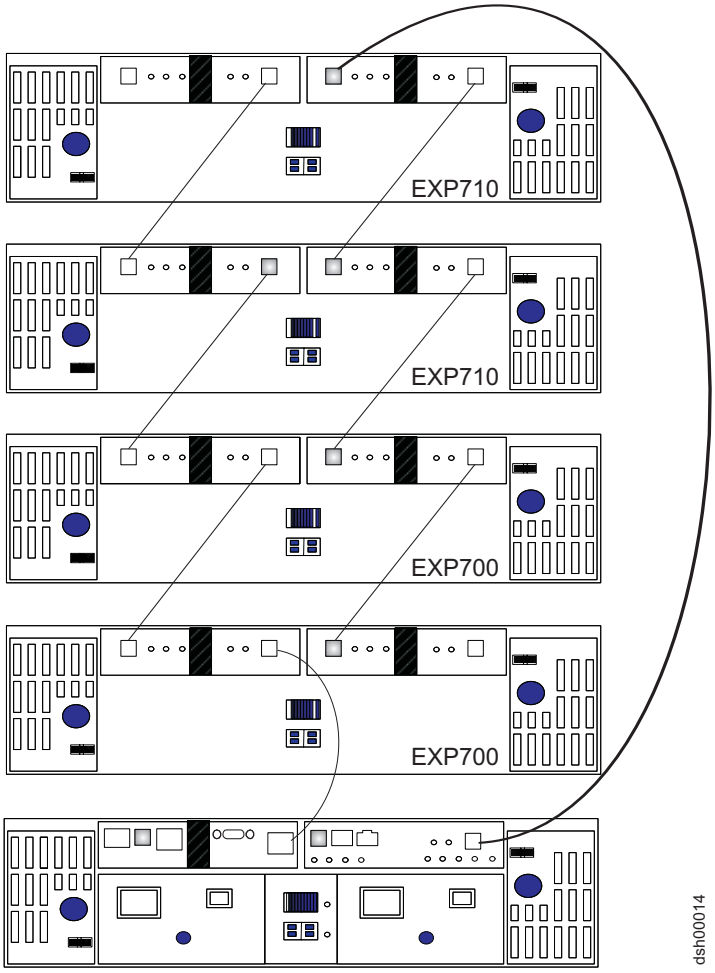

Figure 4. Acceptable intermixed EXP700 and EXP710 loop configuration (2 of 3)

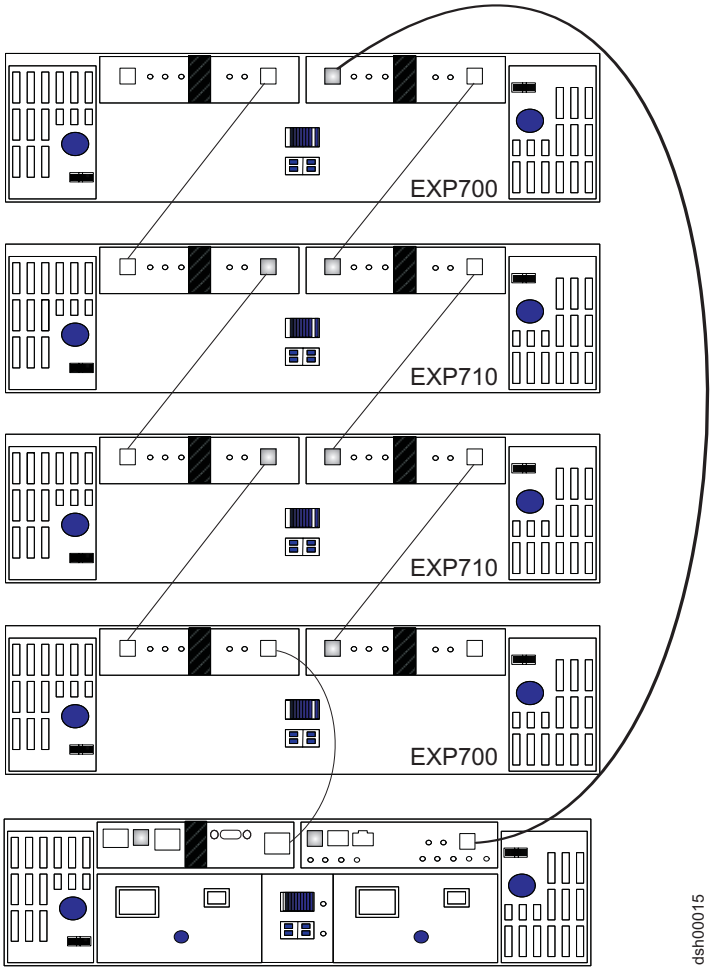

Figure 5. Acceptable (not recommended) intermixed EXP700 and EXP710 loop configuration (3 of 3)

In Figure 6 on page 11 and Figure 7 on page 12, the intermixed configurations shown are unacceptable because the EXP710 storage expansion enclosures in the redundant drive loop are not grouped together.

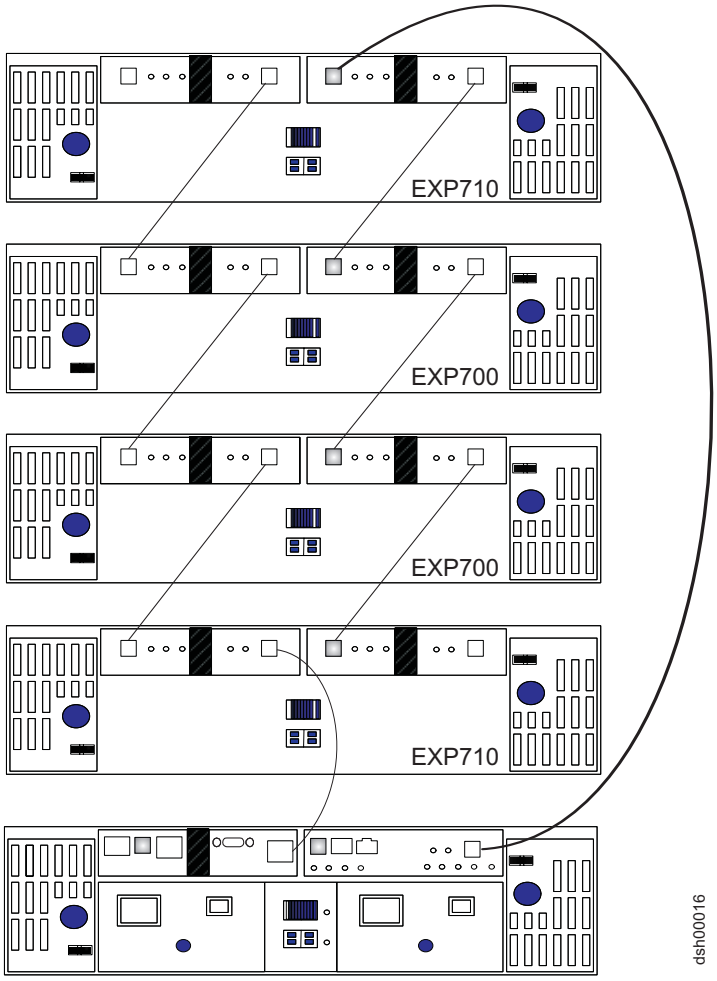

Figure 6. Unacceptable intermixed EXP700 and EXP710 loop configuration (1 of 2)

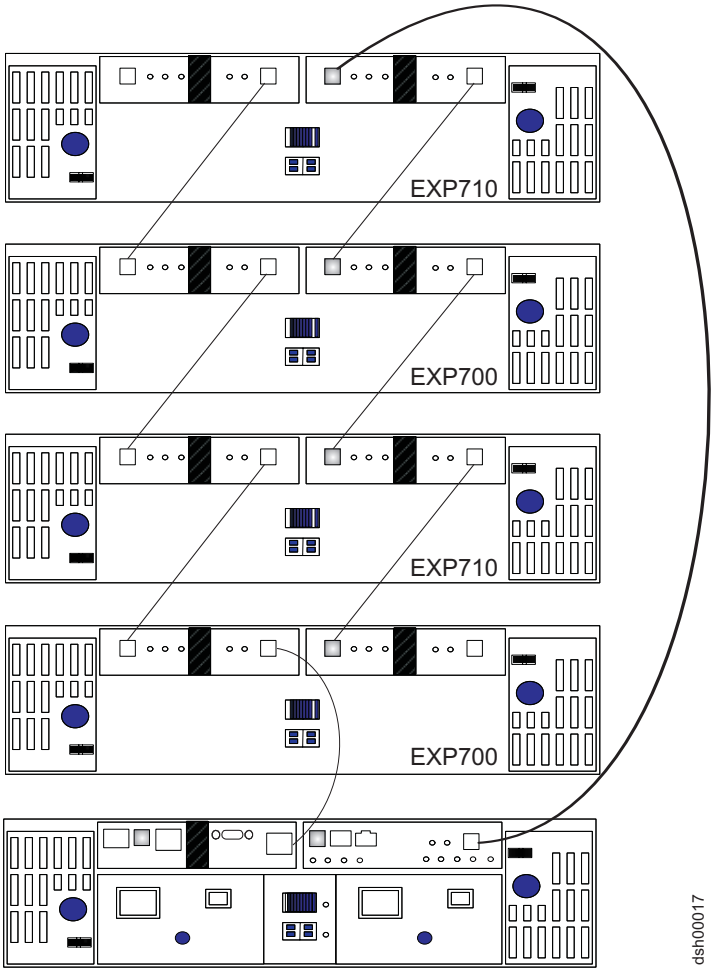

Figure 7. Unacceptable intermixed EXP700 and EXP710 loop configuration (2 of 2)

Storage subsystem loop schemes

Although a variety of cable loop schemes may function acceptably, IBM recommends consistent use of only one such scheme when connecting DS4000 storage servers and expansion enclosures. Figure 8 on page 13 illustrates the only cable loop scheme that IBM recommends when connecting DS4000 storage servers and expansion enclosures.

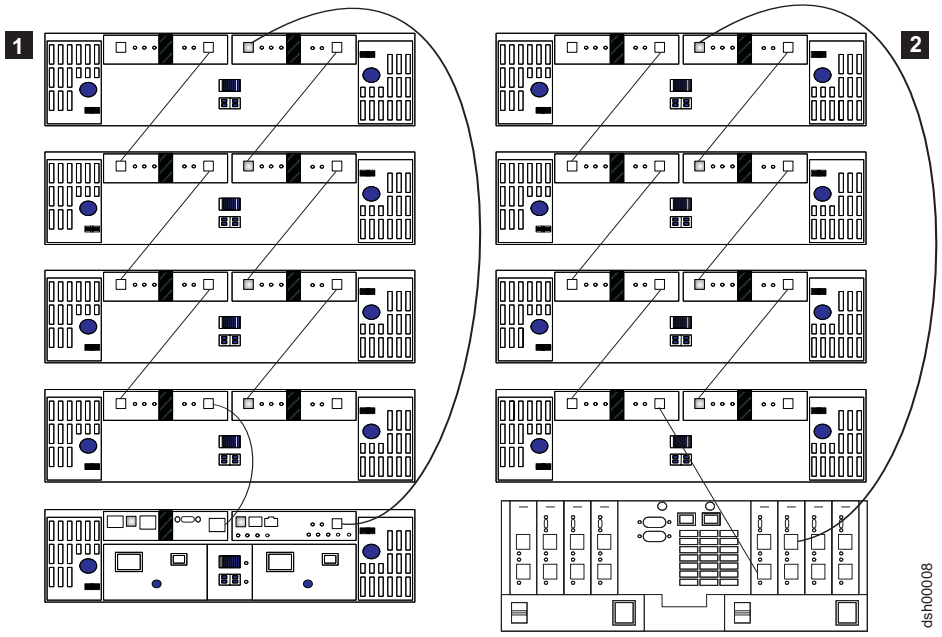

Figure 8. Cable loop scheme advised when connecting DS4000 storage subsystems

Legend:

1 Integrated drive/controller DS4000 storage subsystem (for example, DS4300 or DS4100)

2 Controller only DS4000 storage subsystem (for example, DS4400 or DS4500)

IBM recommends against inconsistent use of any cable loop scheme. IBM also recommends against the use of cable loop schemes illustrated in Figure 9 on page 14 through Figure 12 on page 17 when connecting DS4000 storage servers and expansion enclosures because they are not standardized for IBM DS4000 Support.

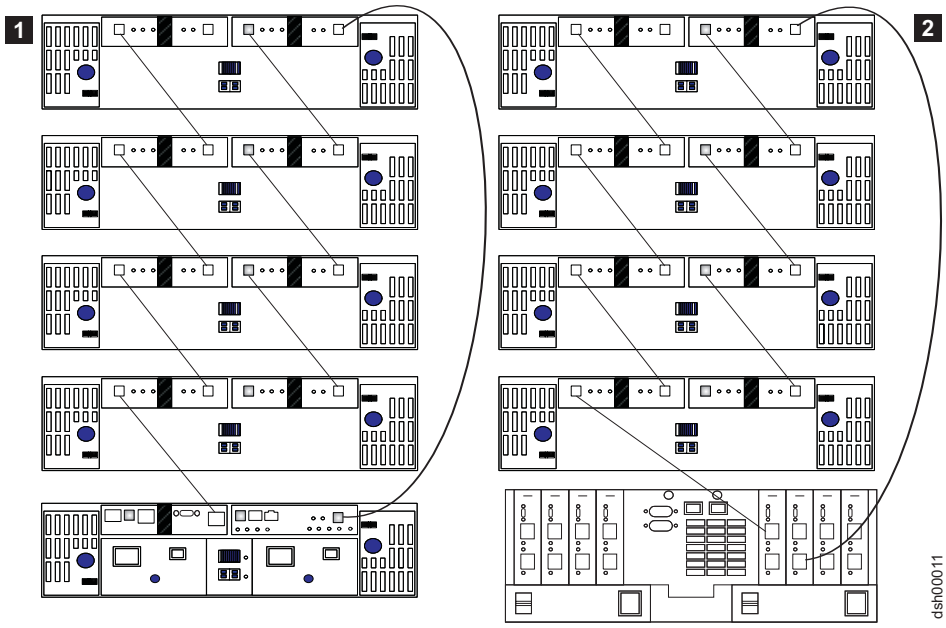

Figure 9. Alternate cable loop schemes possible but not recommended when connecting DS4000 storage subsystems (1 of 4)

Legend:

1 Integrated drive/controller DS4000 storage subsystem (for example, DS4300 or DS4100)

2 Controller only DS4000 storage subsystem (for example, DS4400 or DS4500)

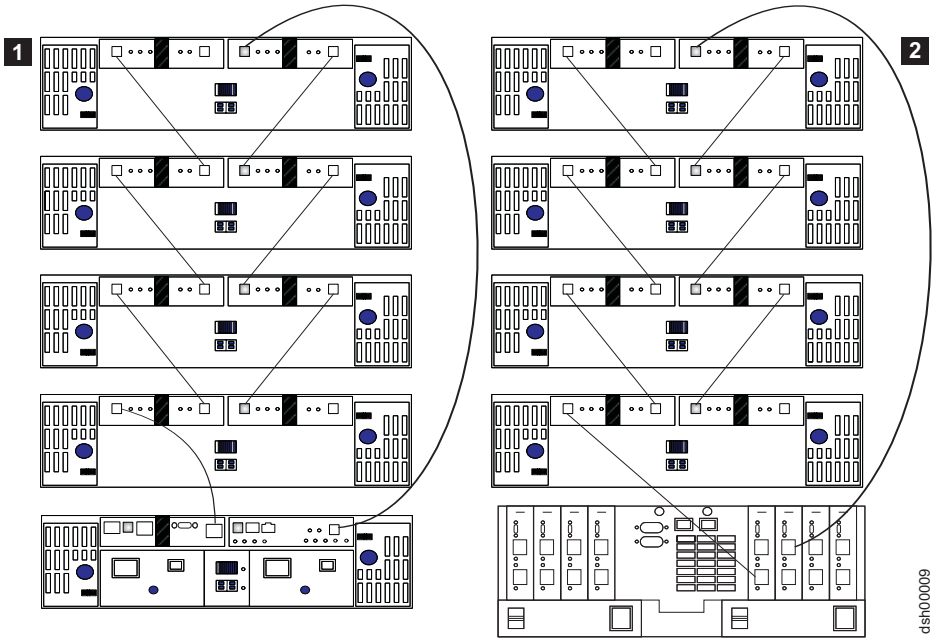

Figure 10. Alternate cable loop schemes possible but not recommended when connecting DS4000 storage subsystems (2 of 4)

Legend:

1 Integrated drive/controller DS4000 storage subsystem (for example, DS4300 or DS4100)

2 Controller only DS4000 storage subsystem (for example, DS4400 or DS4500)

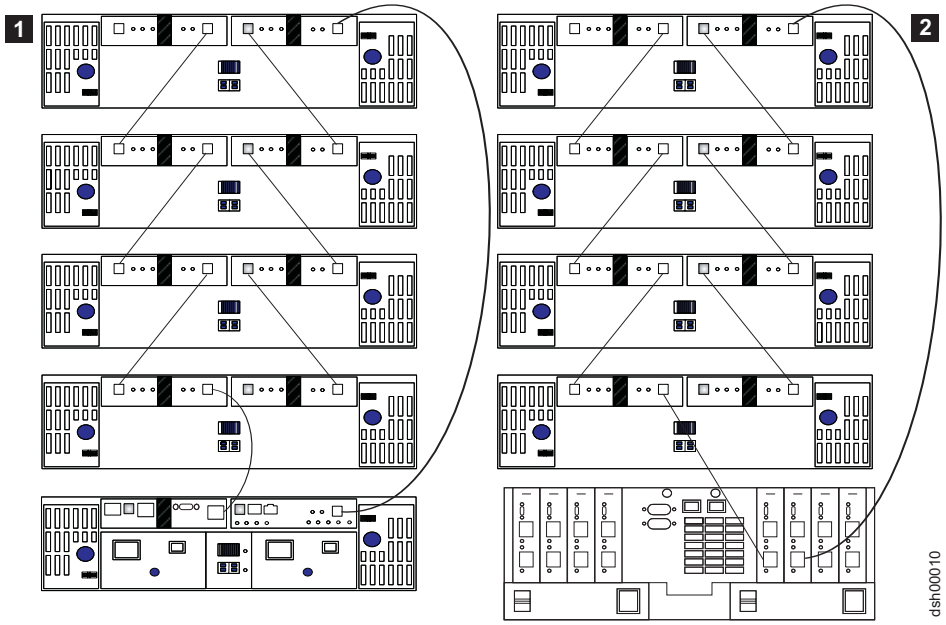

Figure 11. Alternate cable loop schemes possible but not recommended when connecting DS4000 storage subsystems (3 of 4)

Legend:

1 Integrated drive/controller DS4000 storage subsystem (for example, DS4300 or DS4100)

2 Controller only DS4000 storage subsystem (for example, DS4400 or DS4500)

Figure 12. Alternate cable loop schemes possible but not recommended when connecting DS4000 storage subsystems (4 of 4)

Legend:

1 Integrated drive/controller DS4000 storage subsystem (for example, DS4300 or DS4100)

2 Controller only DS4000 storage subsystem (for example, DS4400 or DS4500)

Enclosure IDs

Each drive enclosure in a DS4000 storage subsystem drive loop must have a unique drive enclosure ID. DS4000 controllers use a combination of the enclosure ID and the number of the physical slot that a hard drive occupies to create a unique loop address or arbitrated loop physical address (AL_PA) for each drive in a drive loop. The enclosure ID consists of two digits, a tens (x10) digit and a ones (x1) digit. The possible values for the tens and the ones digits are 0-9 for FAStT500 drive enclosures, and 0-7 for DS4400 drive enclosures.

Give each drive expansion enclosure in a redundant drive loop a unique ones digit ID. This setting will enforce hard AL_PAs (unchangeable between Loop Initializations [LIPs]) for the drives and facilitate drive loop problem troubleshooting in the event of an error. If the ones digits are not unique, two or more devices will have the same hard AL_PA. In such a case, the controller will use soft AL_PAs for the devices that have identical hard AL_PAs.

The problem with soft addressing is that addresses may change between LIPs. This possibility increases the difficulty of troubleshooting drive loop problems because it is difficult to ascertain whether the same device with a different address or a different device may be causing a problem. Since the DS4000 storage server supports more enclosures than available values of the enclosure ID ones digit, Table 11 on page 18 through Table 15 on page 20 suggest enclosure ID settings for various drive expansion enclosure families to minimize soft addressing in a drive loop.

Table 11. EXP500 Storage Expansion Enclosure ID settings

Storage expansion enclosure	Enclosure ID setting for enclosure in the first redundant drive loop	Enclosure ID setting for enclosure in the second redundant drive loop if applicable/supported
1st unit (storage expansion enclosure or storage server with internal drive slots)	00	x0 (where x is 2-7)
2nd unit (EXP500)	01	x1 (where x is 2-7)
3rd unit (EXP500)	02	x2 (where x is 2-7)
4th unit (EXP500)	03	x3 (where x is 2-7)
5th unit (EXP500)	04	x4 (where x is 2-7)
6th unit (EXP500)	05	x5 (where x is 2-7)
7th unit (EXP500)	06	x6 (where x is 2-7)
8th unit (EXP500)	07	x7 (where x is 2-7)
9th unit (EXP500)	08	x8 (where x is 2-7)
10th unit (EXP500)	09	x9 (where x is 2-7)
11th unit (EXP500)	10	x0 (where x is 3-7)

Note: Drives in the 11th enclosures of each drive loop in Table 11 will have soft AL_PAs.

Table 12 suggests enclosure ID settings that minimize soft addressing for EXP100 storage expansion enclosures in a drive loop.

Table 12. EXP100 Storage Expansion Enclosure ID settings

Storage expansion enclosure (unmixed)	Enclosure ID setting for enclosure in the first redundant drive loop	Enclosure ID setting for enclosure in the second redundant drive loop if applicable/supported
1st unit (EXP100 Expansion Enclosure or DS4000 Storage Server with internal drive slots)	00	x0 (where x is 2-7)
2nd unit (EXP100)	01	x1 (where x is 2-7)
3rd unit (EXP100)	02	x2 (where x is 2-7)
4th unit (EXP100)	03	x3 (where x is 2-7)

Table 12. EXP100 Storage Expansion Enclosure ID settings (continued)

Storage expansion enclosure (unmixed)	Enclosure ID setting for enclosure in the first redundant drive loop	Enclosure ID setting for enclosure in the second redundant drive loop if applicable/supported
5th unit (EXP100)	04	x4 (where x is 2-7)
6th unit (EXP100)	05	x5 (where x is 2-7)
7th unit (EXP100)	06	x6 (where x is 2-7)
8th unit (EXP100)	07	x7 (where x is 2-7)
9th unit (EXP100, where the first unit is a DS4300 only)	11	

Note: All drives in drive loops described in Table 12 on page 18 will be assigned hard AL_PAs.

Table 13 suggests enclosure ID settings that minimize soft addressing for EXP700 or EXP710 storage expansion enclosures in a drive loop.

Table 13. EXP700 or EXP710 Storage Expansion Enclosure ID settings

Storage expansion enclosure (unmixed)	Enclosure ID setting for enclosure in the first redundant drive loop	Enclosure ID setting for enclosure in the second redundant drive loop if applicable/supported
1st unit (storage expansion enclosure or DS4000 Storage Server with internal drive slots)	00	x0 (where x is 2-7)
2nd unit (EXP700)	01	x1 (where x is 2-7)
3rd unit (EXP700)	02	x2 (where x is 2-7)
4th unit (EXP700)	03	x3 (where x is 2-7)
5th unit (EXP700)	04	x4 (where x is 2-7)
6th unit (EXP700)	05	x5 (where x is 2-7)
7th unit (EXP700)	06	x6 (where x is 2-7)
8th unit (EXP700)	07	x7 (where x is 2-7)

Note: All drives in drive loops described in Table 13 will be assigned hard AL_PAs.

Table 14 on page 20 suggests enclosure ID settings that minimize soft addressing for the EXP500 and EXP700 Storage Expansion Enclosure when intermixed in a

redundant drive loop.

Table 14. Intermixed EXP500 and EXP700 Storage Expansion Enclosure ID settings

Storage expansion enclosure models (intermixed)	Enclosure ID setting for enclosure in the first redundant drive loop	Enclosure ID setting for enclosure in the second redundant drive loop
1st unit (storage expansion enclosure or DS4000 Storage Server with internal drive slots)	00	x0 (where x is 2-7)
2nd unit (EXP500 or EXP700)	01	x1 (where x is 2-7)
3rd unit (EXP500 or EXP700)	02	x2 (where x is 2-7)
4th unit (EXP500 or EXP700)	03	x3 (where x is 2-7)
5th unit (EXP500 or EXP700)	04	x4 (where x is 2-7)
6th unit (EXP500 or EXP700)	05	x5 (where x is 2-7)
7th unit (EXP500 or EXP700)	06	x6 (where x is 2-7)
8th unit (EXP500 or EXP700)	07	x7 (where x is 2-7)
9th unit (EXP500 or EXP700)	10	x0 (where x is 2-7)
10th unit (EXP500 or EXP700)	11	x1 (where x is 2-7)

Note: The drives in the 9th and 10th enclosures in each drive loop described in Table 14 will have soft AL_PAs.

Table 15 suggests enclosure ID settings that minimize soft addressing for the EXP700 and EXP710 Storage Expansion Enclosure when intermixed in a redundant drive loop.

Table 15. Intermixed EXP700 and EXP710 Storage Expansion Enclosure ID settings

Storage expansion enclosure models (intermixed)	Enclosure ID setting for enclosure in the first redundant drive loop	Enclosure ID setting for enclosure in the second redundant drive loop
1st unit (storage expansion enclosure or DS4000 Storage Server with internal slots)	00	x0 (where x is 2-7)
2nd unit (EXP700 or EXP710)	01	x1 (where x is 2-7)
3rd unit (EXP700 or EXP710)	02	x2 (where x is 2-7)
4th unit (EXP700 or EXP710)	03	x3 (where x is 2-7)
5th unit (EXP700 or EXP710)	04	x4 (where x is 2-7)

Table 15. Intermixed EXP700 and EXP710 Storage Expansion Enclosure ID settings (continued)

Storage expansion enclosure models (intermixed)	Enclosure ID setting for enclosure in the first redundant drive loop	Enclosure ID setting for enclosure in the second redundant drive loop
6th unit (EXP700 or EXP710)	05	x5 (where x is 2-7)
7th unit (EXP700 or EXP710)	06	x6 (where x is 2-7)
8th unit (EXP700 or EXP710)	07	x7 (where x is 2-7)

Note: The drives in the 9th and 10th enclosures in each drive loop described in Table 15 on page 20 will have soft AL_PAs.

DS4000 Storage Manager installation and support guides

This publication frequently cites *IBM TotalStorage DS4000 Storage Manager installation and support guides* supporting various versions and operating system environments. There are currently two, namely:

- *IBM TotalStorage DS4000 Storage Manager Installation and Support Guide for AIX, HP-UX, Solaris and Linux on Power*
- *IBM TotalStorage DS4000 Storage Manager Installation and Support Guide for Intel-based Operating System Environments*

Visit the following Web site to access documentation related to your particular operating system and DS4000 Storage Manager version.

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

See “DS4000 Storage Server publications” on page xvi for more information.

Chapter 2. Prerequisites to adding capacity and hard drive migration

Perform the preliminary steps detailed in this chapter before you add storage capacity or migrate hard drives. After you meet these prerequisite requirements, proceed to any of the following sections to address your particular storage hardware addition or migration requirements:

- Chapter 3, “Adding one or more new hard drives,” on page 31
- Chapter 4, “Adding expansion units containing new hard drives,” on page 37
- Chapter 5, “Migrating one or more hard drives,” on page 47
- Chapter 6, “Migrating expansion units containing hard drives,” on page 55
- Chapter 7, “Upgrading a storage server in a functioning configuration,” on page 63

Failure to perform the steps listed in this section might result in loss of data availability, and in some cases, loss of data. Perform the following steps on the DS4000 Storage Server to which you will migrate or add new hard drives:

__ Step 1. Complete a full backup of all data residing on the DS4000 Storage Server.

__ Step 2. Verify that the backup was successful.

__ Step 3. Verify that the DS4000 Storage Server has the latest controller firmware, non-volatile storage random access memory (NVSRAM), and ESM firmware.

Note: If your DS4000 Storage Server has controller firmware version 04.01.02.29 or lower, download and install controller firmware version 4.01.02.33 or higher before you download and install controller firmware version 5.30.xx.xx or higher.

__ Step 4. Verify that the drive firmware is at the latest level. If it is not, see “Upgrading drive firmware levels” on page 26.

__ Step 5. Verify that the DS4000 Storage Server to which you will migrate the hard drives is in `optimal` state. If it is not, perform the appropriate steps listed in the Recovery Guru to bring the storage server into `optimal` state.

__ Step 6. Use the `Read_Link_Status` function of the Storage Manager client program and the DS4000 Storage Server management event log (MEL) to verify that the drive loops are in `optimal` state. If the DS4000 storage subsystem controller firmware is version 06.10.xx.xx or higher, use the drive channel diagnostics to determine if the drive loop is optimal.

__ Step 7. Investigate and resolve any errors that reported in the DS4000 Storage Server MEL.

__ Step 8. Save and store the storage subsystem profile of the DS4000 Storage Server.

Important: Do not store DS4000 Storage Server profiles in the same location as the logical drives defined on your DS4000 Storage Server. Should you do so, and a RAID array failure occurs during subsequent migration, the data will be lost.

If you are migrating drives from another DS4000 Storage Server, you must also perform the preceding steps 1 on page 23 through 8 on page 23 on the DS4000 Storage Server from which you intend to migrate hard drives. You must also perform the following steps to flush server-cached I/O to disks.

__ Step 1. Stop all programs, services or processes in the host servers that access the logical drives defined in the migrated hard drives.

__ Step 2. Verify that there are no programs, services, or processes running in the background that might write data to the logical drives. (For example, Microsoft® MSCS service periodically writes to the “Quorum” disk.)

__ Step 3. Unmount the file systems to flush I/O from the server cache to disk.

Notes:

a. In a Microsoft Windows® environment, it is also necessary for you to remove the drive letter or the mount points of the mapped LUNs instead of unmounting the file systems.

b. Consult documentation associated with your particular operating system for detailed information regarding the unmount procedure.

After you meet prerequisites described in this section, proceed to any of the following sections to address your particular drive migration requirements.

- Chapter 3, “Adding one or more new hard drives,” on page 31
- Chapter 4, “Adding expansion units containing new hard drives,” on page 37
- Chapter 5, “Migrating one or more hard drives,” on page 47
- Chapter 6, “Migrating expansion units containing hard drives,” on page 55
- Chapter 7, “Upgrading a storage server in a functioning configuration,” on page 63

Verifying ESM firmware and NVSRAM file levels

The controller firmware and NVSRAM of the DS4000 Storage Server to which you will migrate hard drives, and the ESM firmware in the DS4000 storage expansion enclosures must be at the levels indicated in Table 16 to ensure firmware compatibility between the migrating and original hardware. Additionally, DS4000 Storage Manager version 8.3 or higher client software, in conjunction with the controller firmware level 5.30.xx.xx or higher, allows you to upgrade the ESM firmware while the storage server receives I/O from the host server.

Tip: Even though you can upgrade the DS4000 Storage Server and ESM firmware while it processes I/O from the host server, schedule upgrades to occur during time periods of low I/O between the DS4000 storage servers and host servers.

Table 16 lists IBM DS4000 machine types and model numbers, as well as their current firmware (AppWare or BootWare) and NVSRAM versions.

Table 16. Compatible controller firmware and NVSRAM version by machine type and model number

Product name/model	Machine type	Model number	Firmware version (AppWare / BootWare)	NVSRAM version
IBM TotalStorage DS4100 Storage Server	1724	100	05.42.xx.xx	N1724F100R842V07

Table 16. Compatible controller firmware and NVSRAM version by machine type and model number (continued)

Product name/model	Machine type	Model number	Firmware version (AppWare / BootWare)	NVSRAM version
IBM TotalStorage FAStT200 Fibre Channel Storage Server	3542	1RU 1RX	05.30.16.00	N3542-1RUR830V09
IBM TotalStorage FAStT200 HA Fibre Channel Storage Server		2RU 2RX	05.30.16.00	N3542-2RUR830V12
IBM TotalStorage FAStT500 Fibre Channel Storage Server	3552	1RU 1RX	05.30.16.00	N3552F500R830V05
IBM TotalStorage DS4300 Fibre Channel Storage Server	1722	60X 60U	05.34.02.00	N1722F600R834V01
IBM TotalStorage DS4300 Turbo Fibre Channel Storage Server			06.10.06.00 06100100	N1722F600R910V03
IBM TotalStorage DS4300 Single Controller Fibre Channel Storage Server		6LU 6LX	05.34.02.00	N1722F60LR834V0
IBM TotalStorage DS4400 Fibre Channel Storage Server	1742	1RU 1RX	06.10.06.00 06100100	N1742F700R910V02
IBM TotalStorage DS4500 Fibre Channel Storage Server	1742	90X 90U	06.10.06.00 06100100	N1742F900R910V02

Note: Visit the following Web site either to verify software version levels or to identify possible interim updates to firmware and NVSRAM file versions described in Table 16 on page 24.

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

Update the DS4000 controller firmware and NVSRAM to the levels indicated in Table 16 on page 24 (or higher) before you upgrade the ESM firmware on the storage expansion enclosures to versions indicated in Table 17 on page 26.

Table 17 on page 26 lists IBM DS4000 storage expansion enclosure models by name, machine type, model number, and current ESM firmware version.

Table 17. Compatible expansion unit ESM firmware version by machine type and model number

DS4000 Storage Expansion Unit product name/model	Machine type	Model number	ESM firmware version
IBM TotalStorage DS4000 EXP100	1710	10U	9554
IBM TotalStorage DS4000 EXP500	3560	1RU 1RX	9166
IBM TotalStorage DS4000 EXP700	1740	1RU 1RX	9326
IBM TotalStorage DS4000 EXP710	1740	710	9627

Perform the following steps to upgrade ESM firmware for a down-level controller:

__ Step 1. Upgrade the DS4000 Storage Manager software to the latest version. That is DS4000 Storage Manager version 9.1x. For additional information, see the *IBM TotalStorage DS4000 Storage Manager installation and support guide* for the appropriate server operating system environment at:

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

Note: To ensure the highest level of software compatibility, update the host server's multi-path software (Redundant Disk Array Controller [RDAC], IBMSAN.CDM, or Linux failover adapter driver) to the level that is either supported by or released with the controller firmware that you intend to download. See the following Web site for current details on software compatibility:

www-1.ibm.com/support/docview.wss?uid=psg1MIGR-50176

__ Step 2. Upgrade the controller firmware and NVSRAM. See Table 16 on page 24 and the web site listed earlier in conjunction with step1.

Note: See the readme file in the DS4000 Storage Manager controller firmware package associated with the appropriate host operating system environment for a support statement about the concurrent controller firmware download (that is, downloading code to the DS4000 Storage Server while it is processing I/O from the host server).

__ Step 3. Upgrade the storage expansion enclosure ESM firmware. With DS4000 Storage Manager version 8.3 or higher and controller firmware version 05.3x.xx.xx or higher, you can update the ESM firmware while the DS4000 Storage Server is processing I/O from the host server.

Important: Even though the DS4000 Storage Server supports controller and ESM firmware upgrade while the DS4000 Storage Server processes I/O from the host server, schedule controller and ESM firmware upgrades to occur during time periods of low I/O between the DS4000 storage servers and host servers.

Upgrading drive firmware levels

Before you begin migration, upgrade the drive firmware to the latest level. Do not move or migrate fibre channel drives from a 1 Gbps fibre channel environment to a 2 Gbps fibre channel environment unless you have installed the latest firmware documented to enable their operation in a 2 Gbps fibre channel environment.

Downloading drive firmware

This section provides instructions for downloading DS4000 drive firmware. See the online help for additional information.

Important:

1. IBM supports firmware download with I/O, sometimes referred to as ″concurrent firmware download″. This feature is not supported for drive firmware.
2. Before starting the drive firmware download process:
   - Stop all I/O activity before downloading drive firmware to a DS4000 Storage Server.
   - Unmount the file systems on all logical drives accessing the drives that you select for firmware upgrade.
   - Complete a full backup of all data residing on the drives that you select for firmware upgrade.

Downloading Storage Manager version 9.10 drive firmware

To download drive firmware for DS4000 Storage Manager version 9.10, perform the following steps:

1. From the Enterprise Management window, select a storage subsystem.
2. On the Enterprise Management window's menu bar, click **Tools → Manage Device**. The Subsystem Management window opens.
3. On the Subsystem Management window's menu bar, click **Advanced → Maintenance → Download → Drive Firmware/Mode pages ...**. The Download Drive Firmware wizard window opens to the Introduction page. Read the instructions displayed and click **Next**.

   Note: Storage Manager version 9.10 offers you the option to download and update up to four different firmware file types simultaneously. Previous Storage Manager versions did not offer this capability.
4. Click **Browse** to locate the server directory that contains the firmware that you plan to download.
5. Select the firmware file that you plan to download and click **OK**. The file appears listed in the ″Selected Packages″ window pane.
6. Select the firmware file for any additional drive types that you intend to download and click **OK**. Additional files appear listed in the ″Selected Packages″ window pane. A maximum total of four drive types are possible.
7. Click **Browse** to repeat step 6 until you have selected each firmware file that you plan to download.
8. When you have finished specifying the firmware packages for download, select **Next**.
9. The Select Drive window opens, containing two tabs, a **Compatible Drives** tab and an **Incompatible Drives** tab. The **Compatible Drives** tab contains a list of the drives compatible to the firmware package types that you selected. From that list, select the drives to which you plan to download the drive firmware that you selected in steps 6 and 7.

   Note: The firmware that you propose to download should be listed on the **Compatible Drives** tab. If your particular drives' product ID matches the firmware type, however, and it is not listed as compatible on the tab, contact your IBM technical support representative for additional instructions.
10. Select the **Compatible Drives** tab.

Press and hold the **Ctrl** key while using your mouse to select multiple drives individually, or press and hold the **shift** key while using your mouse to select multiple drives listed in series. The compatible firmware that you selected in steps 5 on page 27 and 6 on page 27 will download to the drives that you select.

11. Click **Finish** to initiate download of the drive firmware to each compatible drive that you selected in step 9 on page 27.
12. The Download Drive Firmware warning opens and prompts: ″Do you want to continue?″ Type **yes** and click **OK** to start the drive firmware download.
13. The Download Progress window opens. Do not intervene until the download process completes.
14. Every drive scheduled for firmware download will be designated as `in progress` until `successful` or `failed`.

    Note: Complete the following two steps if you receive a failure.
    a. Click the **Save as** button to save the error log.
    b. On the Subsystem Management window's menu bar, click **Advanced →Trouble Shooting → Open Event Log** and complete the following tasks necessary to save the storage subsystem event log before contacting your IBM Service Representative and proceeding to step 16.
       1) Click the **Select all** button.
       2) Click **Save the Storage Subsystem Event Log**.
15. When the **Close** button appears active, the drive firmware download process is complete.
16. Click **Close** to exit the Download Progress window.
17. Use either of the following procedures to determine or verify what level of drive firmware resides on a particular drive:
    - Right-click on that drive in the Logical/Physical View in the Subsystem Management window and click **Properties**. The associated drive firmware version will be listed in the drive properties table.
    - Right-click on **Storage Subsystem → View Profile** in the Logical/Physical View of the Subsystem Management window.

Downloading Storage Manager version 8.x drive firmware

To download drive firmware for DS4000 Storage Manager version 8.x, perform the following steps:

1. From the Enterprise Management window, select a storage subsystem.
2. Click **Tools → Manage Device**. The Subsystem Management window opens.
3. Click **Advanced → Download → Drive Firmware**. The Download Drive Firmware window opens. It presents a list of all installed drives.
4. From the list of all installed drives, select the drive to which you plan to download drive firmware.

   Press and hold the **Ctrl** key while using your mouse to select multiple drives singly, or press and hold the **shift** key while selecting multiple drives in series by using your mouse pointer.
5. Click **Browse** to identify the directory that contains the drive firmware that you intend to download.
6. Select the file containing the drive firmware that you intend to download.
7. Select **Start**. The Confirm Download window appears.

8. Type **yes** when the Confirm Download window prompts: `Are you sure you want to continue?`
9. The download begins and the Status window indicates progress. Do not intervene until the download process completes.
10. When the **Cancel** button appears active, the download process is complete. Press **Cancel** to close the Status window.
11. To determine or verify the level of drive firmware residing on a particular drive, click **View → Subsystem Profile** in the Logical/Physical View of the Subsystem Management window.

Bringing storage subsystems and drive loops into optimal state

Note: For additional information on how to make this determination, see the *DS4000 Problem Determination Guide* associated with your particular DS4000 hardware model.

After you have updated or verified that a DS4000 Storage Server is using the latest firmware and NVSRAM:

__ Step 1. Bring the DS4000 Storage Server to its `optimal` state before reconfiguring it with new hardware.

__ Step 2. Use the DS4000 Storage Manager client program to display the status of the DS4000 Storage Server and to correct any problems that might cause the DS4000 Storage Server to enter its `Needs Attention` state.

__ Step 3. Verify that all indicator lights on the storage subsystem are in their `optimal` state.

__ Step 4. In addition, use the `Read_Link_Status` function of the DS4000 Storage Manager client program and the DS4000 Storage Server MEL to verify that all components in the drive loop are in their `optimal` states (that is, there are no drive loop component errors in the event log and no errors in the `Read_Link_Status` window.) If you are using controller firmware 06.10.xx.xx, use the drive channel diagnostics to determine if the drive loop is optimal. See the DS4000 Storage Manager Client program Subsystem Management window Online help for more information on the RLS and drive channel diagnostics if they are supported by the installed version of your controller firmware.

Drive channel diagnostics are only available if you are using controller firmware version 06.10.xx.xx.

__ Step 5. If the arrays are in `degraded` state due to a failed drive, correct the problem before migration.

If necessary, contact the IBM Help Center in your geography for assistance with event log interpretation.

It is necessary for certain tasks to complete before proceeding to add drives or enclosures. Before you add drives or enclosures, verify that the storage subsystem involved is not performing any of the following tasks.

- Dynamic logical drive capacity expansion (dynamic volume expansion [DVE] or dynamic capacity expansion [DCE])
- Logical drive segment size modification
- Array RAID-level modification
- User-initiated array redundancy checking (menu option **Array → Check Redundancy** in the Subsystem Management window)

- Remote mirror logical drive synchronization
- FlashCopy® or VolumeCopy logical drive creation
- Logical drive reconstruction or copyback. This action is sometimes referred to as logical drive sparing.

Saving the storage subsystem profile

Use the DS4000 Storage Manager client program to save a DS4000 Storage Server profile. Such a profile is necessary to restore a storage subsystem configuration in the event of a catastrophic failure. Migration from one DS4000 Storage Server configuration to another will require that you save both DS4000 Storage Server configuration profiles involved. For details on this procedure, see one of the following:

- DS4000 Storage Manager client program Client Subsystem Management window online help
- *IBM TotalStorage DS4000 Storage Manager installation and support guide* associated with your particular operating system environment located at:

  www-1.ibm.com/servers/storage/support/fastt/index.html
- *Saving a module profile report and state capture information to help prevent data loss* located at:

  www-3.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-4VVPEF

Important: Do not store DS4000 Storage Server profiles in the same location as the logical drives defined on your DS4000 Storage Server. Should you do so, and a RAID array failure occurs during subsequent migration, the data will be lost.

Chapter 3. Adding one or more new hard drives

While adding a hard drive to either a controller or a drive expansion enclosure, observe these important rules:

- Observe proper electrostatic discharge (ESD) procedures when handling electronic equipment.
- Never alter the physical configuration of a DS4000 Storage Server while it is powered off unless you are instructed to do so as part of a DS4000 configuration procedure. Specifically, never attach storage components to or remove storage components from a configured DS4000 Storage Server while it is powered off.
- Any hard drive, whether new or old, might contain configuration data. Unless you intend to migrate a drive from another DS4000 Storage System (retaining its configuration data), always use the following procedure to add one or more hard drives to a functioning DS4000 Storage Server configuration.
- The following DS4000 storage server devices support only 2 Gbps fibre channel hard drives:
  - DS4000 EXP700 storage expansion units
  - DS4000 EXP710 storage expansion units
  - DS4300 storage servers

  1 Gbps fibre channel drives will not spin up when you insert them into their drive slots.

  To identify a 1 Gbps fibre channel drive, locate the product's label and examine its ID or Model Number. Hard drives with ID or Model Number values that end with "04FC" or "03FC" are 1 Gbps fibre channel drives. For example, "ST173404FC", "ST318203FC" and "ST136403FC" are model numbers that appear on several 1 Gbps fibre channel hard drives.
- Do not mix SATA and fibre channel drives or enclosures together in the same drive loop.
- Do not install SATA drives in fibre channel device enclosures.
- Do not install fibre channel drives in SATA device enclosures.

The following procedure outlines the steps necessary to add one or more new hard drives to empty drive slots in either DS4100, FAStT200, or DS4300 controllers or in EXP100, EXP500, EXP700, or EXP710 storage expansion enclosures. If you plan to add a used drive, be sure that there is no configuration data on the drive that you need to preserve. Add drives to a DS4000 Storage Server only while it is powered on and in `optimal` state. See the *DS4000 Problem Determination Guide* associated with your particular DS4000 hardware model or "Bringing storage subsystems and drive loops into optimal state" on page 29 for additional information on how to make this determination.

Activity 1: Disabling the drive migration settings

Before you add drives to the subsystem, perform this activity to remove any configuration data that they may contain.

__ Step 1. Open the Storage Manager client program's Enterprise Management window.

__ Step 2. Right-click on the name of the DS4000 storage subsystem to which you intend to add drives and click **Execute Script**.

__ Step 3. A script editor window opens. Click **File → Load Script**.

__ Step 4. A Load Script file selection window opens. Locate and select the file named DisableDriveMigration.scr and click **OK**. The DisableDriveMigration.scr file is normally located in the SCRIPTS directory of the IBM DS4000 Storage Manager Installation Compact Disc (CD). Use this file to reset the DS4000 storage subsystem setting to ignore configuration data that might reside on newly discovered hard drives. Figure 14 on page 35 provides a listing of the DisableDriveMigration.scr file.

__ Step 5. Click **Tools → Verify and Execute** to run the script.

__ Step 6. When the script completes execution, reset both DS4000 controllers to enable the DS4000 drive migration setting.

If you used the DisableDriveMigration.scr script associated with this document and described in Figure 13 on page 34, it is not necessary for you to perform this step because the last two commands in that script file automatically reset the controllers.

To reset the controllers, open the Storage Subsystem Management window and sequentially (one at a time) reset each controller by clicking **Advanced → Reset Controller**. Then, follow the instructions in the Reset Controller window when it opens.

Activity 2: Inserting drives

__ Step 1. Insert drives as pairs (two at a time) into the empty drive slots.

__ Step 2. Wait until each drive pair has fully spun up and displayed in the DS4000 Storage Subsystem Management window before inserting the next drive pair.

Activity 3: Re-enabling the drive migration settings

Perform this activity to re-enable the drive migration settings if you performed “Activity 1: Disabling the drive migration settings” on page 31 to disable DS4000 storage subsystem drive migration settings. If you do not, whenever you might subsequently, even momentarily remove a drive from the storage subsystem for any reason, its configuration data will be cleared. When the storage subsystem next recognizes such a drive, it will display it as unconfigured.

Attention: In order to prevent data loss, set the DS4000 Storage Server drive migration to enable after you complete the hard drive addition process.

__ Step 1. Open the Storage Manager client program Enterprise Management window.

__ Step 2. Right-click on the name of the DS4000 storage subsystem to which you want to add drives and click **Execute Script**.

__ Step 3. A script editor window opens. Click **File → Load Script**.

__ Step 4. A Load Script file selection window opens. Locate, and select the file named EnableDriveMigration.scr and click **OK**. The file EnableDriveMigration.scr is normally located in the SCRIPTS directory of the IBM DS4000 Storage Manager Installation CD. Use this file to reset the DS4000 storage subsystem setting in order to check for configuration data that might reside on newly discovered hard drives. Figure 13 on page 34 provides a listing of the EnableDriveMigration.scr file.

__ Step 5. Click **Tools → Verify and Execute** to run the script.

__ Step 6. When the script completes execution, reset both DS4000 controllers to enable the DS4000 drive migration setting.

If you use the EnableDriveMigration.scr script associated with this document and described in Figure 13 on page 34, it is not necessary for you to perform this step because the last two commands in that script file automatically reset the controllers.

To reset the controllers, open the Storage Subsystem Management window and sequentially (one at a time) reset each controller by clicking **Advanced → Reset Controller**, and then following the instructions in the Reset Controller window when it opens.

Result: The newly added drives are ready for you to configure and map to host servers.

The next two figures list the EnableDriveMigration.scr and DisableDriveMigration.scr files.

```
// Name: Enable Drive Migration
//
// Date: 05-08-2004
// Revision: 1.3
// Comments:
// This script is intended to work with controllers at Firmware 05.30.xx.xx and
// higher only.
//
// This script returned the FAStT to it's default operation of importing
// configuration informration from disks.
//
// This script will reboot both controllers in the FAStT unit. If your
// hosts are configured for multi-path support, this can be done with I/O
// running to the controllers. If your hosts are not configured for
// redundant access you must schedule downtime before running this
// script.
//
// See the directions at the bottom of this script if you do not have multi
// path software installed and wish to prevent the controller restarts
//
// Show the current state of Drive Migration
show "Showing the current state of Drive Migration (80=Off, 82=On)";
show controller[a] nvsrambyte[0x35];
show controller[b] nvsrambyte[0x35];
//
// Setting Drive Migration to Enable
show "Setting Drive Migration to Enable";
set controller[a] nvsrambyte[0x35] = 0x02,0x00;
set controller[b] nvsrambyte[0x35] = 0x02,0x00;
show controller[a] nvsrambyte[0x35];
show controller[b] nvsrambyte[0x35];
//
// Reset Controllers to make changes active. Note:
// To prevent the controllers from restarting, add '//' to the beginning
// of each of the lines below. This will comment out the restart of the
// controllers. Important: The controllers will have to be restarted for the
// changes in this script to take effect.
//
show "Resetting controller A";
reset Controller [a];
show "Resetting controller B";
reset Controller [b];
show "Drive Migration is now enabled.";
```

Figure 13. EnableDriveMigration.scr file listing

```
// Name: Disable Drive Migration
//
// Date: 05-08-2004
// Revision: 1.3
// Comments:
// This script is intended to work with controllers at Firmware 05.30.xx.xx and
// higher only.
// This script allows the addition of disk drives while the system is running
// and by clearing the configuration of any drives as unused capacity
// regardless of past configuration of these drives.
//
// Attention: This setting should not be left active after the new disks have
// been added to the subsystem. Leaving this setting active could
// cause the configuration for the FAStT to be lost if the FAStT is
// power cycled incorrectly. Please run the EnableDriveMigration.scr
// after all the disks are added.
//
//
// This script will reboot both controllers in the FAStT unit. If your
// hosts are configured for multi-path support, this can be done with I/O
// running to the controllers. If your hosts are not configured for
// redundant access you much schedule downtime before running this
// script.
//
// Show the current state of Drive Migration
show "Showing the current state of Drive Migration (80=Off, 82=On)";
show controller[a] nvsrambyte[0x35];
show controller[b] nvsrambyte[0x35];
//
// Setting Drive Migration to Disable
show "Setting Drive Migration to Disable";
set controller[a] nvsrambyte[0x35] = 0x02,0x02;
set controller[b] nvsrambyte[0x35] = 0x02,0x02;
show controller[a] nvsrambyte[0x35];
show controller[b] nvsrambyte[0x35];
//
// Reset Controllers to make changes active
// To prevent the controllers from restarting, add '//' to the beginning
// of each of the lines below. This will comment out the restart of the
// controllers. Important: The controllers will have to be restarted for
// the changes in this script to take effect.
show "Resetting controller A";
reset Controller [a];
show "Resetting controller B";
reset Controller [b];
//
show "Drive Migration is now disabled. Add the new drives to the subsystem,";
show "then execute the EnableDriveMigrationScript.scr to re-enable drive ";
show "migration.";
```

Figure 14. DisableDriveMigration.scr file listing

Chapter 4. Adding expansion units containing new hard drives

While adding storage expansion enclosures containing new hard drives, observe these important rules:

- Observe proper ESD procedures when handling electronic equipment.
- Never alter the physical configuration of a DS4000 Storage Server while it is powered off unless you are instructed to do so as part of DS4000 configuration procedure. Specifically, never attach storage components to or remove storage components from a configured DS4000 Storage Server while it is powered off.
- Any hard drive, whether new or old, might contain configuration data. Unless you intend to migrate drives from another DS4000 Storage System (retaining their configuration data), always use the following procedure to add one or more storage expansion enclosures containing one or more hard drives to a functioning DS4000 Storage Server configuration.
- The following DS4000 storage server devices support only 2 Gbps fibre channel hard drives:
  - DS4000 EXP700 storage expansion units
  - DS4000 EXP710 storage expansion units
  - DS4300 storage servers

  1 Gbps fibre channel drives will not spin up when you insert them into their drive slots.

  To identify a 1 Gbps fibre channel drive, locate the product's label and examine its ID or Model Number. Hard drives with ID or Model Number values that end with "04FC" or "03FC" are 1 Gbps fibre channel drives. For example, "ST173404FC", "ST318203FC" and "ST136403FC" are model numbers that appear on several 1 Gbps fibre channel hard drives.
- Do not mix SATA and fibre channel drives or enclosures together in the same drive loop.
- Do not install SATA drives in fibre channel device enclosures.
- Do not install fibre channel drives in SATA device enclosures.

The following procedure describes the steps required to add one or more DS4000 storage expansion enclosures containing new drives to a functioning DS4000 Storage Server configuration.

Activity 1: Preliminary activities

Add a new DS4000 storage expansion enclosure as follows:

__ Step 1. Verify that the DS4000 Storage Server is both powered on and in `optimal` state. See the *DS4000 Problem Determination Guide* associated with your particular DS4000 hardware model or "Bringing storage subsystems and drive loops into optimal state" on page 29 for additional information on how to make this determination. You can perform this process while the DS4000 Storage Server is processing I/O from or to the host server. However, because the drive loops are interrupted momentarily during the addition process, schedule additions to occur during time periods of low I/O between the DS4000 storage servers and host servers. Review the readme and the *IBM TotalStorage DS4000 Storage Manager installation and support guide* associated with the operating system environment of the host servers that connect

to the DS4000 Storage Server for any additional restrictions or required preparation tasks specific to your particular operating system environment. You will find the *IBM TotalStorage DS4000 Storage Manager installation and support guides* at:

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

__ Step 2. Unpack and mount any additional storage expansion enclosures in the rack using the mounting hardware supplied with each storage expansion enclosure.

Important: Do not fully insert hard drives into the enclosures at this time. Keep them unlatched and no less than ½-inch away from their full insertion points in the drive slots.

__ Step 3. Set the enclosure ID of the additional storage expansion enclosures. Each drive enclosure in the DS4000 storage subsystem drive loop must have a unique drive enclosure ID. In a EXP500 storage expansion enclosure, there is an enclosure ID switch mounted on each of two ESM canisters. Set each ESM canister's enclosure ID switch in the EXP500 drive enclosure to the same unique number in the drive loop. In a EXP700 storage expansion enclosure, the only enclosure ID switch is mounted between the power supplies. See the appropriate *DS4000 storage expansion unit installation and user's guide* for additional information. Figure 15 illustrates the location of speed switches on the EXP100, EXP700, EXP710, and EXP500 storage enclosures.

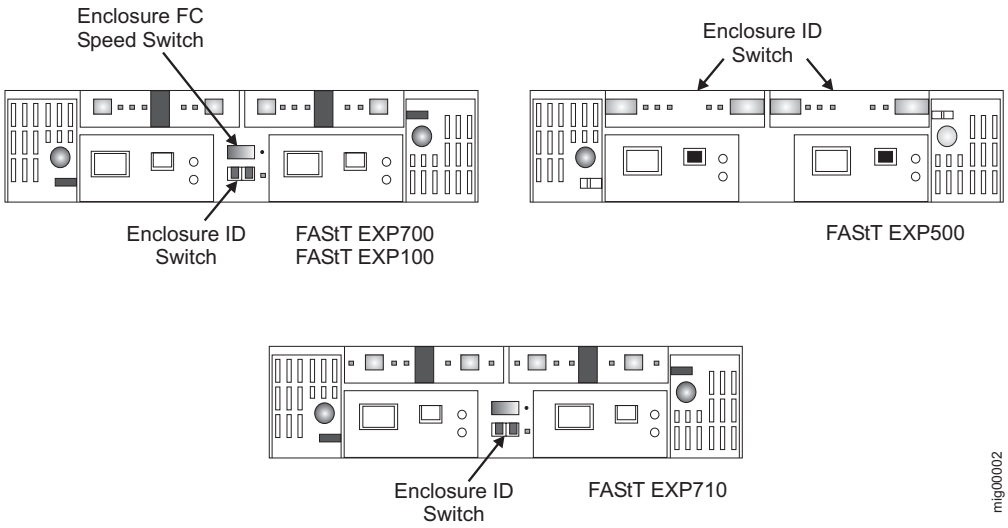

Figure 15. EXP100, EXP500, EXP700, and EXP710 enclosure ID and speed switches

If the DS4000 Storage Server to which the storage expansion enclosure will attach is either a FAStT200 or DS4300, the enclosure IDs of additional storage expansion enclosures must differ from the FAStT200 or DS4300 Storage Server enclosure IDs, which are normally set to "0" at the factory.

__ Step 4. Verify that the EXP700 Storage Expansion Unit speed switch is set to the correct drive loop speed.

Note: If a fibre channel enclosure speed switch was originally set to 1 Gbps, do not automatically set it to 2 Gbps unless you are sure that each fibre channel hard drive that it now contains is capable

of 2 Gbps operation and that you have installed the latest firmware enabling their operation in a 2 Gbps fibre channel environment.

__ Step 5. Insert the small form-factor pluggables (SFPs) or gigabit interface converters (GBICs) into only those ports you intend to use. Do not leave GBICs or SFPs inserted into port slots without connecting them to other ports using cables.

Activity 2: Cabling new storage expansion units

To complete addition of DS4000 storage expansion enclosures, cable the new storage expansion enclosures to the end of the functioning storage expansion enclosure drive loop to which you are migrating them. Add only one enclosure at a time to a functioning drive loop if you intend to attach multiple storage expansion enclosures.

The cabling instructions in the steps that follow are based on the cable routing scheme that is documented in *IBM TotalStorage DS4000 Storage Manager installation and support guides*. The cabling instructions illustrated in Figure 16 on page 41, Figure 17 on page 42, and Figure 18 on page 43 describe cabling a DS4000 EXP700 Storage Expansion Enclosure to the redundant drive loop of a functioning DS4300 Storage Server (model 60X or 60U).

The general cabling scheme for DS4000 external drive enclosures is described in the *IBM TotalStorage DS4000 Fibre Channel Cabling Guide* available at:

www-3.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-4KELS5

See also “Storage subsystem loop schemes” on page 12.

__ Step 1. Extend one of the drive loops (that is, drive loop A) in a DS4000 Storage Server redundant drive loop pair by connecting the `OUT` port of the last storage expansion enclosure to the `IN` port of the new storage expansion enclosure as shown in Figure 16 on page 41.

Warning: Carefully reconfigure only one drive loop at a time, making sure that the drive loop that you modify is properly connected and in `optimal` state before you attempt to reconfigure another drive loop. Take this precaution to prevent the arrays from being inadvertently failed by the DS4000 Storage Server controllers. This happens when two or more drives in the arrays cannot be reached through either drive loop in the redundant drive loop pair.

__ Step 2. Power on the newly added storage expansion enclosure unit.

__ Step 3. Wait a few seconds; verify that the port bypass LEDs of all of the ports in drive loop A, now extended to the new storage expansion enclosure, are not lit. Using the DS4000 Storage Manager Client Subsystem Management window, verify that the new storage expansion enclosure is added and displayed in the Logical/Physical view of the window.

Correct any errors before proceeding to step 4 on page 40. For port bypass:

__ a. Verify that the SFPs and GBICs or fibre cables are in good condition.

__ b. Remove and reinsert SFPs, GBICs and fibre cables.

__ c. Make sure the new drive expansion enclosure speed switch is set to the same speed as the existing drive expansion enclosures and the DS4000 Storage Server speed setting.

__ d. Verify that the ESM is good by physically removing and swapping it with the other ESM in the same drive expansion enclosure. For enclosure ID conflict, set the drive expansion enclosure ID switch to values unique from the current settings in the existing drive expansion enclosures and storage server.

Call the IBM Help Center in your geography for assistance if the problems persist.

__ Step 4. In the other drive loop (that is, drive loop B) in a DS4000 Storage Server redundant drive loop pair, remove the connection from the storage subsystem drive loop port to the `OUT` port of the last storage expansion enclosure and connect it to the `OUT` port of the new drive enclosure as shown in Figure 17 on page 42.

__ Step 5. Wait a few seconds; verify that the port bypass LEDs of the two ports in the connection between the storage subsystem drive loop port and the `OUT` port of the new drive enclosure are not lit. Using the DS4000 Storage Manager Client Subsystem Management window, verify that the new drive enclosure does not indicate the `drive enclosure lost redundancy path` error. See the preceding step 3 on page 39 for possible corrective actions, if needed.

__ Step 6. In drive loop B, cable the new drive enclosure's `IN` port to the `OUT` port of the last enclosure in the already functioning storage expansion enclosure drive loop as shown in Figure 18 on page 43.

__ Step 7. Wait a few seconds; verify that the port bypass LEDs of all of the ports in drive loop B to which you have added a new connection are not lit. Using the DS4000 Storage Manager Client Subsystem Management window, verify that all of the drive enclosures in the DS4000 redundant drive loop pair to which the new enclosure was added does not report the `drive enclosure lost redundancy path` error.

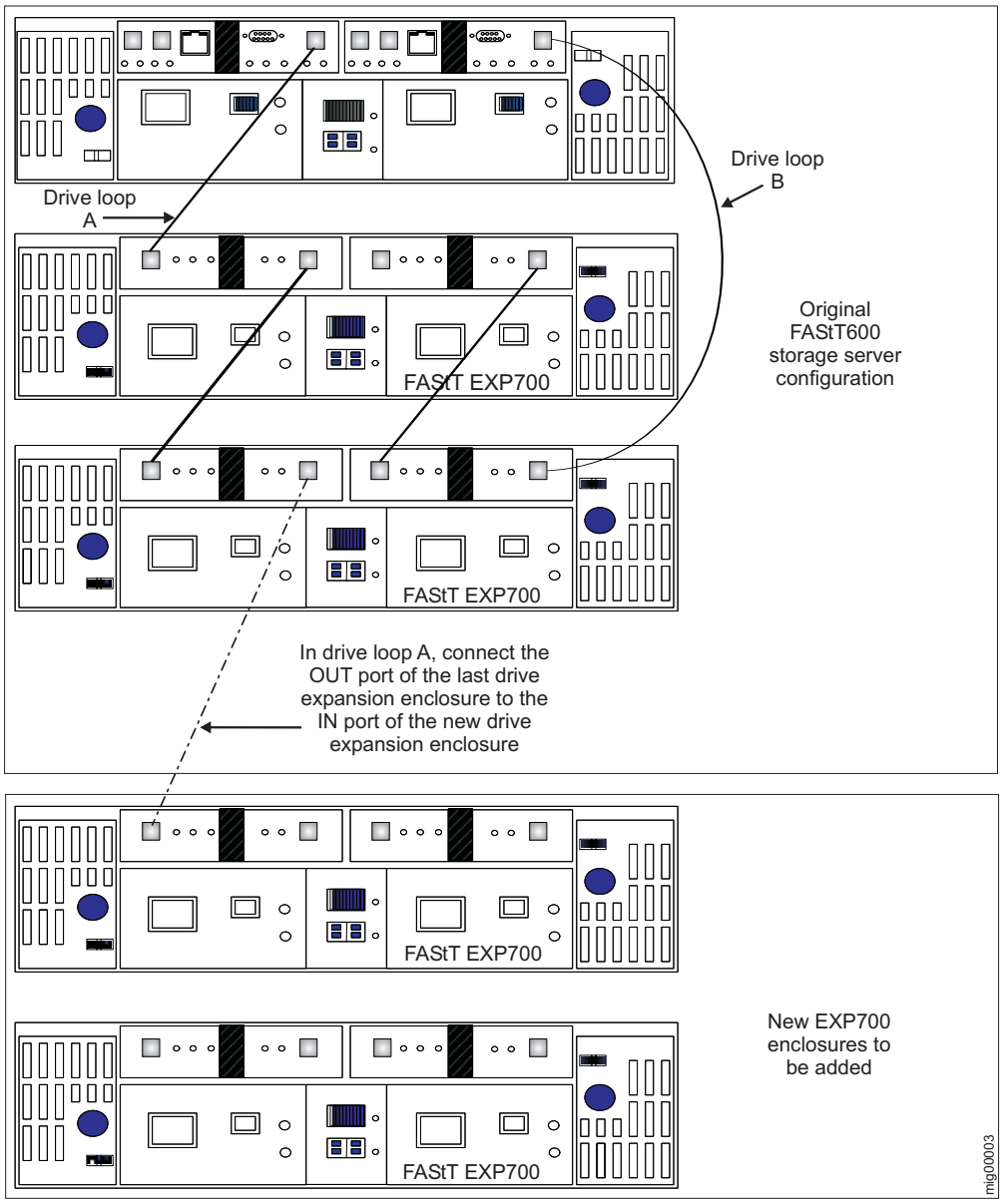

Figure 16. First connection: Cabling a single drive enclosure to a functioning drive loop

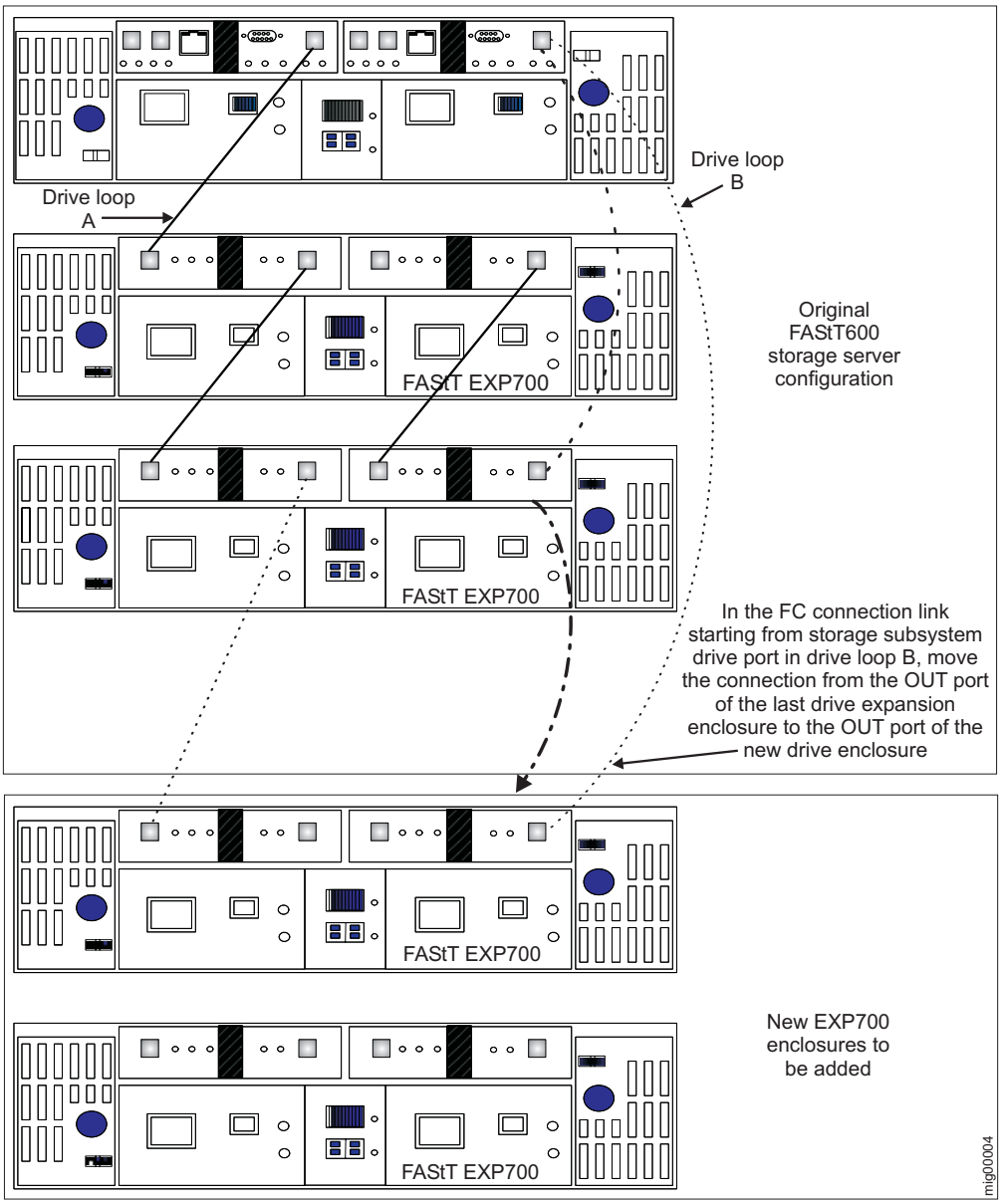

Figure 17. Second connection: Cabling a single drive enclosure to a functioning drive loop

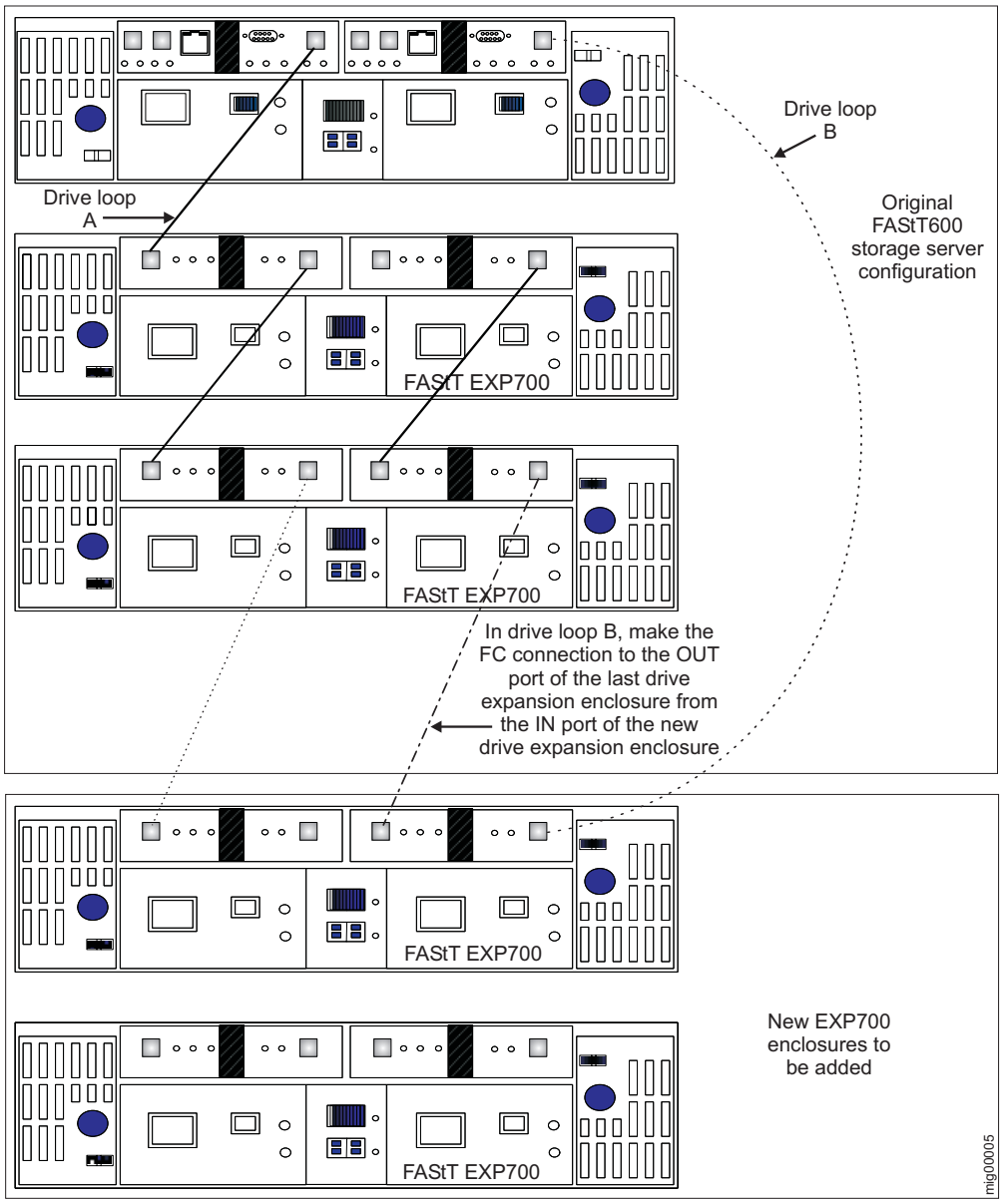

Figure 18. Third (final) connection: Cabling a single drive enclosure to a functioning drive loop

Activity 3: Disabling storage subsystem drive migration settings

When you have completed cabling the new storage expansion enclosures, disable DS4000 storage subsystem drive migration settings as follows:

__ Step 1. Open the Storage Manager Client program Enterprise Management window.

__ Step 2. Right-click on the name of the DS4000 storage subsystem to which you want to add drives, and select **Execute Script**.

__ Step 3. A script editor window opens. Click **File → Load Script**.

__ Step 4. A Load Script file selection window opens. Locate and select the `DisableDriveMigration.scr` file and click **OK**. The file

DisableDriveMigration.scr file is normally in the SCRIPTS directory of the IBM DS4000 Storage Manager Installation CD. This file is used to reset the DS4000 storage subsystem setting, in order to treat all newly-discovered hard drives as “new” drives, and to ignore any configuration information that might exist in the new hard drives. Figure 14 on page 35 contains the DisableDriveMigration.scr file listing.

__ Step 5. Click **Tools → Verify and Execute** to run the script.

__ Step 6. When the script execution completes, reset both DS4000 controllers to make the disable drive migration settings effective. If you used the DisableDriveMigration.scr file described in this document in Figure 14 on page 35, you do not need to perform this step because the last two commands in the script file automatically reset the controllers. To reset the controllers, open the Storage Subsystem Management window and alternately (one at a time) reset each controller by clicking **Advanced → Reset Controller** and following the instructions in the Reset Controller window when it opens.

Activity 4: Inserting drives and cabling additional storage expansion units

Once you have disabled DS4000 storage subsystem drive migration settings, insert drives and connect additional storage expansion enclosures to complete the installation process as follows:

__ Step 1. Insert the appropriate drives into empty drive slots in the new enclosure in pairs (two at a time). Wait until the inserted drive pair fully spins up and displays in the DS4000 Storage Subsystem Management window before inserting the next drive pair.

__ Step 2. To connect additional storage expansion enclosures to the functioning drive loop pair, perform Activity 1: Preliminary activities step 2 on page 38 through step 5 on page 39, Activity 2: Cabling new storage expansion units step 1 on page 39 through step 6 on page 40, and step 1 (immediately preceding this step) for each additional storage expansion enclosure that you intend to add . (See Figure 19 on page 45.) When you have completed adding enclosures, proceed to Activity 5: Re-enabling drive migration settings step1 on page 46 to re-enable the drive migration settings.

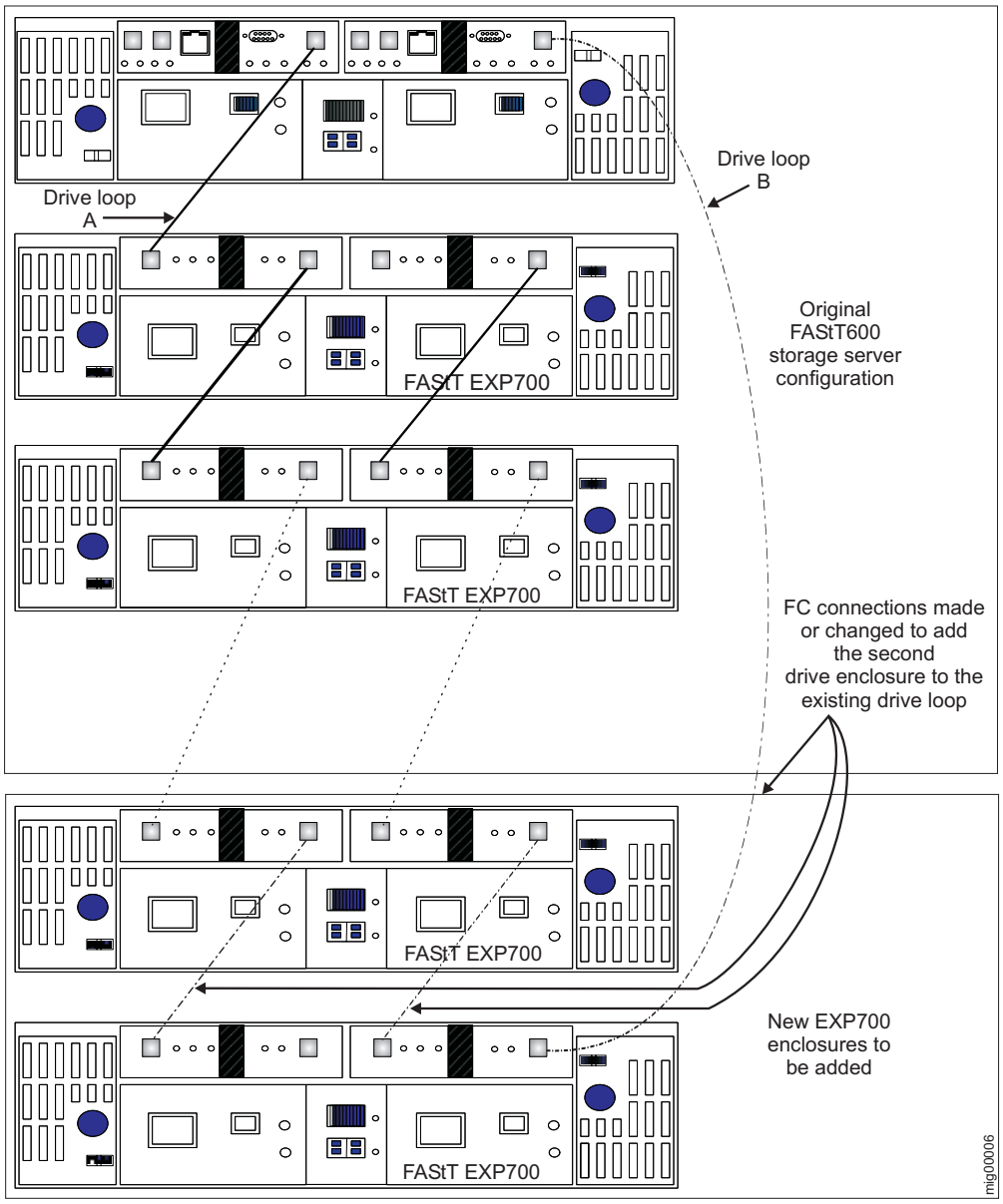

Figure 19. Cabling a second drive enclosure to a functioning drive loop

Activity 5: Re-enabling drive migration settings

If you performed steps 1 on page 43 through 6 on page 44 of Activity 3: Disabling storage subsystem drive migration settings to disable DS4000 storage subsystem drive migration settings, perform the following steps 1 on page 46 through 6 on page 46 to re-enable the drive migration settings. If you should ever momentarily remove a drive from the storage subsystem, the storage subsystem clears its configuration data when it later recognize it. When this happens, the drive displays as `unconfigured`.

Attention: In order to prevent data loss, set the DS4000 Storage Server drive migration setting to `enable` after you complete the hard drive addition process.

__ Step 1. Open the Storage Manager Client program Enterprise Management window.

__ Step 2. Right-click on the name of the DS4000 storage subsystem to which you want to add drives and click **Execute Script**.

__ Step 3. A script editor window opens. Click **File → Load Script**.

__ Step 4. A Load Script file selection window opens. Locate and select the EnableDriveMigration.scr file and click **OK**. The file EnableDriveMigration.scr file is normally in the `SCRIPTS` directory of the IBM DS4000 Storage Manager Installation CD. Use this file to reset the DS4000 storage subsystem setting in order to check for any configuration data that might exist on the newly discovered hard drives.

__ Step 5. Click **Tools → Verify and Execute** to run the script.

__ Step 6. When the script execution completes, reset both DS4000 controllers to make the setting effective.

If you use the EnableDriveMigration.scr script associated with this document and described in Figure 13 on page 34, it is not necessary for you to perform this step because the last two commands in that script file automatically reset the controllers. To reset the controllers, open the Storage Subsystem Management window and alternately (one at a time) reset each controller by clicking **Advanced → Reset Controller** and following the instructions in the Reset Controller window when it opens.

Result: The newly added drives are now ready for you to configure and map to host servers.

Note: Listings of the `EnableDriveMigration.scr` and `DisableDriveMigration.scr` files are found in Figure 13 on page 34 and Figure 14 on page 35.

Chapter 5. Migrating one or more hard drives

Note: When migrating hard drives from multiple DS4000 storage servers to a single DS4000 Storage Server, move all of the hard drives from the first DS4000 Storage Server as an independent 'set' to the destination DS4000 Storage Server. Before moving hard drives as a 'set' from subsequent DS4000 storage servers, ensure that all of the hard drives from the previous 'set' have been successfully transferred to the destination DS4000 Storage Server. If you do not transfer hard drives as 'sets' to the destination DS4000 Storage Server, the newly relocated array may not appear in the Subsystem Management window.

While migrating a hard drive to either a controller or a drive expansion enclosure, observe these important rules:

- Observe proper ESD procedures when handling electronic equipment.
- Never alter the physical configuration of a DS4000 Storage Server while it is powered off unless you are instructed to do so as part of DS4000 configuration procedure. Specifically, never attach storage components to or remove storage components from a configured DS4000 Storage Server while it is powered off.
- Any hard drive, whether new or old, might contain configuration data. Use this procedure to preserve the configuration and user data in one or more hard drives that you will migrate to a functioning DS4000 Storage Server configuration. Do not use this procedure if you are unsure of the quality of the data on the hard drives.
- The following DS4000 storage server devices support only 2 Gbps fibre channel hard drives:
  - DS4000 EXP700 storage expansion units
  - DS4000 EXP710 storage expansion units
  - DS4300 storage servers

  1 Gbps fibre channel drives will not spin up when you insert them into their drive slots.

  To identify a 1 Gbps fibre channel drive, locate the product's label and examine its ID and Model Number. Hard drives whose ID/Model Number values end with "04FC" or "03FC" are 1 Gbps fibre channel drives. For example, "ST173404FC", "ST318203FC" and "ST136403FC" are model numbers that appear on several 1 Gbps fibre channel hard drives.
- Do not mix SATA and fibre channel drives or enclosures together in the same drive loop.
- Do not install SATA drives in fibre channel device enclosures.
- Do not install fibre channel drives in SATA device enclosures.

The following procedure describes the steps that you must perform to migrate one or more drives from a functioning DS4000 Storage Server configuration to another DS4000 Storage Server configuration. Drives described in the following steps are those that contain configuration data that you want to preserve. Add such drives to a DS4000 Storage Server only while it is powered on and in its `optimal` state. See the *DS4000 Problem Determination Guide* associated with your particular DS4000 hardware model or "Bringing storage subsystems and drive loops into optimal state" on page 29 for additional information on how to assess the state of a DS4000 Storage Server.

Tip: Before you attempt to complete the drive migration procedure, review and perform the steps documented in Chapter 2, “Prerequisites to adding capacity and hard drive migration,” on page 23.

The procedure for migrating hard drives which contain configuration data that you want to preserve is as follows:

Activity 1: Preliminary activities

Before you remove drives from a functioning DS4000 Storage Server, perform the following steps to ensure that you successfully migrate the drives to the destination DS4000 Storage Server.

__ Step 1. Perform a backup of the logical drives defined in the hard drives that you plan to migrate.

__ Step 2. Stop all programs, services or processes in the host servers that access the logical drives defined in the migrated hard drives. Make sure that there are not any running background programs, services or processes that write data to the logical drives. (For example, the Microsoft MSCS service periodically writes to the “Quorum” disk.)

__ Step 3. Unmount the file systems to flush I/O from the server cache to disks.

Notes:

a. In a Microsoft Windows environment, remove the drive letter or the mount points of the mapped LUNs instead of unmounting the file systems.

b. Consult documentation associated with your particular operating system for detailed information regarding the Unmount procedure.

__ Step 4. Verify that the DS4000 Storage Server controller and NVSRAM of both the source and destination systems are at or above levels described in Table 16 on page 24.

__ Step 5. Verify that the names of the logical drives that are associated with hard drives on both the source and destination systems are unique. If they are not, make the necessary changes.

__ Step 6. In addition to array configuration information, any storage partitioning configuration data that may reside on drives you plan to migrate will migrate with those drives when installed on another DS4000 Storage Server. For this reason, take the following precautions to facilitate the migration process and prevent problems in storage partitioning configuration data migration.

a. If a DS4000 storage partitioning premium feature has been enabled both on a drive’s original and destination DS4000 storage servers, assure that the defined host ports, hosts, and host group names are unique to each DS4000 storage server involved in the migration.

b. If you must use identical names on both DS4000 storage servers, make the names unique before you perform the drive migration.

If necessary, customize the storage partitioning information on the DS4000 storage server to which you have migrated the drives after you complete the migration.

__ Step 7. Delete any flashcopies of the logical drives defined on the drives that you plan to migrate.

__ Step 8. Remove any remote mirror relationships using the logical drives defined on the drives that you plan to migrate.

__ Step 9. Ensure that the arrays and logical drives are in `optimal` state before starting the migration process. See the *DS4000 Problem Determination Guide* associated with your particular DS4000 hardware model or “Bringing storage subsystems and drive loops into optimal state” on page 29 for additional information on how to make this determination.

__ Step 10. Place the arrays defined in the hard drives that you plan to migrate in `offline` state. To do so, right-click on the name of the array in the Storage Subsystem Management window and click **Place → Offline**.

__ Step 11. If you migrate drive expansion enclosures from a 1 Gbps fibre channel environment to a 2 Gbps fibre channel environment, verify that the fibre channel hard drives that you plan to migrate are each capable of 2 Gbps operation and that you have installed the latest firmware enabling them to work properly in a 2 Gbps fibre channel environment.

__ Step 12. Save the DS4000 storage subsystem profile of the functioning DS4000 Storage Server configuration to which the migration will occur in a location other than that of the logical drives you plan to migrate.

__ Step 13. If you migrate the drives to a single controller DS4000 Storage Server (for example, DS4300 Storage Server Model 6LU or 6LX), change the logical drive’s preferred owner to Controller A using the DS4000 Storage Manager client program before taking it offline and removing it from the DS4000 Storage Server. To set Controller A as the logical drive preferred owner, right-click the logical drive entry in the Subsystem Management window and select **Change → Ownership/Preferred Path → Controller A**.

Activity 2: Removing the drives to be migrated

While the functioning DS4000 Storage Server is still powered on, remove the hard drives that you plan to migrate one at a time using the following steps:

__ Step 1. Press on the inside of the bottom of the tray handle to release the blue latch.

__ Step 2. Lift the closed latch to its open position. (The latch is at a 90-degree angle to the front of the drive when open.)

__ Step 3. Using the handle, slowly pull the drive ½-inch out of its drive slot.

__ Step 4. Wait at least 20 seconds to allow the hard drive to spin down before fully removing it from the drive slot.

__ Step 5. Place the hard drive into an ESD bag or container before moving it to the new DS4000 Storage Server.

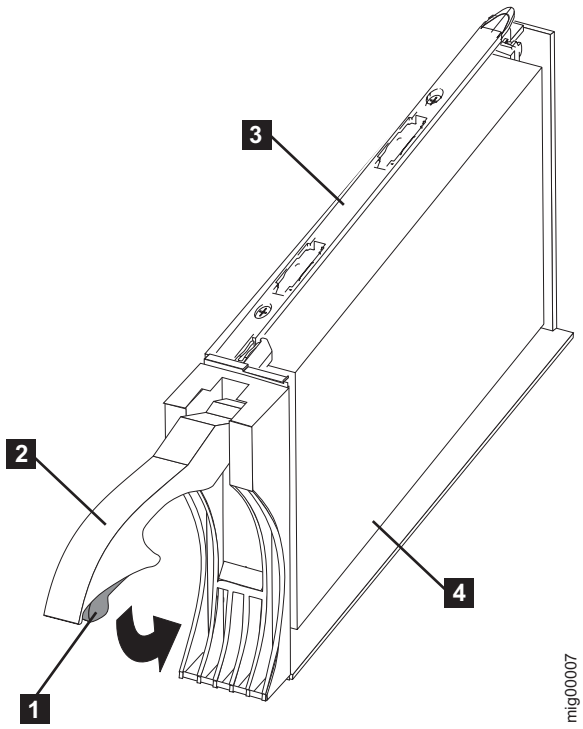

Figure 20. Drive CRU assembly

Legend:

1. Blue latch
2. Drive CRU handle
3. Tray
4. FC hard drive

Attention: Orient drives horizontally and place them in appropriate ESD bags or containers before relocation. When in transit, use only moving equipment that prevents shock to the drives. Never stack drives.

Activity 3: Inserting the drives to be migrated

Note: When migrating hard drives from multiple DS4000 storage servers to a single DS4000 Storage Server, move all of the hard drives from the first DS4000 Storage Server as an independent 'set' to the destination DS4000 Storage Server. Before moving hard drives as a 'set' from subsequent DS4000 storage servers, ensure that all of the hard drives from the previous 'set' have been successfully transferred to the destination DS4000 Storage Server. If you do not transfer hard drives as 'sets' to the destination DS4000 Storage Server, the newly relocated array may not appear in the Subsystem Management window.

__ Step 1. While the destination DS4000 Storage Server is powered on, insert the migrating drives into the empty drive slots in pairs. Wait until the inserted drive pair is fully spun up and displayed in the DS4000 Storage Subsystem Management window before inserting the next drive pair.

__ Step 2. As the DS4000 Storage Server recognizes the drives, it reads and displays the array and logical drive information in the Logical/Physical view of the DS4000 Storage Subsystem Management window. The

storage subsystem represents arrays in `offline` state until it recognizes that you have inserted all of the drives that comprise an array.

__ Step 3. After you migrate all of the drives, manually change the state of the arrays and logical drives involved from `optimal` to `online` state if it has not changed automatically. To do so, right-click on the array name in the Storage Subsystem Management window and select **Place → Online**. If any of the following conditions persist, contact the IBM Help Center in your geography for assistance:

- The empty drive slot icon () displayed for the drive slot into which you inserted the migrating drive.
- The `Failed` unconfigured drive icon () or the `Failed` configured drive icon () displayed for the drive slot into which you inserted the migrating drive.
- Array configuration data on the drives you have added is incomplete.
- You cannot bring the array online.

Attention: Do not initialize a drive that you want to keep (by right-clicking its icon and selecting **Initialize** from the pull-down menu) if it contains configuration or user data. Initializing any drives in a defined array causes all hard drives known to comprise that array to return to the `Unconfigured Capacity` storage pool, deleting their array definitions from the DS4000 Storage Server configuration. The user data on such drives is lost.

Result: Once the arrays are online, they are ready to for you to configure and map to host servers. You might also then recreate flashcopies of the logical drives.

__ Step 4. Use the DS4000 Storage Manager program to view the storage partitioning definitions and make any necessary corrections.

__ Step 5. The DS4000 Storage Server that the drives are migrated from will display the logical drives that are defined in these drives as “missing LUNs”. In order to remove these “missing LUNs” entries, right-click on each entry and select **Delete** from the pull-down menu.

Migrating arrays within storage subsystems

Important:

1. Assure that your controller firmware is at or above the level documented in Table 16 on page 24. Do not rearrange more than two or three arrays at a time.
2. Unmount the file systems to flush I/O from the server cache to disks.

   Notes:

   a. In a Microsoft Windows environment, remove the drive letter or the mount points of the mapped LUNs instead of unmounting the file systems.

   b. Consult documentation associated with your particular operating system for detailed information regarding the Unmount procedure.

Using the configuration data on existing drives, it is possible to redistribute the drives that made up an RAID array across a storage subsystem to which you may be adding expansion enclosures. Figure 21 on page 52 illustrates a storage array distributed across three drives on a single storage device before and after reordering. When you redistribute each drive to a different position in the same

storage enclosure as recommended, the array automatically redistributes accordingly.

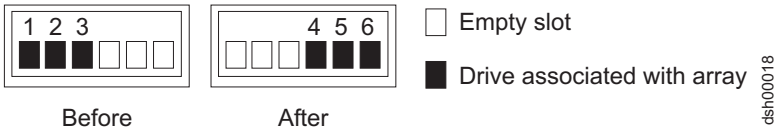

Figure 21. Manner recommended for reordering a defined array using empty slots in one storage enclosure

Figure 22 illustrates a storage array distributed across three drives on a single storage device before reordering across two storage devices. When the drives are redistributed across an additional storage enclosure in the storage subsystem as recommended, the array automatically redistributes accordingly.

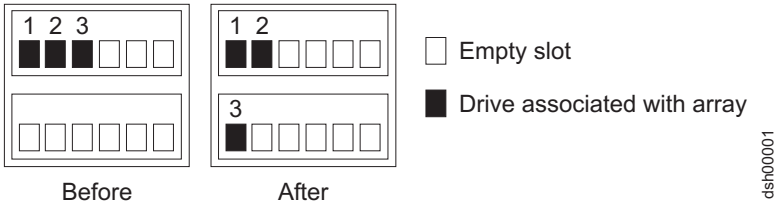

Figure 22. Manner recommended for reordering a defined array using empty slots in two storage enclosures

Figure 23 illustrates two arrays distributed across five drives and two storage enclosures before and after reordering the same drives across other drive slots in the same two storage enclosures.

Important: Completely remove all of the drives of both arrays from both storage enclosures and wait for the storage manager to mark the arrays/logical drives as missing before you attempt to reinsert any of the drives from either enclosure. After you insert the drives associated with the first array, wait until that array comes online in a DS4000 Storage Manager Subsystem Management window before you insert the drives associated with the second array.

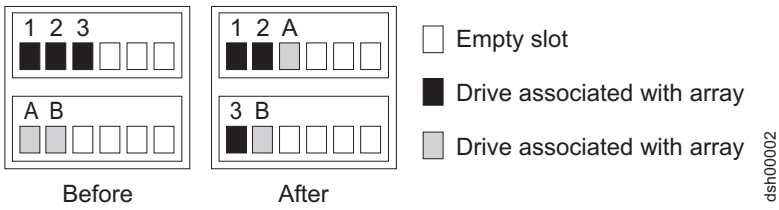

Figure 23. Reordering multiple defined arrays across previously used slots in two storage enclosures

Perform the following steps to ensure success when you reorder drives that make up arrays across different drive slots in the same DS4000 Storage Server configuration.

1. Start the DS4000 Storage Manager Client program and open the Subsystem Management window (for the DS4000 Storage Subsystem which drives you intend to reorder).
2. Set the arrays that you plan to move offline.

3. Mark the drives in the arrays.
4. Unlatch the drives from their respective slots. Wait at least 2 minutes for each drive to spin down.
5. Slowly and carefully remove the drives from their slots.
6. Assure that all of the drives that made up the arrays are completely removed from their slots.
7. Wait for the storage manager to mark the arrays/logical drives as missing in the Subsystem Management window. See Figure 24.

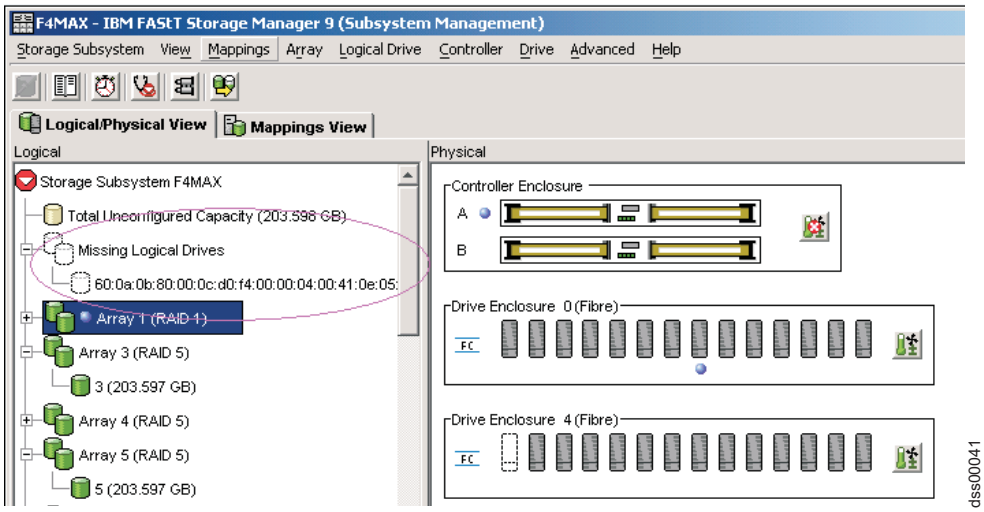

Figure 24. Subsystem Management Logical/Physical View of Missing Logical Drives

8. Carefully reinsert all of the drives that made up an array only into the empty slots of the storage enclosure. Do not insert the drives into empty slots that are part of another array definition whose drives are still inserted in the storage enclosures. Data on the drives you insert will be replaced with the reconstructed data from the previously installed RAID array.
9. The system will recognize the array and bring it online when you finish inserting all of the drives.
10. Repeat steps 8 and 9 for each of the arrays that were removed from the storage enclosure.
11. Save the storage subsystem profile. See “Saving the storage subsystem profile” on page 30 for information on performing this activity.

Note: Do not reinsert drives from multiple arrays in random order into the storage enclosures.

Chapter 6. Migrating expansion units containing hard drives

Note: When migrating hard drives from multiple DS4000 storage servers to a single DS4000 Storage Server, move all of the hard drives from the first DS4000 Storage Server as an independent 'set' to the destination DS4000 Storage Server. Before moving hard drives as a 'set' from subsequent DS4000 storage servers, ensure that all of the hard drives from the previous 'set' have been successfully transferred to the destination DS4000 Storage Server. If you do not transfer hard drives as 'sets' to the destination DS4000 Storage Server, the newly relocated array may not appear in the Subsystem Management window.

While migrating a fibre channel or SATA hard drive to either a controller or a drive expansion enclosure, observe these important rules:

- Observe proper ESD procedures when handling electronic equipment.
- Never alter the physical configuration of a DS4000 Storage Server while it is powered off unless you are instructed to do so as part of DS4000 configuration procedure. Specifically, never attach storage components to or remove storage components from a configured DS4000 Storage Server while it is powered off.
- Use this procedure to preserve the configuration and user data in one or more fibre channel hard drives that you will migrate to a functioning DS4000 Storage Server configuration. Do not use this procedure if you are unsure of the quality of the data on the hard drives. Import of incorrect configuration data from hard drives could cause a DS4000 Storage Server failure.

Use this procedure to migrate one or more DS4000 storage expansion enclosures containing hard drives which themselves contain configuration data from a functioning DS4000 Storage Server configuration to another DS4000 Storage Server configuration.

Attention: Make additions to the DS4000 Storage Server only while it is powered on and in `optimal` state. See "Bringing storage subsystems and drive loops into optimal state" on page 29 for additional information on how to make this determination. You can complete this process while the DS4000 Storage Server is receiving I/O from the host server. However, because the drive loops are interrupted momentarily during the addition process, schedule the addition to occur during time periods of low I/O between the DS4000 storage servers and host servers.

Review the readme and the *IBM TotalStorage DS4000 Storage Manager installation and support guides* associated with the operating system environment of the host servers that connect to the DS4000 Storage Server for information about any operating system-specific restrictions in addition to those detailed in this document. You will also find preliminary tasks that you may be required to complete detailed in that documentation. *IBM TotalStorage DS4000 Storage Manager installation and support guides* are located at the following Web site:

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

Tip: Before proceeding with the migration procedure, review and perform the steps outlined in Chapter 2, "Prerequisites to adding capacity and hard drive migration," on page 23.

The procedure for migrating a new DS4000 storage expansion enclosure is as follows:

Activity 1: Preliminary activities

Before disconnecting any storage expansion enclosures from a DS4000 Storage Server, to ensure a successful migration of your drives to the DS4000 Storage Server, perform the following steps:

__ Step 1. Verify that both the functioning source and the destination DS4000 Storage Servers' controller firmware and NVSRAM are at the levels recommended in Table 16 on page 24.

__ Step 2. Verify that the firmware of the ESMs in the storage expansion enclosures that you plan to migrate are at the levels recommended in Table 17 on page 26.

__ Step 3. Verify that the firmware of the ESMs in the storage expansion enclosures attached to the DS4000 Storage Server to which you will migrate your drives is at the levels recommended in Table 17 on page 26.

__ Step 4. If you migrate storage expansion enclosures from a 1 Gbps fibre channel environment to a 2 Gbps fibre channel environment, verify that the fibre channel hard drives that you plan to migrate are each capable of 2 Gbps operation and that you have installed the latest firmware enabling them to work properly in a 2 Gbps fibre-channel environment.

__ Step 5. Verify that the names of the logical drives that are created using the hard drives in the migrated storage expansion enclosures are unique in the DS4000 Storage Server to which these storage expansion enclosures will migrate. If they are not unique, make any necessary changes.

__ Step 6. If you migrate the drives to a single controller DS4000 Storage Server (for example, DS4300 Storage Server Model 6LU or 6LX), change the logical drive's preferred owner to Controller A using the DS4000 Storage Manager Client program before taking it offline and removing it from the DS4000 Storage Server. To set Controller A as the logical drive preferred owner, right-click the logical drive entry in the Subsystem Management window and select **Change → Ownership/Preferred Path → Controller A**.

Activity 2: Deleting partition mappings, remote mirror relationships, and flashcopies

__ Step 1. In addition to array configuration information, any storage partitioning configuration data that may reside on drives you plan to migrate will migrate with those drives when installed on another DS4000 Storage Server. For this reason, take the following precautions to facilitate the migration process and prevent problems in storage partitioning configuration data migration.

a. If a DS4000 storage partitioning premium feature has been enabled both on a drive's original and destination DS4000 storage servers, assure that the defined host ports, hosts, and host group names are unique to each DS4000 storage server involved in the migration.

b. If you must use identical names on both DS4000 storage servers, make the names unique before you perform the drive migration.

If necessary, customize the storage partitioning information on the DS4000 storage server to which you have migrated the drives after you complete the migration.

__ Step 2. Delete any flashcopies of logical drives defined in the hard drives that you plan to migrate.

__ Step 3. Remove any remote mirror relationships that involve the logical drives defined on the drives that you plan to migrate.

Activity 3: Preparing and backing up the drives

__ Step 1. If the arrays and logical drives involved are not in `optimal` state, perform the steps necessary to bring these arrays and logical drives to their `optimal` state before attempting migration. See “Bringing storage subsystems and drive loops into optimal state” on page 29 for additional information on how to make this determination.

__ Step 2. If the drive enclosures that you plan to migrate are not in `optimal` state, perform the steps necessary to bring them to their `optimal` state before attempting migration. See “Bringing storage subsystems and drive loops into optimal state” on page 29 for additional information on how to make this determination.

__ Step 3. Perform a backup of the logical drives defined in the storage expansion enclosures that you plan to migrate.

__ Step 4. Monitor the DS4000 Storage Server event log for any errors in the drive loop or its components for several days before migrating storage expansion enclosures.

__ Step 5. Stop all programs, services or processes in the host servers that access the logical drives defined in the migrated hard drives. Make sure that there are not any running background programs, services or processes that write data to the logical drives. (For example, Microsoft MSCS service periodically writes to the “Quorum” disk.)

__ Step 6. Unmount the file systems to flush I/O from the server cache to disks.

Notes:

a. In a Microsoft Windows environment, remove the drive letter or the mount points of the mapped LUNs instead of unmounting the file systems.

b. Consult documentation associated with your particular operating system for detailed information regarding the Unmount procedure.

__ Step 7. Place the arrays defined in the storage expansion enclosures that you plan to migrate in `offline` state. In the Storage Subsystem Management window, right-click on the name of the array and click **Place → Offline**.

__ Step 8. Save the DS4000 storage subsystem profile of the functioning DS4000 Storage Server configuration to which the migration will occur in a location other than that of the logical drives you plan to migrate.

Activity 4: Shutting down and moving the storage expansion unit

__ Step 1. Because removing a storage expansion enclosure from a functioning DS4000 Storage Server will disrupt its drive loops, shutdown the functioning destination DS4000 Storage Server while you remove its storage expansion enclosures for reconfiguration. If you cannot shutdown the DS4000 Storage Server, carefully reconfigure only one drive loop, making sure that the drive loop that you modify is connected correctly and in `optimal` state before you attempt to reconfigure the

other drive loop. For additional information on making this determination, see “Bringing storage subsystems and drive loops into optimal state” on page 29.

Take this precaution to prevent the arrays from being inadvertently failed by the DS4000 Storage Server controllers because two or more drives in the arrays cannot be reached through either drive loop in the redundant drive loop pair.

Perform the following steps to verify that the drive loops are in `optimal` state:

__ Step a. Physically trace the actual cable connections making sure that connections are properly modified and that the cable connectors are firmly inserted into the SFPs or GBICs.

__ Step b. Verify that the following LEDs are not lit or briefly flashed in the modified drive loop:

- ESM Fault
- port bypass
- ID conflict

__ Step c. Verify that the controller drive loop LED remains lit. If the controller drive loop LED becomes unlit momentary, there are problems in the drive loop and the Loop Initialization Primitives (LIPs) are generated by the DS4000 Storage Server controller.

__ Step d. In the DS4000 Storage Manager Client Subsystem Management window, verify that there are no `loss of ESM path redundancy` errors in the storage expansion enclosures that are not migrated.

Do not modify the second drive loop in the redundant drive loop pair until you are sure that the first modified drive loop is operating optimally.

__ Step 2. Power down the storage expansion enclosures and move them to the DS4000 Storage Server to which you plan to migrate them.

Notes:

- A storage expansion enclosure with 14 drives weighs up to 100 lbs. (45 kg). If necessary, remove the drives and other storage expansion enclosure components to reduce the weight of the unit for easier handling. Mark each drive before removing it in order to return it to the same drive slot when you reassemble the components at the destination location.
- Move drives only in a horizontal position using an appropriate ESD bag or container and moving equipment that prevents shock to the drives during transit. Never stack drives.

Activity 5: Installing and setting storage expansion unit IDs and speeds

__ Step 1. Once the storage expansion enclosures and drives are at the location of DS4000 Storage Server to which they will be migrated, install them into the rack. If the drives were removed during transit, return them to the slots from which they were removed, unlatched and no less than ½-inch away from their full insertion points in the drive slots. If the drives were not removed, unlatch and pull them out no less than ½-inch away from their full insertion points in the drive slots.

__ Step 2. See Figure 15 on page 38 for an illustration of how to set the enclosure ID of the storage expansion enclosures. Each drive enclosure in the DS4000 storage subsystem drive loop must have a unique drive enclosure ID. In a EXP500 Storage Expansion Unit, there is an enclosure ID switch mounted on each of two ESM canisters. Set each ESM canister's enclosure ID switch in the EXP500 drive enclosure to the same unique number in the drive loop. In a EXP700 Storage Expansion Unit, the only enclosure ID switch is mounted between the power supplies. To access the appropriate *DS4000 storage expansion unit installation and user's guide* for additional information, use the following Web link:

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

Important: If the DS4000 Storage Server to which you will attach migrating hard drives is either a FAStT200 or DS4300 (model 60X or 60U), the enclosure IDs of additional storage expansion enclosures must differ from the FAStT200 or DS4300 storage servers' enclosure IDs. These IDs are normally set to "0" at the factory.

__ Step 3. Verify that you set the enclosure speed switch of the DS4400 to the correct drive loop speed.

If the enclosure speed switch was originally set to 1 Gbps, do not automatically set it to 2 Gbps unless you are sure that each fibre channel hard drive it now contains is capable of 2 Gbps operation and that you have installed the latest firmware enabling their operation in a 2 Gbps fibre-channel environment.

Activity 6: Cabling, powering on, and verifying storage expansion unit operation

__ Step 1. Insert the SFPs or GBICs only into the ports that you plan to use. Do not leave GBICs or SFPs inserted in port slots without connecting them to other ports using cables.

__ Step 2. Cable the new storage expansion enclosures to the end of the functioning storage expansion enclosure drive loop to which you are migrating them.

Add only one enclosure at a time to a functioning drive loop if you intend to attach multiple storage expansion enclosures. The cabling instructions are illustrated in Figure 16 on page 41.

The general cabling scheme for DS4000 external drive enclosures is described in the *IBM TotalStorage Fibre Channel Cabling Guide*, which is available at:

www-3.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-4KELS5

See also "Storage subsystem loop schemes" on page 12.

__ Step 3. Extend one of the drive loops (that is, drive loop A) in a DS4000 Storage Server redundant drive loop pair by connecting the `OUT` port of the last storage expansion enclosure to the `IN` port of the new storage expansion enclosure as shown in Figure 16 on page 41.

Warning: Carefully reconfigure only one drive loop at a time, making sure that the drive loop that you modify is properly connected and in `optimal` state before you attempt to reconfigure another drive loop. Take this precaution to prevent the arrays from being inadvertently failed by the DS4000 Storage Server controllers. This happens when

two or more drives in the arrays cannot be reached through either drive loop in the redundant drive loop pair.

__ Step 4. Power on the newly added storage expansion enclosure unit.

__ Step 5. Wait a few seconds; verify that the port bypass LEDs of all of the ports in drive loop A, now extended to the new storage expansion enclosure, are not lit. Using the DS4000 Storage Manager Client Subsystem Management window, verify that the new storage expansion enclosure is added and displayed in the Logical/Physical view of the window.

Correct any errors before proceeding to step 6. For port bypass:

__ Step a. Verify that the SFPs and GBICs or cables are in good condition.

__ Step b. Remove and reinsert SFPs, GBICs and cables.

__ Step c. Make sure the new drive expansion enclosure fibre channel speed switch is set to the same speed as the existing drive expansion enclosures and the DS4000 Storage Server fibre channel speed setting.

__ Step d. Verify that the ESM is good by physically removing and swapping it with the other ESM in the same drive expansion enclosure. For enclosure ID conflict, set the drive expansion enclosure ID switch to values unique from the current settings in the existing drive expansion enclosures and storage server.

Call the IBM Help Center in your geography for assistance if the problems persist.

__ Step 6. In the other drive loop (that is, drive loop B) in a DS4000 Storage Server redundant drive loop pair, remove the connection from the storage subsystem drive loop port to the `OUT` port of the last storage expansion enclosure and connect it to the `OUT` port of the new drive enclosure as shown in Figure 17 on page 42.

__ Step 7. Wait a few seconds; verify that the port bypass LEDs of the two ports in the connection between the storage subsystem drive loop port and the `OUT` port of the new drive enclosure are not lit. Using the DS4000 Storage Manager Client Subsystem Management window, verify that the new drive enclosure does not indicate the `drive enclosure lost redundancy path` error. See the preceding step 5 for possible corrective actions, if needed.

__ Step 8. In drive loop B, cable the new drive enclosure's `IN` port to the `OUT` port of the last enclosure in the already functioning storage expansion enclosure drive loop as shown in Figure 18 on page 43.

__ Step 9. Wait a few seconds; verify that the port bypass LEDs of all of the ports in drive loop B to which you have added a new connection are not lit. Using the DS4000 Storage Manager Client Subsystem Management window, verify that all of the drive enclosures in the DS4000 redundant drive loop pair to which the new enclosure was added does not report the `drive enclosure lost redundancy path` error.

Activity 7: Inserting hard drives and placing logical drives online

Note: When migrating hard drives from multiple DS4000 storage servers to a single DS4000 Storage Server, move all of the hard drives from the first DS4000 Storage Server as an independent 'set' to the destination DS4000 Storage Server. Before moving hard drives as a 'set' from subsequent

DS4000 storage servers, ensure that all of the hard drives from the previous 'set' have been successfully transferred to the destination DS4000 Storage Server. If you do not transfer hard drives as 'sets' to the destination DS4000 Storage Server, the newly relocated array may not appear in the Subsystem Management window.

__ Step 1. Insert the drives into the empty drive slots in the new enclosure in pairs. Wait until each drive pair has fully spun up and displayed in the DS4000 Storage Subsystem Management window before inserting the next drive pair.

__ Step 2. For each additional enclosure that you that you intend to migrate to the functioning drive loop pair, perform Activity 5: Installing and setting storage expansion unit IDs and speeds step 1 on page 58 through step 3 on page 59, Activity 6: Cabling, powering on, and verifying storage expansion unit operation step 1 on page 59 through step 9 on page 60, and step 1 of this activity. (See Figure 19 on page 45.) When you have completed adding enclosures, proceed to step 3.

__ Step 3. As the DS4000 Storage Server recognizes the drives, it reads and displays the array and logical drive information on the drives in the Logical/Physical view of the DS4000 Storage Subsystem Management window. The storage subsystem places the array in `offline` state until it recognizes that you have inserted all of the drives that comprise the array.

__ Step 4. Once you insert all of the drives and the DS4000 Storage Server recognizes them, change the state of the arrays or logical drives to the `online` state by right-clicking on the array name in the Storage Subsystem window and clicking **Place → Online**.

If any of the following conditions persist, contact the IBM Help Center in your geography for assistance.

- The empty drive slot icon () displayed for the drive slot into which you inserted the migrating drive.
- The `Failed` unconfigured drive icon () or the `Failed` configured drive icon () displayed for the drive slot into which you inserted the migrating drive.
- Array configuration data on the drives you have added is incomplete.
- You cannot bring the array online.

Attention: Do not initialize a drive that you want to keep (by right-clicking its icon and selecting **Initialize** from the pull-down menu) if it contains configuration or user data. Initializing any of the drives in a defined array causes all hard drives that comprise an array to return to the `Unconfigured Capacity` storage pool, deleting their array definitions from the DS4000 Storage Server configuration. The user data on such drives is lost.

Result: Once the arrays are online, they are ready for you to configure and map to host servers. You might also then recreate flashcopies and remote mirror relationships.

__ Step 5. Use the DS4000 Storage Manager program to view the storage partitioning definitions and make any necessary corrections.

__ Step 6. The DS4000 Storage Server that the drives are migrated from will display the logical drives that are defined in these drives as "missing

LUNs". In order to remove these "missing LUNs" entries, right-click on each entry and select **Delete** from the pull-down menu.

Chapter 7. Upgrading a storage server in a functioning configuration

Note: When migrating hard drives from multiple DS4000 storage servers to a single DS4000 Storage Server, move all of the hard drives from the first DS4000 Storage Server as an independent 'set' to the destination DS4000 Storage Server. Before moving hard drives as a 'set' from subsequent DS4000 storage servers, ensure that all of the hard drives from the previous 'set' have been successfully transferred to the destination DS4000 Storage Server. If you do not transfer hard drives as 'sets' to the destination DS4000 Storage Server, the newly relocated array may not appear in the Subsystem Management window.

This procedure details the steps that are required to upgrade a DS4000 Storage Server in a functioning DS4000 configuration. Where either an identical or newer DS4000 Storage Server model is involved, this upgrade involves only the replacement of the DS4000 storage controller to be upgraded. DS4000 storage expansion enclosures that had been attached to drives containing configuration data are connected to the new DS4000 Storage Server. The upgraded (original) DS4000 Storage Server being replaced will be either scrapped or returned to operation (redeployed) at a later date with new drives and/or new storage expansion enclosures. Table 18 on page 64 illustrates what DS4000 Storage Server models you can use as replacements.

Preliminary considerations: Server upgrade

While upgrading a storage server in a functioning configuration, remain aware of these important considerations:

- Observe proper ESD handling procedures when handling electronic equipment.
- IBM assigns premium feature entitlements only to specific DS4000 storage servers. In order to enable premium features in a replacement DS4000 Storage Server configuration that had been enabled in an original DS4000 Storage Server configuration, you must purchase appropriate entitlements for the replacement DS4000 Storage Server. In addition, IBM assigns host kits only to specific DS4000 storage servers. You must also purchase the appropriate host kits for new DS4000 storage servers.
- See the appropriate *DS4000 storage controller's installation and user's guide* for information on the proper power on or power off sequences.

Note: The remainder of this topic pertains to the original DS4000 Storage Server that is designated for replacement as either the original or old DS4000 Storage Server.

This task requires that you shutdown the DS4000 Storage Server configuration. In addition, after the upgrade, premium features previously enabled in the original DS4000 Storage Server along with the enable-by-default premium features in the new DS4000 Storage Server will automatically be placed in `Out-of-Compliance` state. Full data availability is retained, but you must generate new premium feature SAFE keys in order to re-enable premium features. You can generate new SAFE keys by contacting the IBM Help Center in your geography. Be sure to have the necessary proof of purchase. Alternately, you can also generate new SAFE keys by using instructions located at the following Web site:

www.premiumfeatures.com

The new DS4000 Storage Server controller identifies itself using a new Worldwide Name (WWN) that is different from the WWN used by the original DS4000 Storage Server controller. For this reason, additional tasks might be required after the upgrade for any host applications or drivers that rely on the WWNs to identify logical drives defined in a given DS4000 Storage Server. See your application program's documentation, your driver's user guide, or related documentation for detailed instructions on how to update the WWN of the DS4000 Storage Server in the application or driver. Additionally, review the readme file and the related *IBM TotalStorage DS4000 Storage Manager installation and support guide* for information about any preparation tasks required in addition or operating system-specific restrictions. *IBM TotalStorage DS4000 Storage Manager installation and support guides* are located at the following Web site:

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

Table 18 associates DS4000 Storage Servers with their supported replacements.

Table 18. DS4000 storage servers by their supported replacements

DS4000 Storage Server product	Supported replacement DS4000 Storage Server product
DS4100	DS4100
FAStT200	FAStT200, FAStT500, DS4400, DS4500
FAStT500	FAStT500, DS4400, DS4300 (60U/60X) (see 2), DS4300 Turbo (60U/60X) (see 2), DS4500
DS4300 Single Controller (6LU/6LX)	DS4300 (6LU/6LX), DS4300 (60U/60X), DS4300 Turbo (60U/60X)
DS4300 (60U/60X)	DS4300 (60U/60X), DS4300 Turbo (60U/60X), DS4400, DS4500
DS4300 Turbo (60U/60X)	DS4300 (60U/60X), DS4300 Turbo (60U/60X), DS4400, DS4500
DS4400	FAStT500 (see 3), DS4300 (60U/60X), DS4300 Turbo (60U/60X), DS4400, DS4500
DS4500	FAStT500 (see 3), DS4300 (60U/60X), DS4300 Turbo (60U/60X), DS4400, DS4500

Attention:

1. Migration to a DS4300 Storage Server configuration from FAStT500, DS4400 or DS4500 Storage Server configurations with more than eight drive expansion enclosures will require more than one DS4300 Storage Server. See Table 7 on page 1.
2. DS4300 and DS4300 Turbo storage servers do not accommodate DS4000 EXP500 drive expansion enclosures. Do not migrate the EXP500 enclosures in FAStT500, DS4400 or DS4500 Storage Server configurations to DS4300 or DS4300 Turbo Storage Server configurations.
3. Set the DS4000 EXP700 storage expansion enclosure's speed switch to 1 Gbps when migrating from 2 Gbps configurations to a FAStT500 Storage Server 1 Gbps configuration.

Preliminary considerations: Firmware behavior during server upgrade

This section describes technical considerations regarding basic DS4000 Storage Server controller firmware behavior during a DS4000 Storage Server upgrade. It covers firmware behavior during system upgrade, where a new DS4000 Storage Server connects to functioning drives and storage expansion enclosures, as well as firmware behavior during system redeployment, where the original (old) DS4000 Storage Server serves as a logically distinct entity, optionally, using some of the drives from the original system.

DS4000 configuration behavior after upgrade and DS4000 Storage Server replacement

The new DS4000 Storage Server that powers up in a functioning storage expansion enclosure configuration as part of the DS4000 Storage Server upgrade process impacts the following areas of the DS4000 Storage Server identification and premium features:

1. Worldwide Name (WWN):

   The worldwide names that were used by the original DS4000 Storage Server prior to the upgrade are not returned when the upgrade is complete. Rather, the new DS4000 Storage Server begins to advertise itself using WWNs that are based on an embedded unique identifier from its controller blades. This statement applies to both the port WWNs and the node WWNs. Consequently, any hosts that were aware of the logical drives in the original DS4000 Storage Server based on the original DS4000 storage server's WWN values will likely be confused. The data volumes that resided behind the previously known WWNs now reside behind a seemingly new device with different WWNs.

2. Storage Array Identifier (SAI or SA Identifier):

   The storage array identifier, or SA Identifier, is the identification value used by the DS4000 Storage Manager host software (SMclient) to uniquely identify managed storage servers. The DS4000 Storage Manager SMclient program maintains SA Identifier records of previously discovered storage servers in the host resident file, which allows it to retain discovery information in a persistent fashion. This identifier is stored on DACstore, and persists across reboots, power cycles, and so on. The new DS4000 Storage Server that powers up in a functioning storage expansion enclosure configuration as part of the DS4000 Storage Server upgrade process continues to use the SA Identifier of the original DS4000 Storage Server.

3. SAFE Premium Feature Identifier (SAFE ID) and Premium Feature Enable Status:

   The new DS4000 Storage Server retains the SAFE ID of the original DS4000 Storage Server. It also retains all of the features previously enabled on the original DS4000 Storage Server. The feature states, however, are set to the `Out-of-Compliance` state. As a result, the system sends alert notices and establishes a `Needs Attention` condition. Also, any features that are marked in the new controller's NVSRAM for automatic enablement are enabled, though their feature states are also set to `Out-of-Compliance`. You must re-enable the premium features by using premium feature SAFE key files.

Redeployed DS4000 configuration behavior in an original (replaced) DS4000 Storage Server

When you redeploy DS4000 Storage Server hardware in another DS4000 storage server's configuration, identification and premium features of the redeployed system behave somewhat differently from information described in "DS4000 configuration

behavior after upgrade and DS4000 Storage Server replacement" on page 65. This section describes those relevant behavioral differences.

- Worldwide Name (WWN):

  The worldwide names that were used by the original DS4000 Storage Server are retained on the redeployed system. These values are based on an embedded unique identifier from the original DS4000 Storage Server controller blades, and are stored in the NVSRAM on each controller board within the controller blade. Assuming that both controllers remain fully optimal after the redeployment, they recognize the stored value and continue to use it. Consequently, any hosts that were aware of the original DS4000 Storage Server, based on its WWN values, will likely be confused. The logical drives that used to reside behind the previously-known WWNs no longer reside there, because they are now part of the new DS4000 Storage Server, which has a different WWN.

- Storage Array Identifier or SA Identifier:

  If you return one or more drives that were originally moved from a DS4000 Storage Server back to the original DS4000 Storage Server configuration before it is redeployed, it is possible that the SA Identifier that was used on the original DS4000 Storage Server system will also be reused in the redeployed DS4000 Storage Server configuration. Whether or not this occurs depends on the specific selection of transported drives. If certain conditions are met, however, the redeployed unit adopts the same SA Identifier that was retained by the new DS4000 Storage Server. Otherwise, or in cases in which only new drives are used in the redeployed configuration, the redeployed DS4000 Storage Server generates a new (and unique) SA Identifier that does not conflict with the one that was retained by the upgraded unit.

  If both the new and the redeployed DS4000 Storage Server have the same SA Identifier, serious problems will result when you start the DS4000 Storage Manager SMclient program. Since there will be two DS4000 storage servers with the same SA Identifier, the DS4000 Storage Manager SMclient program will respond by arbitrarily selecting either the new or the redeployed DS4000 Storage Server. The storage server that the DS4000 Storage Manager SMclient program arbitrarily selects will be manageable, and the other storage server will be unmanageable.

- SAFE Premium Feature Identifier (SAFE ID)

  Premium Feature Enable status:

  If you return any drives from an original DS4000 Storage Server, along with the original DS4000 Storage Server controllers, to a redeployed DS4000 configuration, the SAFE ID of the original DS4000 Storage Server will be retained, and all enabled features will remain fully enabled and compliant.

  If you do not move any drives from an original DS4000 Storage Server, it generates a new SAFE ID when redeployed, enabling none of the premium features from the original system. This new SAFE ID prevents the system from using any previously-acquired SAFE key files and re-enabling any premium features. In cases where the original DS4000 Storage Server was pre-loaded with NVSRAM codes to enable certain premium features, NVSRAM codes are cleared from the DS4000 Storage Server when redeployed and powered on for the first time. Therefore, premium features that were enabled as standard features do not reactivate on the redeployed system. The system retains full data availability, but you must generate new premium feature SAFE keys in order to re-enable premium features. You can generate new SAFE keys by contacting the IBM Help Center in your geography. Be sure to have the necessary proof of purchase. Alternately, you can also generate new SAFE keys by using instructions located at the following Web site:

www.premiumfeatures.com

- Controller IP addresses:

  When the DS4000 Storage Server controllers were assigned static IP addresses, the IP addresses were stored in the NVSRAM of the controller board as well as the DACstore on the disks. If the new (replacement) DS4000 Storage Server controllers were assigned the same IP addresses as the original (replaced) DS4000 Storage Server controllers, network problem will arise when the original (replaced) DS4000 Storage Server is eventually redeployed . The problem will occur because two devices have the same IP address in the Ethernet network. The best practice is to assign new unique IP addresses to new (replacement) DS4000 Storage Server controllers instead of using the same IP addresses as the DS4000 controllers that they replace.

Upgrading storage servers in functioning DS4000 configurations

Before you perform the following upgrade procedure, review and perform the steps detailed in Chapter 2, “Prerequisites to adding capacity and hard drive migration,” on page 23.

Complete the following activities to upgrade your DS4000 Storage Server:

Activity 1: Preliminary activities

Perform the following steps before you disconnect storage expansion enclosures from an original DS4000 Storage Server that is being replaced to ensure a successful DS4000 Storage Server upgrade.

__ Step 1. Verify that the original DS4000 storage server’s controller firmware and NVSRAM are at the levels shown in Table 16 on page 24.

__ Step 2. Verify that the firmware of the ESMs in the storage expansion enclosures is at the levels shown in Table 17 on page 26.

__ Step 3. Disable or delete any flashcopies of the logical drives.

__ Step 4. Delete any remote mirror relationships.

__ Step 5. If the arrays (logical drives) are not in `optimal` state, perform the steps necessary to bring the arrays (logical drives) into their `optimal` state before you attempt their migration. See the *DS4000 Problem Determination Guide* associated with your particular DS4000 hardware model or “Bringing storage subsystems and drive loops into optimal state” on page 29 for additional information on how to make this determination.

__ Step 6. If the drive enclosures are not in `optimal` state, perform the steps necessary to bring them to `optimal` state before attempting migration. Perform the following steps to verify that the drive loops are in `optimal` state:

  __ Step a. Physically trace the actual cable connections making sure that connections are properly modified and that the cable connectors are firmly inserted into the SFPs or GBICs.

  __ Step b. Verify that the following LEDs are not lit or briefly flashed in the modified drive loop:

  - ESM fault
  - port bypass
  - ID conflict

  __ Step c. Verify that the controller drive loop LED remains lit. If the controller drive loop LED becomes unlit momentary, there

are problems in the drive loop and the LIPs are generated by the DS4000 Storage Server controller.

__ Step d. In the DS4000 Storage Manager Client Subsystem Management window, verify that there are no `loss of ESM path redundancy` errors in the drives expansion enclosures that are not migrated.

Do not modify the second drive loop in a redundant drive loop pair until you are sure that the first modified drive loop is operating optimally. See the *DS4000 Problem Determination Guide* associated with your particular DS4000 hardware model or "Bringing storage subsystems and drive loops into optimal state" on page 29 for additional information on how to make this determination.

__ Step 7. Perform a full backup of the original DS4000 Storage Server and schedule it for down time. This is necessary because you must power down the DS4000 Storage Server configuration during the upgrade procedure.

__ Step 8. Save the DS4000 storage subsystem profile of the original DS4000 Storage Server configuration in a location other than that in which the logical drives are defined in the original DS4000 Storage Server configuration.

__ Step 9. Stop all programs, services or processes in the host servers that access the logical drives defined in the migrated hard drives. Make sure that there are not any running background programs, services or processes that write data to the logical drives. (For example, Microsoft MSCS service periodically writes to the "Quorum" disk.)

__ Step 10. Unmount the file systems to flush I/O from the server cache to disks.

Notes:

a. In a Microsoft Windows environment, remove the drive letter or the mount points of the mapped LUNs instead of unmounting the file systems.

b. Consult documentation associated with your particular operating system for detailed information regarding the Unmount procedure.

__ Step 11. Place the arrays defined on the DS4000 Storage Server in `offline` state. In the Storage Subsystem Management window, right-click on the name of the array and select **Place → Offline**.

__ Step 12. Retrieve proofs of purchase for both the original and new DS4000 storage servers and for the additional premium feature entitlements on the new and original DS4000 storage servers. IBM support personnel will require this information to regenerate premium feature SAFE key files that were enabled in the original DS4000 Storage Server for use on the new DS4000 Storage Server.

Activity 2: Powering off the original DS4000 Storage Server

Power down the original DS4000 Storage Server and remove it from the DS4000 configuration. Do not redeploy this DS4000 Storage Server in the same management domain as its upgrade (replacement) DS4000 Storage Server until you regenerate its SA identifier using the instructions in "Redeploying the original (replaced) DS4000 Storage Server" on page 71.

Note: See the appropriate *DS4000 storage controller's installation and user's guide* for details on the correct power off sequence.

Activity 3: Installing new DS4000 Storage Servers and setting minihub speed

Install the new DS4000 Storage Server. For DS4400 and DS4500 Storage Servers, set the drive minihub speed switch to the speed of the storage expansion enclosure ports to which they are connected.

Note: The DS4300 drive loop port operates only at 2 Gbps. If you migrate storage expansion enclosures from a 1 Gbps fibre channel environment to a 2 Gbps fibre channel environment, do not automatically change the storage expansion enclosure speed settings from 1 Gbps to 2 Gbps. Before you do, verify that each fibre channel drive involved is capable of 2 Gbps operation and that you have installed the latest firmware enabling them to work properly in a 2 Gbps fibre channel environment.

Important: If the new DS4000 Storage Server is either a FAStT200 or DS4300 Storage Server, set the FAStT200 or DS4300 enclosure ID to a value unique from other EXP storage expansion enclosures in the fibre channel drive loop. These IDs are normally set to “0” at the factory.

Activity 4: Making connections

Insert the SFPs or GBICs into the DS4000 Storage Server drive port slots and make the connections from the DS4000 Storage Server to the storage expansion enclosures. For detailed information, see the appropriate *DS4000 storage controller's installation and user guide*.

Activity 5: Powering on the expansion unit and setting IP addresses

__ Step 1. Verify that all of the storage expansion enclosures are powered on and in `optimal` state by examining the expansion enclosure LED states. Then, power on the new DS4000 Storage Server. Using the DS4000 Storage Manager client program, verify that the DS4000 Storage Server is operational and that all of the drives are recognized and in `optimal` state. See the *DS4000 Problem Determination Guide* associated with your particular DS4000 hardware model or “Bringing storage subsystems and drive loops into optimal state” on page 29 for additional information on how to make this determination.

Notes:

a. Your storage subsystem will identify the new DS4000 Storage Server as the machine type it replaced until you download the appropriate NVSRAM file for the new storage server. For example, if you replace a FAStT500 with a DS4500, the DS4500 will be reported as a FAStT500 until you download the appropriate NVSRAM file for the DS4500.

b. See the appropriate *DS4000 storage controller's installation and user guide* for information on the proper power on sequence.

__ Step 2. If the new DS4000 Storage Server is managed out-of-band, perform the steps for setting the IP addresses for new DS4000 Storage Server controllers defined in the *IBM TotalStorage DS4000 Storage Manager installation and support guide* associated with your operating system environment. *DS4000 Storage Manager installation and support guides* are located at the following Web site:

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

Changing DS4000 Storage Server IP addresses

__ Step 1. Open the Storage Manager client program's Enterprise Management window.

Note: The new DS4000 Storage Server will have the same IP addresses as the DS4000 Storage Server previously removed.

__ Step 2. Select the entry of the DS4000 storage subsystem that you want to manage.

__ Step 3. Right click and select **Manage Device** from the pop-up menu. The DS4000 Storage Manager Client Subsystem Management window opens.

__ Step 4. In the Logical/Physical view of the window, select **Controller → Change → Network Configuration**. The Change Network Configuration window opens.

__ Step 5. Select the **Slot A** tab.

__ Step 6. Select the radio button labeled **Specify Configuration Setting**.

__ Step 7. Type in the new IP address, subnet mask, and gateway information.

__ Step 8. Click **OK**.

__ Step 9. Select the **Slot B** tab.

__ Step 10. Select the radio button labeled **Specify Configuration Setting**.

__ Step 11. Type in the new IP address, subnet mask, and gateway information.

__ Step 12. Click **OK** to enable the IP address changes.

__ Step 13. Close the DS4000 Storage Manager Client Subsystem Management window.

__ Step 14. Select the entry of the DS4000 storage subsystem whose IP address you just changed. Right click.

__ Step 15. Select **Remove Device** from the pop-up menu.

__ Step 16. Click **Yes** to confirm removal of each device.

__ Step 17. Select **Edit → Add Device**. The Add Device window opens.

__ Step 18. Type in the name or new IP address of controller A and close the window.

__ Step 19. Type in the name or new IP address of controller B and close the window.

Activity 6: Downloading firmware and NVSRAM and returning arrays online

__ Step 1. Use the DS4000 Storage Manager client program to download the firmware and the NVSRAM for the new DS4000 Storage Server.

__ Step 2. Return the offline arrays to `online` state by right-clicking on the array and selecting **Place → Online**. If any of the following conditions persist, contact the IBM Help Center in your geography for assistance:

- The empty drive slot icon () displayed for the drive slot into which you inserted the migrating drive.
- The `Failed` unconfigured drive icon () or the `Failed` configured drive icon () displayed for the drive slot into which you inserted the migrating drive.

- Array configuration data on the drives you have added is incomplete.
- You cannot bring the array online.

Activity 7: Generating and applying premium feature SAFE key files

Generate the new premium feature SAFE key files using the new DS4000 Storage Server Feature Enable Identifier. Apply premium feature SAFE keys to remove `Out-of-Compliance` errors on enabled premium features.

Result: You are now able to recreate flashcopies and remote mirror relationships, if required.

Redeploying the original (replaced) DS4000 Storage Server

As a safety measure, force generation of a new SA Identifier when you redeploy an original (replaced) DS4000 Storage Server. Use the controller shell commands to generate a new SA Identifier. To gain access to the controller shell, you will require a null modem cable and a terminal emulation program that is capable of sending a `BREAK` signal. The setting for the terminal emulation session is `8-N-1` (8 data bits, no parity bit and 1 stop bit). Once you enter the controller shell, use the following command sequence to force the controller to generate a new SA Identifier:

```
ld </Debug
symbolGenerateNewSAIdentifier
```

Note: It is necessary for you to run this command sequence on only one controller. Then, reset both DS4000 Storage Server controllers and proceed with the normal DS4000 Storage Server installation and configuration process.

Accessing the DS4000 Storage Server controller shell

The following steps describe how to access the DS4000 Storage Server controller shell using the terminal emulation program of your choice. One example of such a terminal emulation program for which IBM neither makes nor implies a warranty, HyperTerminal, Private Edition; version 6.3 or higher, is available for your consideration at the following Web site:

www.hilgraeve.com

A generic version of steps involved in accessing the DS4000 Storage Server controller shell using the terminal emulation program of your choice follows:

__ Step 1. Stop all I/O on the DS4000 Storage Server.

__ Step 2. Connect a null modem serial cable from one of the DS4000 Storage Server controller communications (COM) ports to a system with an available terminal emulator.

__ Step 3. Open the terminal emulation program of your choice, such as the HyperTerminal, Private Edition program and from the menu bar, click **File → Properties → Configure**. Establish the following property settings:

- Bits per second: 57600
- Data bits: 8
- Parity: None
- Stop Bit: 1
- Flow Control: None

__ Step 4. Connect to the DS4000 Storage Server controller shell by sending a BREAK signal. (If you are using the HyperTerminal, Private Edition program, press the Ctrl and BREAK keys simultaneously to send the BREAK signal.)

__ Step 5. Repeat step 4 until the following message displays:

"Press the space bar for baud rate within 5 seconds."

__ Step 6. Press the space bar within the time limit to establish the correct baud rate setting.

__ Step 7. Send another BREAK signal. The following message is displayed:

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

__ Step 8. Press the ESC key within the time limit to access the controller shell.

__ Step 9. When prompted, type the following password:

infiniti

__ Step 10. You are now accessing the DS4000 Storage Server controller shell.

Important: Be careful when entering commands in the DS4000 Storage Server controller shell. Improper use of DS4000 Storage Server controller shell commands could result in loss of configuration data.

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

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Avis de conformité à la réglementation d'Industrie Canada

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United Kingdom telecommunications safety requirement

Notice to Customers

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Glossary

This glossary provides definitions for the terminology and abbreviations used in IBM TotalStorage DS4000 publications.

If you do not find the term you are looking for, see the *IBM Glossary of Computing Terms* located at the following Web site:

www.ibm.com/ibm/terminology

This glossary also includes terms and definitions from:

- *Information Technology Vocabulary* by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.
- *IBM Glossary of Computing Terms*. New York: McGraw-Hill, 1994.

The following cross-reference conventions are used in this glossary:

See Refers you to (a) a term that is the expanded form of an abbreviation or acronym, or (b) a synonym or more preferred term.

See also Refers you to a related term.

Abstract Windowing Toolkit (AWT). A Java graphical user interface (GUI).

accelerated graphics port (AGP). A bus specification that gives low-cost 3D graphics cards faster access to main memory on personal computers than the usual peripheral component interconnect (PCI) bus. AGP reduces the overall cost of creating high-end graphics subsystems by using existing system memory.

access volume. A special logical drive that allows the host-agent to communicate with the controllers in the storage subsystem.

adapter. A printed circuit assembly that transmits user data input/output (I/O) between the internal bus of the host system and the external fibre-channel (FC) link and vice versa. Also called an I/O adapter, host adapter, or FC adapter.

advanced technology (AT) bus architecture. A bus standard for IBM compatibles. It extends the XT bus architecture to 16 bits and also allows for bus mastering, although only the first 16 MB of main memory are available for direct access.

agent. A server program that receives virtual connections from the network manager (the client program) in a Simple Network Management Protocol-Transmission Control Protocol/Internet Protocol (SNMP-TCP/IP) network-managing environment.

AGP. See *accelerated graphics port*.

AL_PA. See *arbitrated loop physical address*.

arbitrated loop. One of three existing fibre-channel topologies, in which 2 - 126 ports are interconnected serially in a single loop circuit. Access to the Fibre Channel-Arbitrated Loop (FC-AL) is controlled by an arbitration scheme. The FC-AL topology supports all classes of service and guarantees in-order delivery of FC frames when the originator and responder are on the same FC-AL. The default topology for the disk array is arbitrated loop. An arbitrated loop is sometimes referred to as a Stealth Mode.

arbitrated loop physical address (AL_PA). An 8-bit value that is used to uniquely identify an individual port within a loop. A loop can have one or more AL_PAs.

array. A set of fibre-channel hard drives that are logically grouped together to form a redundant array of independent disks (RAID) set.

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

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

ATA. See *AT-attached*.

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

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

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

AWT. See *Abstract Windowing Toolkit*.

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

BIOS. See *basic input/output system*.

BOOTP. See *bootstrap protocol*.

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

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

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

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

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

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

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

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

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

CRC. See *cyclic redundancy check*.

CRT. See *cathode ray tube*.

CRU. See *customer replaceable unit*.

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

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

dac. See *disk array controller*.

dar. See *disk array router*.

DASD. See *direct access storage device*.

default host group. A logical collection of discovered host ports, defined host computers, and defined host groups in the storage-partition topology that fulfill the following requirements:

- Are not involved in specific logical drive-to-LUN mappings
- Share access to logical drives with default logical drive-to-LUN mappings

device type. Identifier used to place devices in the physical map, such as the switch, hub, or storage.

DHCP. See *Dynamic Host Configuration Protocol*.

direct access storage device (DASD). A device in which access time is effectively independent of the location of the data. Information is entered and retrieved without reference to previously accessed data. (For example, a disk drive is a DASD, in contrast with a tape drive, which stores data as a linear sequence.) DASDs include both fixed and removable storage devices.

direct memory access (DMA). The transfer of data between memory and an input/output (I/O) device without processor intervention.

disk array controller (dac). A disk array controller device that represents the two controllers of an array. See also *disk array router*.

disk array router (dar). A disk array router that represents an entire array, including current and deferred paths to all logical unit numbers (LUNs) (hdisks on AIX). See also *disk array controller*.

DMA. See *direct memory access*.

domain. The most significant byte in the node port (N_port) identifier for the fibre-channel (FC) device. It is not used in the fibre channel-small computer system interface (FC-SCSI) hardware path ID. It is required to be the same for all SCSI targets logically connected to an FC adapter.

DRAM. See *dynamic random access memory*.

Dynamic Host Configuration Protocol (DHCP). A protocol defined by the Internet Engineering Task Force that is used for dynamically assigning Internet Protocol (IP) addresses to computers in a network.

dynamic random access memory (DRAM). A storage in which the cells require repetitive application of control signals to retain stored data.

ECC. See *error correction coding*.

EEPROM. See *electrically erasable programmable read-only memory*.

EISA. See *Extended Industry Standard Architecture*.

electrically erasable programmable read-only memory (EEPROM). A type of memory chip which can retain its contents without consistent electrical power. Unlike the PROM which can be programmed only once, the EEPROM can be erased electrically. Because it can only be reprogrammed a limited number of times before it wears out, it is appropriate for storing small amounts of data that are changed infrequently.

electrostatic discharge (ESD). The flow of current that results when objects that have a static charge come into close enough proximity to discharge.

environmental services monitor (ESM) canister. A component in a drive enclosure that monitors the environmental condition of the components in that enclosure. Not all storage subsystems have ESM canisters.

E_port. See *expansion port*.

error correction coding (ECC). A method for encoding data so that transmission errors can be detected and corrected by examining the data on the receiving end. Most ECCs are characterized by the maximum number of errors they can detect and correct.

ESD. See *electrostatic discharge*.

ESM canister. See *environmental services monitor canister*.

EXP. See *expansion unit*.

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

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

Extended Industry Standard Architecture (EISA). A bus standard for IBM compatibles that extends the Industry Standard Architecture (ISA) bus architecture to 32 bits and allows more than one central processing unit (CPU) to share the bus. See also *Industry Standard Architecture*.

fabric. A Fibre Channel entity which interconnects and facilitates logins of N_ports attached to it. The fabric is responsible for routing frames between source and destination N_ports using address information in the frame header. A fabric can be as simple as a point-to-point channel between two N-ports, or as complex as a frame-routing switch that provides multiple and redundant internal pathways within the fabric between F_ports.

fabric port (F_port). In a fabric, an access point for connecting a user's N_port. An F_port facilitates N_port logins to the fabric from nodes connected to the fabric. An F_port is addressable by the N_port connected to it. See also *fabric*.

DS4000 MSJ. See *DS4000 Management Suite Java*.

DS4000 Management Suite Java (DS4000 MSJ). A diagnostic and configuration utility that can be used on Linux, Microsoft Windows, and Novell NetWare host systems. In Linux, it is also used with the QLRemote agent to define preferred and non-preferred paths for logical drives.

FC. See *fibre channel*.

FC-AL. See *arbitrated loop*.

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

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

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

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

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

FlashCopy. A premium feature for DS4000 that can make an instantaneous copy of the data in a volume.

F_port. See *fabric port*.

FRU. See *field replaceable unit*.

GBIC. See *gigabit interface converter*

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

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

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

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

GUI. See *graphical user interface.*

HBA. See *host bus adapter*.

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

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

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

host computer. See *host*.

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

host port. Ports that physically reside on the host adapters and are automatically discovered by the DS4000 Storage Manager software. To give a host computer access to a partition, its associated host ports must be defined.

hot swap. To replace a hardware component without turning off the system.

hub. In a network, a point at which circuits are either connected or switched. For example, in a star network, the hub is the central node; in a star/ring network, it is the location of wiring concentrators.

IBMSAN driver. The device driver that is used in a Novell NetWare environment to provide multipath input/output (I/O) support to the storage controller.

IC. See *integrated circuit*.

IDE. See *integrated drive electronics*.

in-band. Transmission of management protocol over the fibre-channel transport.

Industry Standard Architecture (ISA). Unofficial name for the bus architecture of the IBM PC/XT personal computer. This bus design included expansion slots for plugging in various adapter boards. Early versions had an 8-bit data path, later expanded to 16 bits. The ″Extended Industry Standard Architecture″ (EISA) further expanded the data path to 32 bits. See also *Extended Industry Standard Architecture*.

initial program load (IPL). The initialization procedure that causes an operating system to commence operation. Also referred to as a system restart, system startup, and boot.

integrated circuit (IC). A microelectronic semiconductor device that consists of many interconnected transistors and other components. ICs are constructed on a small rectangle cut from a silicon crystal or other semiconductor material. The small size of these circuits allows high speed, low power dissipation, and reduced manufacturing cost compared with board-level integration. Also known as a *chip*.

integrated drive electronics (IDE). A disk drive interface based on the 16-bit IBM personal computer Industry Standard Architecture (ISA) in which the controller electronics reside on the drive itself, eliminating the need for a separate adapter card. Also known as an Advanced Technology Attachment Interface (ATA).

Internet Protocol (IP). A protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network.

Internet Protocol (IP) address. The unique 32-bit address that specifies the location of each device or workstation on the Internet. For example, 9.67.97.103 is an IP address.

interrupt request (IRQ). A type of input found on many processors that causes the processor to suspend normal processing temporarily and start running an interrupt handler routine. Some processors have several interrupt request inputs that allow different priority interrupts.

IP. See *Internet Protocol*.

IPL. See *initial program load*.

IRQ. See *interrupt request*.

ISA. See *Industry Standard Architecture*.

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

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

JRE. See *Java Runtime Environment*.

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

LAN. See *local area network*.

LBA. See *logical block address*.

local area network (LAN). A computer network located on a user's premises within a limited geographic area.

logical block address (LBA). The address of a logical block. Logical block addresses are typically used in hosts' I/O commands. The SCSI disk command protocol, for example, uses logical block addresses.

logical partition (LPAR). (1) A subset of a single system that contains resources (processors, memory, and input/output devices). A logical partition operates as an independent system. If hardware requirements are met, multiple logical partitions can exist within a system. (2) A fixed-size portion of a logical volume. A logical partition is the same size as the physical partitions in its volume group. Unless the logical volume of which it is a part is mirrored, each logical partition corresponds to, and its contents are stored on, a single physical partition. (3) One to three physical partitions (copies). The number of logical partitions within a logical volume is variable.

logical unit number (LUN). An identifier used on a small computer system interface (SCSI) bus to distinguish among up to eight devices (logical units) with the same SCSI ID.

loop address. The unique ID of a node in fibre-channel loop topology sometimes referred to as a loop ID.

loop group. A collection of storage area network (SAN) devices that are interconnected serially in a single loop circuit. Loop groups are discovered by the SANavigator tool and displayed with a gray background on the Physical and Data Path maps.

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

LPAR. See *logical partition*.

LUN. See *logical unit number*.

MAC. See *medium access control*.

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

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

MCA. See *micro channel architecture*.

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

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

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

MIB. See *management information base*.

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

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

model. The model identification that is assigned to a device by its manufacturer.

MSCS. See *Microsoft Cluster Server*.

network management station (NMS). In the Simple Network Management Protocol (SNMP), a station that runs management application programs that monitor and control network elements.

NMI. See *non-maskable interrupt*.

NMS. See *network management station*.

non-maskable interrupt (NMI). A hardware interrupt that another service request cannot overrule (mask). An NMI bypasses and takes priority over interrupt requests generated by software, the keyboard, and other such devices and is issued to the microprocessor only in disastrous circumstances, such as severe memory errors or impending power failures.

node. A physical device that allows for the transmission of data within a network.

node port (N_port). A fibre-channel defined hardware entity that performs data communications over the fibre-channel link. It is identifiable by a unique worldwide name. It can act as an originator or a responder.

nonvolatile storage (NVS). A storage device whose contents are not lost when power is cut off.

N_port. See *node port*.

NVS. See *nonvolatile storage*.

NVSRAM. Nonvolatile storage random access memory. See *nonvolatile storage*.

Object Data Manager (ODM). An AIX proprietary storage mechanism for ASCII stanza files that are edited as part of configuring a drive into the kernel.

ODM. See *Object Data Manager*.

out-of-band. Transmission of management protocols outside of the fibre-channel network, typically over Ethernet.

partitioning. See *storage partition*.

PCI local bus. See *peripheral component interconnect local bus*.

PDF. See *portable document format*.

performance events. Events related to thresholds set on storage area network (SAN) performance.

peripheral component interconnect local bus (PCI local bus). A local bus for PCs, from Intel, that provides a high-speed data path between the CPU and up to 10 peripherals (video, disk, network, and so on). The PCI bus coexists in the PC with the Industry Standard Architecture (ISA) or Extended Industry Standard Architecture (EISA) bus. ISA and EISA boards plug into an IA or EISA slot, while high-speed PCI controllers plug into a PCI slot. See also *Industry Standard Architecture*, *Extended Industry Standard Architecture*.

polling delay. The time in seconds between successive discovery processes during which discovery is inactive.

port. A part of the system unit or remote controller to which cables for external devices (such as display stations, terminals, printers, switches, or external storage units) are attached. The port is an access point for data entry or exit. A device can contain one or more ports.

portable document format (PDF). A standard specified by Adobe Systems, Incorporated, for the electronic distribution of documents. PDF files are compact; can be distributed globally by e-mail, the Web, intranets, or CD-ROM; and can be viewed with the Acrobat Reader, which is software from Adobe Systems that can be downloaded at no cost from the Adobe Systems home page.

premium feature key. A file that the storage subsystem controller uses to enable an authorized premium feature. The file contains the feature enable identifier of the storage subsystem for which the premium feature is authorized, and data about the premium feature. See also *feature enable identifier*.

private loop. A freestanding arbitrated loop with no fabric attachment. See also *arbitrated loop*.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

PTF. See *program temporary fix*.

RAID. See *redundant array of independent disks*.

RAM. See *random-access memory*.

random-access memory (RAM). A temporary storage location in which the central processing unit (CPU) stores and executes its processes. Contrast with *DASD*.

RDAC. See *redundant disk array controller*.

read-only memory (ROM). Memory in which stored data cannot be changed by the user except under special conditions.

recoverable virtual shared disk (RVSD). A virtual shared disk on a server node configured to provide continuous access to data and file systems in a cluster.

redundant array of independent disks (RAID). A collection of disk drives that appears as a single volume to the server and are fault tolerant through mirroring or parity checking.

redundant disk array controller (RDAC). (1) In hardware, a redundant set of controllers (either active/passive or active/active). (2) In software, a layer that manages the input/output (I/O) through the active controller during normal operation and transparently reroutes I/Os to the other controller in the redundant set if a controller or I/O path fails.

remote mirroring. Online, real-time replication of data between storage subsystems that are maintained on separate media. The Enhanced Remote Mirror Option is a DS4000 premium feature that provides support for remote mirroring. See also *Global Mirroring*, *Metro Mirroring*.

ROM. See *read-only memory*.

router. A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses.

RVSD. See *recoverable virtual shared disk*.

SAI. See *Storage Array Identifier*.

SA Identifier. See *Storage Array Identifier*.

SAN. See *storage area network*.

SATA. See *serial ATA*.

scope. Defines a group of controllers by their Internet Protocol (IP) addresses. A scope must be created and defined so that dynamic IP addresses can be assigned to controllers on the network.

SCSI. See *small computer system interface*.

segmented loop port (SL_port). A port that allows division of a fibre-channel private loop into multiple segments. Each segment can pass frames around as an independent loop and can connect through the fabric to other segments of the same loop.

sense data. (1) Data sent with a negative response, indicating the reason for the response. (2) Data describing an I/O error. Sense data is presented to a host system in response to a sense request command.

serial ATA. The standard for a high-speed alternative to small computer system interface (SCSI) hard drives. The SATA-1 standard is equivalent in performance to a 10 000 RPM SCSI drive.

serial storage architecture (SSA). An interface specification from IBM in which devices are arranged in a ring topology. SSA, which is compatible with small computer system interface (SCSI) devices, allows full-duplex packet multiplexed serial data transfers at rates of 20 Mbps in each direction.

server. A functional hardware and software unit that delivers shared resources to workstation client units on a computer network.

server/device events. Events that occur on the server or a designated device that meet criteria that the user sets.

SFP. See *small form-factor pluggable*.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SL_port. See *segmented loop port*.

SMagent. The DS4000 Storage Manager optional Java-based host-agent software, which can be used on Microsoft Windows, Novell NetWare, HP-UX, and Solaris host systems to manage storage subsystems through the host fibre-channel connection.

SMclient. The DS4000 Storage Manager client software, which is a Java-based graphical user interface (GUI) that is used to configure, manage, and troubleshoot storage servers and expansion units in a DS4000 storage subsystem. SMclient can be used on a host system or on a storage management station.

SMruntime. A Java compiler for the SMclient.

SMutil. The DS4000 Storage Manager utility software that is used on Microsoft Windows, HP-UX, and Solaris host systems to register and map new logical drives to the operating system. In Microsoft Windows, it also contains a utility to flush the cached data of the operating system for a particular drive before creating a FlashCopy.

small computer system interface (SCSI). A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

small form-factor pluggable (SFP). An optical transceiver that is used to convert signals between optical fiber cables and switches. An SFP is smaller than a gigabit interface converter (GBIC). See also *gigabit interface converter*.

SNMP. See *Simple Network Management Protocol* and *SNMPv1*.

SNMP time-out. The maximum amount of time the SANavigator tool will wait for a device to respond to a request. The specified time applies to one retry only.

SNMP trap event. (1) (2) An event notification sent by the SNMP agent that identifies conditions, such as thresholds, that exceed a predetermined value. See also *Simple Network Management Protocol*.

SNMPv1. The original standard for SNMP is now referred to as SNMPv1, as opposed to SNMPv2, a revision of SNMP. See also *Simple Network Management Protocol*.

SRAM. See *static random access memory*.

SSA. See *serial storage architecture*.

static random access memory (SRAM). Random access memory based on the logic circuit know as flip-flop. It is called static because it retains a value as long as power is supplied, unlike dynamic random access memory (DRAM), which must be regularly refreshed. It is however, still volatile, meaning that it can lose its contents when the power is turned off.

storage area network (SAN). A dedicated storage network tailored to a specific environment, combining servers, storage products, networking products, software, and services. See also *fabric*.

Storage Array Identifier (SAI or SA Identifier). The Storage Array Identifier is the identification value used by the DS4000 Storage Manager host software (SMClient) to uniquely identify each managed storage server. The DS4000 Storage Manager SMClient program maintains Storage Array Identifier records of previously-discovered storage servers in the host resident file, which allows it to retain discovery information in a persistent fashion.

storage management station. A system that is used to manage the storage subsystem. A storage management station does not need to be attached to the storage subsystem through the fibre-channel input/output (I/O) path.

storage partition. Storage subsystem logical drives that are visible to a host computer or are shared among host computers that are part of a host group.

storage partition topology. In the DS4000 Storage Manager client, the Topology view of the Mappings window displays the default host group, the defined host group, the host computer, and host-port nodes. The host port, host computer, and host group topological elements must be defined to grant access to host computers and host groups using logical drive-to-LUN mappings.

subnet. An interconnected but independent segment of a network that is identified by its Internet Protocol (IP) address.

sweep method. A method of sending Simple Network Management Protocol (SNMP) requests for information to all the devices on a subnet by sending the request to every device in the network.

switch. A fibre-channel device that provides full bandwidth per port and high-speed routing of data by using link-level addressing.

switch group. A switch and the collection of devices connected to it that are not in other groups. Switch groups are discovered by the SANavigator tool and displayed with a gray background on the Physical and Data Path maps.

switch zoning. See *zoning*.

synchronous write mode. In remote mirroring, an option that requires the primary controller to wait for the acknowledgment of a write operation from the secondary controller before returning a write I/O request completion to the host. See also *asynchronous write mode*, *remote mirroring*, *Metro Mirroring*.

system name. Device name assigned by the vendor's third-party software.

TCP. See *Transmission Control Protocol*.

TCP/IP. See *Transmission Control Protocol/Internet Protocol*.

terminate and stay resident program (TSR program). A program that installs part of itself as an extension of DOS when it is executed.

topology. The physical or logical arrangement of devices on a network. The three fibre-channel topologies are fabric, arbitrated loop, and point-to-point. The default topology for the disk array is arbitrated loop.

TL_port. See *translated loop port*.

transceiver. A device that is used to transmit and receive data. Transceiver is an abbreviation of transmitter-receiver.

translated loop port (TL_port). A port that connects to a private loop and allows connectivity between the private loop devices and off loop devices (devices not connected to that particular TL_port).

Transmission Control Protocol (TCP). A communication protocol used in the Internet and in any network that follows the Internet Engineering Task Force (IETF) standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packed-switched communication networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP). A set of communication protocols that provide peer-to-peer connectivity functions for both local and wide-area networks.

trap. In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition.

trap recipient. Receiver of a forwarded Simple Network Management Protocol (SNMP) trap. Specifically, a trap receiver is defined by an Internet Protocol (IP) address and port to which traps are sent. Presumably, the actual recipient is a software application running at the IP address and listening to the port.

TSR program. See *terminate and stay resident program*.

uninterruptible power supply. A source of power from a battery that is installed between a computer system and its power source. The uninterruptible power supply keeps the system running if a commercial power failure occurs, until an orderly shutdown of the system can be performed.

user action events. Actions that the user takes, such as changes in the storage area network (SAN), changed settings, and so on.

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

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

WORM. See *write-once read-many*.

write-once read many (WORM). Any type of storage medium to which data can be written only a single time, but can be read from any number of times. After the data is recorded, it cannot be altered.

WWN. See *worldwide name*.

zoning. (1) In Fibre Channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones. (2) A function that allows segmentation of nodes by address, name, or physical port and is provided by fabric switches or hubs.

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