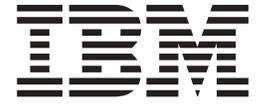IBM System Storage DS8000
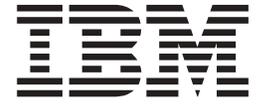
Introduction and Planning Guide

Version 1 Release 2

IBM System Storage DS8000

Introduction and Planning Guide

Version 1 Release 2

> **Note:**
>
> Before using this information and the product it supports, read the information in the **Safety and environmental notices** and **Notices** sections.

Contents

Figures

Tables

About this guide

This publication introduces the IBM® System Storage™ DS8000™ series.

This guide discusses:
- What you need to consider when planning for the DS8000 storage unit.
- How you can customize your DS8000 storage unit.

Who should use this guide

This publication is for storage administrators, system programmers, and performance and capacity analysts.

Notices and publication information

This section contains information about safety notices that are used in this guide, environmental notices for this product, publication information, and information about sending your comments to IBM.

Safety notices

Complete this task to find information about safety notices.

To find the translated text for a danger or caution notice:

1. Look for the identification number at the end of each danger notice or each caution notice. In the following examples, the numbers **1000** and **1001** are the identification numbers.

   DANGER

   A danger notice indicates the presence of a hazard that has the potential of causing death or serious personal injury.

   1000

   CAUTION:
   A caution notice indicates the presence of a hazard that has the potential of causing moderate or minor personal injury.

   1001

2. Find the number that matches in the *IBM System Storage Solutions Safety Notices for IBM Versatile Storage Server and IBM System Storage Enterprise Storage Server*, GC26-7229.

Environmental notices

This section identifies the environmental guidelines that pertain to this product.

Product recycling and disposal

This unit contains recyclable materials.

This unit must be recycled or discarded according to applicable local and national regulations. IBM encourages owners of information technology (IT) equipment to responsibly recycle their equipment when it is no longer needed. IBM offers a variety of product return programs and services in several countries to assist equipment owners in recycling their IT products. Information on IBM product recycling offerings can be found on IBM's Internet site at http://www.ibm.com/ibm/environment/products/prp.shtml.

Notice: This mark applies only to countries within the European Union (EU) and Norway.

Appliances are labeled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to various products to indicate that the product is not to be thrown away, but rather reclaimed upon end of life per this Directive.

In accordance with the European WEEE Directive, electrical and electronic equipment (EEE) is to be collected separately and to be reused, recycled, or recovered at end of life. Users of EEE with the WEEE marking per Annex IV of the WEEE Directive, as shown above, must not dispose of end of life EEE as unsorted municipal waste, but use the collection framework available to customers for the return, recycling and recovery of WEEE. Customer participation is important to minimize any potential effects of EEE on the environment and human health due to the potential presence of hazardous substances in EEE. For proper collection and treatment, contact your local IBM representative.

Battery return program

This product may contain sealed lead acid, nickel cadmium, nickel metal hydride, lithium, or lithium ion battery. Consult your user manual or service manual for specific battery information. The battery must be recycled or disposed of properly. Recycling facilities may not be available in your area. For information on disposal of batteries outside the United States, go to http://www.ibm.com/ibm/ environment/products/batteryrecycle.shtml or contact your local waste disposal facility.

In the United States, IBM has established a return process for reuse, recycling, or proper disposal of used IBM sealed lead acid, nickel cadmium, nickel metal hydride, and other battery packs from IBM Equipment. For information on proper disposal of these batteries, contact IBM at 1-800-426-4333. Please have the IBM part number listed on the battery available prior to your call.

In the Netherlands the following applies:
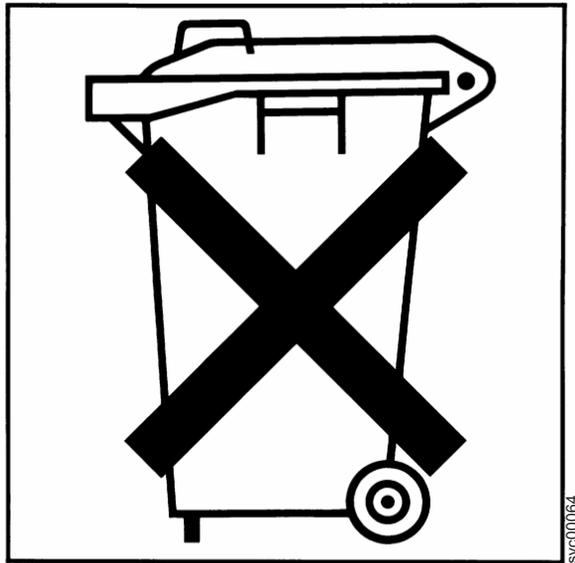
For Taiwan:

Please recycle batteries.

廢電池請回收

Conventions used in this guide

The following typefaces are used to show emphasis:

boldface
Text in **boldface** represents menu items and lowercase or mixed-case command names.

italics Text in *italics* is used to emphasize a word. In command syntax, it is used for variables for which you supply actual values.

`monospace`
Text in `monospace` identifies the data or commands that you type, samples of command output, or examples of program code or messages from the system.

Related information

The tables in this section list and describe the following publications:

- The publications that make up the IBM® System Storage™ DS8000 series library
- Other IBM publications that relate to the DS8000 series
- Non-IBM publications that relate to the DS8000 series

See "Ordering IBM publications" on page xix for information about how to order publications in the IBM System Storage DS8000 series publication library. See "How to send your comments" on page xx for information about how to send comments about the publications.

DS8000 series library

These customer publications make up the DS8000 series library.

Unless otherwise noted, these publications are available in Adobe portable document format (PDF) on a compact disc (CD) that comes with the storage unit. If you need additional copies of this CD, the order number is SK2T-8825. These publications are also available as PDF files by clicking on the **Documentation link** on the following Web site:

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

See "Ordering IBM publications" on page xix for information about ordering these and other IBM publications.

Title	Description	Order Number
IBM System Storage DS: Command-Line Interface User's Guide	This guide describes the commands that you can use from the command-line interface (CLI) for managing your DS8000 configuration and Copy Services relationships. The CLI application provides a set of commands that you can use to write customized scripts for a host system. The scripts initiate predefined tasks in a Copy Services server application. You can use the CLI commands to indirectly control Remote Mirror and Copy and FlashCopy® configuration tasks within a Copy Services server group.	SC26-7625 (See Note.)
IBM System Storage DS8000: Host Systems Attachment Guide	This guide provides guidelines for attaching the DS8000 to your host system and for migrating to fibre-channel attachment from a small computer system interface.	SC26-7628 (See Note.)
IBM System Storage DS8000: Introduction and Planning Guide	This guide introduces the DS8000 product and lists the features you can order. It also provides guidelines for planning the installation and configuration of the storage unit.	GC35-0495
IBM System Storage Multipath Subsystem Device Driver User's Guide	This publication describes how to use the IBM Subsystem Device Driver (SDD) on open-systems hosts to enhance performance and availability on the DS8000. SDD creates single devices (vpaths) that consolidate redundant paths for logical unit numbers. SDD permits applications to run without interruption when path errors occur. It balances the workload across paths, and it transparently integrates with applications.	SC30-4096
IBM System Storage DS8000: User's Guide	This guide provides instructions for setting up and operating the DS8000 and for analyzing problems.	SC26-7623 (See Note.)
IBM System Storage DS Application Programming Interface Reference	This publication provides reference information for the IBM System Storage DS application programming interface (API) and provides instructions for installing the Common Information Model Agent, which implements the API.	GC35-0493

Title	Description	Order Number
IBM System Storage DS8000 Messages Reference	This publication provides explanations of error, information, and warning messages that are issued from the DS8000 user interfaces.	GC26-7659
Note: No hardcopy book is produced for this publication. However, a PDF file is available from the following Web site: http://www-1.ibm.com/servers/storage/support/disk		

Other IBM publications

Other IBM publications contain additional information that is related to the DS product library.

The following list is divided into categories to help you find publications that are related to specific topics. Some of the publications are listed under more than one category. See "Ordering IBM publications" on page xix for information about ordering these and other IBM publications.

Title	Description	Order Number
Data-copy services		
z/OS DFSMS Advanced Copy Services	This publication helps you understand and use IBM Advanced Copy Services functions. It describes three dynamic copy functions and several point-in-time copy functions. These functions provide backup and recovery of data if a disaster occurs to your data center. The dynamic copy functions are peer-to-peer remote copy, extended remote copy, and coupled extended remote copy. Collectively, these functions are known as remote copy. FlashCopy, SnapShot, and concurrent copy are the point-in-time copy functions.	SC35-0428
IBM Enterprise Storage Server	This publication, from the IBM International Technical Support Organization, introduces the Enterprise Storage Server and provides an understanding of its benefits. It also describes in detail the architecture, hardware, and functions, including the advanced copy functions, of the Enterprise Storage Server.	SG24-5465
Implementing Copy Services 0n S/390	This publication, from the IBM International Technical Support Organization, tells you how to install, customize, and configure Copy Services on an Enterprise Storage Server that is attached to an S/390 or zSeries host system. Copy Services functions include peer-to-peer remote copy (PPRC), extended remote copy (XRC), FlashCopy®, and concurrent copy. This publication describes the functions, prerequisites, and corequisites and describes how to implement each function into your environment.	SG24-5680
IBM TotalStorage ESS Implementing Copy Services in an Open Environment	This publication, from the IBM International Technical Support Organization, tells you how to install, customize, and configure Copy Services on UNIX, Windows NT®, Windows 2000, Sun Solaris, HP-UX, Tru64, OpenVMS, and iSeries host systems. The Copy Services functions that are described include peer-to-peer remote copy (PPRC) and FlashCopy. This publication describes the functions and shows you how to implement them into your environment. It also shows you how to implement these functions in a high-availability cluster multiprocessing environment.	SG24-5757
Fibre channel		

Title	Description	Order Number
Fibre Channel Connection (FICON) I/O Interface: Physical Layer	This publication provides information about the fibre-channel I/O interface. This book is also available as a PDF file from the following Web site: http://www.ibm.com/servers/resourcelink/	SA24-7172
Fibre Transport Services (FTS): Physical and Configuration Planning Guide	This publication provides information about fibre-optic and ESCON-trunking systems.	GA22-7234
IBM SAN Fibre Channel Switch: 2109 Model S08 Installation and Service Guide	This guide describes how to install and maintain the IBM SAN Fibre Channel Switch 2109 Model S08.	SC26-7350
IBM SAN Fibre Channel Switch: 2109 Model S08 User's Guide	This guide describes the IBM SAN Fibre Channel Switch and the IBM TotalStorage ESS Specialist. It provides information about the commands and how to manage the switch with Telnet and the Simple Network Management Protocol.	SC26-7349
IBM SAN Fibre Channel Switch: 2109 Model S16 Installation and Service Guide	This publication describes how to install and maintain the IBM SAN Fibre Channel Switch 2109 Model S16. It is intended for trained service representatives and service providers.	SC26-7352
IBM SAN Fibre Channel Switch: 2109 Model S16 User's Guide	This guide introduces the IBM SAN Fibre Channel Switch 2109 Model S16 and tells you how to manage and monitor the switch using zoning and how to manage the switch remotely.	SC26-7351
Implementing Fibre Channel Attachment on the ESS	This publication, from the IBM International Technical Support Organization, helps you install, tailor, and configure fibre-channel attachment of open-systems hosts to the Enterprise Storage Server. It provides you with a broad understanding of the procedures that are involved and describes the prerequisites and requirements. It also shows you how to implement fibre-channel attachment.	SG24-6113
Open-systems hosts		
ESS Solutions for Open Systems Storage: Compaq AlphaServer, HP, and Sun	This publication, from the IBM International Technical Support Organization, helps you install, tailor, and configure the Enterprise Storage Server when you attach Compaq AlphaServer (running Tru64 UNIX), HP, and Sun hosts. This book does not cover Compaq AlphaServer that is running the OpenVMS operating system. This book also focuses on the settings that are required to give optimal performance and on the settings for device driver levels. This book is for the experienced UNIX professional who has a broad understanding of storage concepts.	SG24-6119
IBM TotalStorage ESS Implementing Copy Services in an Open Environment	This publication, from the IBM International Technical Support Organization, tells you how to install, customize, and configure Copy Services on UNIX or Windows 2000 host systems. The Copy Services functions that are described include peer-to-peer remote copy and FlashCopy. This publication describes the functions and shows you how to implement them into your environment. It also shows you how to implement these functions in a high-availability cluster multiprocessing environment.	SG24-5757
Implementing Fibre Channel Attachment on the ESS	This publication, from the IBM International Technical Support Organization, helps you install, tailor, and configure fibre-channel attachment of open-systems hosts to the Enterprise Storage Server. It gives you a broad understanding of the procedures that are involved and describes the prerequisites and requirements. It also shows you how to implement fibre-channel attachment.	SG24-6113

Title	Description	Order Number
	S/390 and zSeries hosts	
Device Support Facilities: User's Guide and Reference	This publication describes the IBM Device Support Facilities (ICKDSF) product that are used with IBM direct access storage device (DASD) subsystems. ICKDSF is a program that you can use to perform functions that are needed for the installation, the use, and the maintenance of IBM DASD. You can also use it to perform service functions, error detection, and media maintenance.	GC35-0033
z/OS Advanced Copy Services	This publication helps you understand and use IBM Advanced Copy Services functions. It describes three dynamic copy functions and several point-in-time copy functions. These functions provide backup and recovery of data if a disaster occurs to your data center. The dynamic copy functions are peer-to-peer remote copy, extended remote copy, and coupled extended remote copy. Collectively, these functions are known as remote copy. FlashCopy, SnapShot, and concurrent copy are the point-in-time copy functions.	SC35-0428
DFSMS/MVS V1: Remote Copy Guide and Reference	This publication provides guidelines for using remote copy functions with S/390 and zSeries hosts.	SC35-0169
Fibre Transport Services (FTS): Physical and Configuration Planning Guide	This publication provides information about fibre-optic and ESCON-trunking systems.	GA22-7234
Implementing ESS Copy Services on S/390	This publication, from the IBM International Technical Support Organization, tells you how to install, customize, and configure Copy Services on an Enterprise Storage Server that is attached to an S/390 or zSeries host system. Copy Services functions include peer-to-peer remote copy, extended remote copy, FlashCopy, and concurrent copy. This publication describes the functions, prerequisites, and corequisites and describes how to implement each function into your environment.	SG24-5680
ES/9000, ES/3090: IOCP User Guide Volume A04	This publication describes the Input/Output Configuration Program that supports the Enterprise Systems Connection (ESCON) architecture. It describes how to define, install, and configure the channels or channel paths, control units, and I/O devices on the ES/9000 processors and the IBM ES/3090 Processor Complex.	GC38-0097
IOCP User's Guide, IBM e(logo)server zSeries 800 and 900	This publication describes the Input/Output Configuration Program that supports the zSeries 800 and 900 servers. This publication is available in PDF format by accessing ResourceLink at the following Web site: www.ibm.com/servers/resourcelink/	SB10-7029
IOCP User's Guide, IBM e(logo)server zSeries	This publication describes the Input/Output Configuration Program that supports the zSeries server. This publication is available in PDF format by accessing ResourceLink at the following Web site: www.ibm.com/servers/resourcelink/	SB10-7037
S/390: Input/Output Configuration Program User's Guide and ESCON Channel-to-Channel Reference	This publication describes the Input/Output Configuration Program that supports ESCON architecture and the ESCON multiple image facility.	GC38-0401
IBM z/OS Hardware Configuration Definition User's Guide	This guide provides conceptual and procedural information to help you use the z/OS Hardware Configuration Definition (HCD) application. It also explains: • How to migrate existing IOCP/MVSCP definitions • How to use HCD to dynamically activate a new configuration • How to resolve problems in conjunction with MVS/ESA HCD	SC33-7988

Title	Description	Order Number
OS/390: Hardware Configuration Definition User's Guide	This guide provides detailed information about the input/output definition file and about how to configure parallel access volumes. This guide discusses how to use Hardware Configuration Definition for both OS/390® and z/OS V1R1.	SC28-1848
OS/390 V2R10.0: MVS System Messages Volume 1 (ABA - ASA)	This publication lists OS/390 MVS™ system messages ABA to ASA.	GC28-1784
Using IBM 3390 Direct Access Storage in a VM Environment	This publication provides device-specific information for the various models of the 3390 and describes methods you can use to manage storage efficiently using the VM operating system. It provides guidance on managing system performance, availability, and space through effective use of the direct access storage subsystem.	GG26-4575
Using IBM 3390 Direct Access Storage in a VSE Environment	This publication helps you use the 3390 in a VSE environment. It includes planning information for adding new 3390 units and instructions for installing devices, migrating data, and performing ongoing storage management activities.	GC26-4576
Using IBM 3390 Direct Access Storage in an MVS Environment	This publication helps you use the 3390 in an MVS environment. It includes device-specific information for the various models of the 3390 and illustrates techniques for more efficient storage management. It also offers guidance on managing system performance, availability, and space utilization through effective use of the direct access storage subsystem.	GC26-4574
z/Architecture Principles of Operation	This publication provides a detailed definition of the z/Architecture™. It is written as a reference for use primarily by assembler language programmers and describes each function at the level of detail needed to prepare an assembler language program that relies on a particular function. However, anyone concerned with the functional details of z/Architecture will find this publication useful.	SA22-7832
SAN		
IBM OS/390 Hardware Configuration Definition User's Guide	This guide explains how to use the Hardware Configuration Data application to perform the following tasks: • Define new hardware configurations • View and modify existing hardware configurations • Activate configurations • Query supported hardware • Maintain input/output definition files (IODFs) • Compare two IODFs or compare an IODF with an actual configuration • Print reports of configurations • Create graphical reports of a configuration • Migrate existing configuration data	SC28-1848
IBM SAN Fibre Channel Switch: 2109 Model S08 Installation and Service Guide	This guide describes how to install and maintain the IBM SAN Fibre Channel Switch 2109 Model S08.	SC26-7350
IBM SAN Fibre Channel Switch: 2109 Model S08 User's Guide	This guide describes the IBM SAN Fibre Channel Switch and the IBM TotalStorage ESS Specialist. It provides information about the commands and how to manage the switch with Telnet and the Simple Network Management Protocol (SNMP).	SC26-7349
IBM SAN Fibre Channel Switch: 2109 Model S16 Installation and Service Guide	This publication describes how to install and maintain the IBM SAN Fibre Channel Switch 2109 Model S16. It is intended for trained service representatives and service providers.	SC26-7352

Title	Description	Order Number
IBM SAN Fibre Channel Switch: 2109 Model S16 User's Guide	This guide introduces the IBM SAN Fibre Channel Switch 2109 Model S16 and tells you how to manage and monitor the switch using zoning and how to manage the switch remotely.	SC26-7351
Implementing Fibre Channel Attachment on the ESS	This publication, from the IBM International Technical Support Organization, helps you install, tailor, and configure fibre-channel attachment of open-systems hosts to the Enterprise Storage Server. It provides you with a broad understanding of the procedures that are involved and describes the prerequisites and requirements. It also shows you how to implement fibre-channel attachment.	SG24-6113
Seascape family		
IBM Enterprise Storage Server	This publication, from the IBM International Technical Support Organization, introduces the Enterprise Storage Server and provides an understanding of its benefits. It also describes in detail the architecture, hardware, and functions, including the advanced copy functions, of the Enterprise Storage Server.	SG24-5465
IBM Enterprise Storage Server Performance Monitoring and Tuning Guide	This guide, from the IBM International Technical Support Organization, provides guidance on the best way to configure, monitor, and manage your Enterprise Storage Server to ensure optimum performance.	SG24-5656
IBM Versatile Storage Server: Introduction and Planning Guide	This publication introduces the IBM Versatile Storage Server™ and lists the features you can order. It also provides planning information for both 2105 Models B09 and 100.	GC26-7223
Implementing the IBM Enterprise Storage Server in Your Environment	This publication, from the IBM International Technical Support Organization, can help you install, tailor, and configure the Enterprise Storage Server in your environment.	SG24-5420
Storage management		
Device Support Facilities: User's Guide and Reference	This publication describes the IBM Device Support Facilities (ICKDSF) product used with IBM direct access storage device (DASD) subsystems. ICKDSF is a program that you can use to perform functions that are needed for the installation, the use, and the maintenance of IBM DASD. You can also use it to perform service functions, error detection, and media maintenance.	GC35-0033
IBM TotalStorage Solutions Handbook	This handbook, from the IBM International Technical Support Organization, helps you understand what makes up enterprise storage management. The concepts include the key technologies that you must know and the IBM subsystems, software, and solutions that are available today. It also provides guidelines for implementing various enterprise storage administration tasks so that you can establish your own enterprise storage management environment.	SG24-5250

Ordering IBM publications

You can order copies of IBM publications using the IBM publications center.

IBM publications center

The publications center is a worldwide central repository for IBM product publications and marketing material.

The IBM publications center offers customized search functions to help you find the publications that you need. Some publications are available for you to view or download free of charge. You can also order publications. The publications center displays prices in your local currency. You can access the IBM publications center through the following Web site:

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

Note: Open the Web site in a new browser window by right clicking on the link
and selecting "Open in New Window."

Web sites

The following Web sites provide information about the IBM System Storage
DS8000 series and other IBM storage products.

Type of Storage Information	Web Site
Concurrent Copy for S/390 and zSeries host systems	http://www.storage.ibm.com/software/sms/sdm/
Copy Services command-line interface (CLI)	http://www-1.ibm.com/servers/storage/support/software/cscli/
DS8000 Information Center	http://publib.boulder.ibm.com/infocenter/ds8000ic/index.jsp
DS8000 series publications	http://www-1.ibm.com/servers/storage/support/disk Click **Documentation**.
FlashCopy for S/390 and zSeries host systems	http://www.storage.ibm.com/software/sms/sdm/
Host system models, operating systems, and adapters that the storage unit supports	http://www.ibm.com/servers/storage/disk/ds8000/ Click **Interoperability matrix**.
IBM Disk Storage Feature Activation (DSFA)	http://www.ibm.com/storage/dsfa
IBM storage products	http://www.storage.ibm.com/
IBM System Storage DS8000 series	http://www-1.ibm.com/servers/storage/disk/ds8000
IBM version of the Java (JRE) that is often required for IBM products	http://www-106.ibm.com/developerworks/java/jdk/
Multiple Device Manager (MDM)	http://www.ibm.com/servers/storage/support/ Click **Storage Virtualization**.
Remote Mirror and Copy (formerly PPRC) for S/390 and zSeries host systems	http://www.storage.ibm.com/software/sms/sdm/
SAN fibre channel switches	http://www.ibm.com/storage/fcswitch/
Storage Area Network Gateway and Router	http://www-1.ibm.com/servers/storage/support/san/
Subsystem Device Driver (SDD)	http://www-03.ibm.com/servers/storage/support/software/sdd
Technical notes and product tips	http://www.ibm.com/servers/storage/support/disk/ds8100/ Click **Technical notes** on the Troubleshooting tab.
z/OS Global Mirror (formerly XRC) for S/390 and zSeries host systems	http://www.storage.ibm.com/software/sms/sdm/

How to send your comments

Your feedback is important to help us provide the highest quality information. If
you have any comments about this information or any other DS8000 series
documentation, you can submit them in the following ways:

- e-mail

  Submit your comments electronically to the following e-mail address:

starpubs@us.ibm.com

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

- Mail

Fill out the Readers' Comments form (RCF) at the back of this book. Return it by mail or give it to an IBM representative. If the RCF has been removed, you can address your comments to:

International Business Machines Corporation
RCF Processing Department
Department 61C
9032 South Rita Road
TUCSON AZ 85775-4401

Summary of Changes for GC35-0515-01 IBM System Storage DS8000 Introduction and Planning Guide

This document contains terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change. This summary of changes describes new features that have been added to this release.

New Information

- Earthquake Resistance Kit planning instructions are now included. If you order an Earthquake Resistance Kit, you must prepare your site prior to the IBM service representative installing the kit.
- New hardware machine types 2421 (one year warranty), 2422 (two-year warranty), 2423 (three-year warranty), and 2424 (four-year warranty) are now available.
- New function authorization machine types 2396 (one year warranty), 2397 (two-year warranty), 2398 (three-year warranty), and 2399 (four-year warranty) are now available.
- The IBM HyperPAV features is now available. This feature associates the volumes with either an alias address or a specified base logical volume number.
- A new performance accelerator feature is now available. This feature allows you to install only two disk drive features (32 disk drives) per device adapter pair instead of four disk drive features (64 disk drives), which is the minimum standard configuration.
- A topic explaining the model conversion limitations is now included.

Changed Information

- The information that describes valid disk drive set configurations has been corrected and enhanced.
- The introductory information for the parallel access volumes (PAV) has been enhanced.
- The information describing the requirements for locating an external master console has been enhanced.

Chapter 1. Introduction to IBM System Storage DS8000 series

IBM System Storage DS8000 is a high-performance, high-capacity series of disk storage that is designed to support continuous operations. DS8000 series models (machine type 2107/242x) use the IBM POWER5™ server technology that is integrated with the IBM Virtualization Engine™ technology. DS8000 series models consist of a storage unit and one or two management consoles, two being the recommended configuration. You can attach a maximum of four DS8000s to each management console. The graphical user interface (GUI) or the command-line interface (CLI) allows you to logically partition storage and use the built-in Copy Services functions. For high-availability, hardware components are redundant.

You can read the following information to familiarize yourself with the DS8000 series:

- DS8000 series machine types
- DS8000 series models, including a model comparison chart
- DS8000 series performance features
- DS8000 series interfaces
- DS8000 series hardware specifics
- Supported systems for open systems, S/390®, and zSeries® hosts
- Data management elements
- Copy Services
- Data migration

You can also view the DS8000 e-learning overview from the DS8000 Storage Manager Welcome page or at the following Web site:

http://www-1.ibm.com/support/docview.wss?rs=1113&uid=ssg1S7001199

The e-learning overview provides an animated presentation about installation and configuration, service and support, and management tasks.

Overview of the DS8000 series machine types

The DS8000 series includes several machine types. You order a hardware machine type for the storage unit hardware and a corresponding function authorization machine type for the licensed functions that you plan to use.

Table 1 shows the available hardware machine types and their corresponding function authorization machine types.

Table 1. Available hardware and function authorization machine types

Hardware		Licensed functions	
Hardware machine type	Available hardware models	Corresponding function authorization machine type	Available function authorization models
Machine type 2107	Models 921, 931, 922, 932, 92E, 9A2, 9B2, and 9AE (See Note)	Machine type 2244	Models OEL, PTC, RMC, RMZ, and PAV

Table 1. Available hardware and function authorization machine types (continued)

Hardware		Licensed functions	
Hardware machine type	Available hardware models	Corresponding function authorization machine type	Available function authorization models
Machine type 2421 (1-year warranty period)	Models 931, 932, 92E, 9B2, 9AE	Machine type 2396 (1-year warranty period)	Model LFA
Machine type 2422 (2-year warranty period)		Machine type 2397 (2-year warranty period)	
Machine type 2423 (3-year warranty period)		Machine type 2398 (3-year warranty period)	
Machine type 2424 (4-year warranty period)		Machine type 2399 (4-year warranty period)	
Note: All 2107 hardware models have been withdrawn from marketing. Although you can no longer order these hardware models directly from IBM, you can order add-on features or licensed functions for your existing 2107 hardware models. You can obtain the hardware models on an as-available basis through IBM Business Partners.			

An intermix of 242x hardware machine types (warranty machine types) is not supported within one storage unit. For example, you cannot have a storage unit composed of a 2421 Model 931 (one-year warranty) and a 2423 Model 92E (three-year warranty). The only exception is that 2424 models can be intermixed with 2107 models. For example, you can have a storage unit composed of a 2107 Model 932 and a 2424 Model 92E.

Because the 242x hardware machine types are built upon the 2107 machine type and microcode, you may see some interfaces propogate or display "2107". This is normal, and you should not be alarmed. (The 242x machine type that you purchased is the valid machine type.)

Overview of the DS8000 series models

The DS8000 series offers various choices of base and expansion models, so you can configure storage units that meet your performance and configuration needs.

DS8100

> The DS8100 (Models 921 and 931) features a dual two-way processor complex and support for one expansion frame.

DS8300

> The DS8300 (Models 922, 932, 9A2, and 9B2) features a dual four-way processor complex and support for one or two expansion frames. Models 9A2 and 9B2 support two IBM System Storage System logical partitions (LPARs) in one storage unit.

DS8000 expansion models (Models 92E, 9AE) can be attached to a base model to expand its capabilities:

> 921 and 931 (base) can attach to 92E (expansion)

> 922 and 932 (base) can attach to 92E (expansion)

9A2 and 9B2 (base) can attach to 9AE (expansion)

Note: Models 921, 922, and 9A2 apply only to hardware machine type 2107. These models and all other 2107 hardware models have been withdrawn from marketing. Although you can no longer order these hardware models directly from IBM, you can order add-on features or licensed functions for your existing 2107 hardware models. You can obtain the hardware models on an as-available basis through IBM Business Partners.

Figure 1 provides a high-level view of the components of a base model (Models 921, 922, 931, 932, 9A2, 9B2).
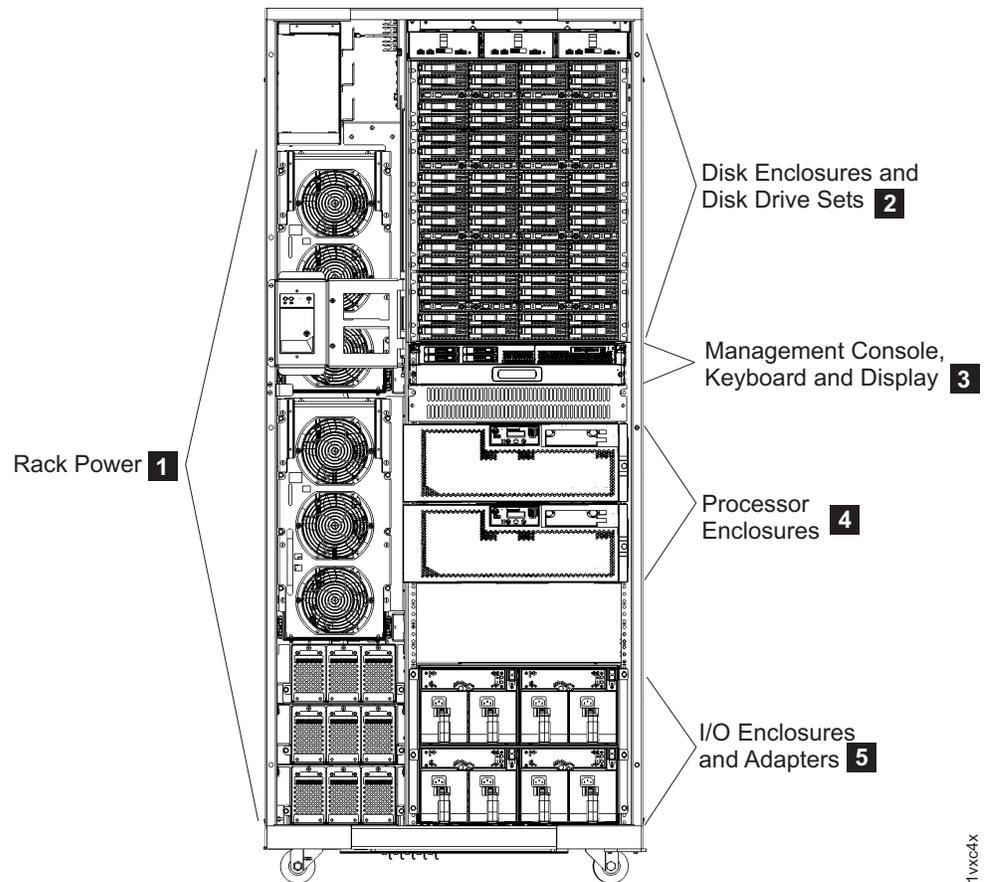
Figure 1. A base model (with front cover off) and its main components

The following notes provide additional information about the labeled components on Figure 1:

1. The *rack power* area of the base models provides redundant power supplies (two primary power supplies), power control cards, and backup battery assemblies to help protect data in the event of a loss of external power. Models 921 and 931 contain two batteries. Models 922, 932, 9A2, and 9B2 contain three batteries to support the 4-way processors.

2. All base models allow up to eight *disk enclosures*, which contain the disk drives. In a maximum configuration, each base model can hold up to 128 disk drives.

3. All base models contain one *management console*, a keyboard, and display. The management console is the focal point for configuration, copy services management, and maintenance activities.

4. All base models contain two *processor enclosures*. The Model 921 and 931 processor enclosures have 2-way processors. Processor enclosures on Models 922, 932, 9A2, and 9B2 have 4-way processors.

5. All base models contain *I/O enclosures* and *adapters*. The I/O enclosures hold the adapters and provide connectivity between the adapters and the processors. Both device adapters and host adapters are installed in the I/O enclosure.

Figure 2 provides a high-level view of the components of an expansion model (Models 92E, 9AE).
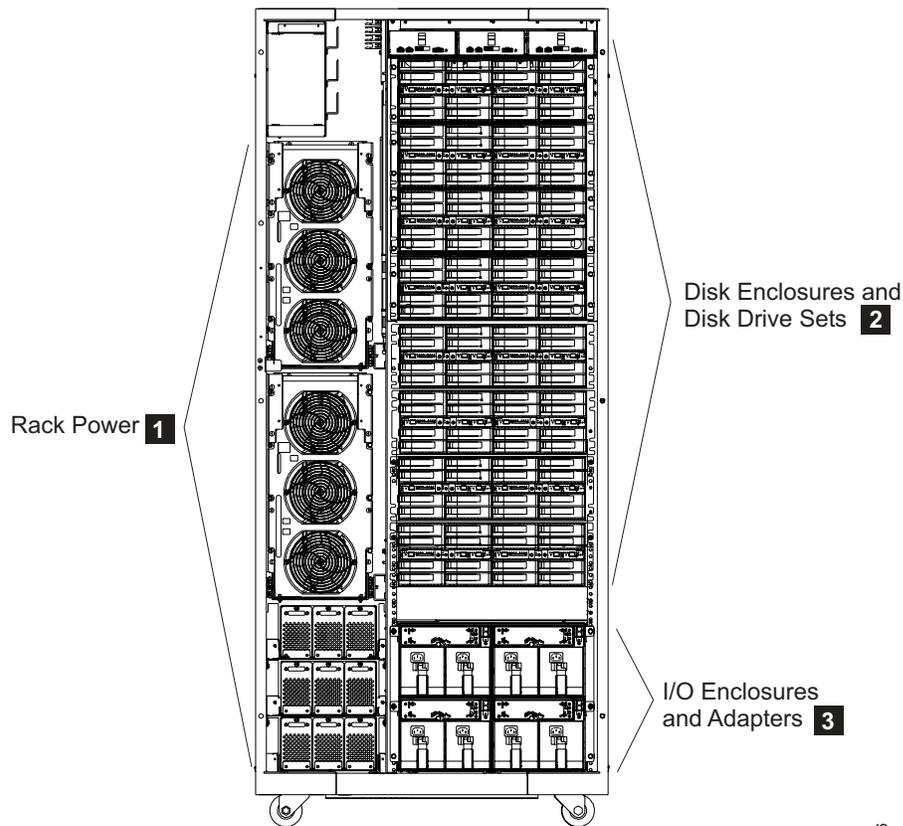
Figure 2. An expansion model (with front cover off) and its main components

The following notes provide additional information about the labeled components on Figure 2:

1. The *rack power* area of each expansion model provides redundant power supplies (two primary power supplies) and power control cards. If the expansion unit contains I/O enclosures or the extended power line disturbance (PLD) feature, two or three backup battery assemblies are also installed to help protect data in the event of a loss of external power.

2. All expansion models allow up to 16 *disk enclosures*, which contain the disk drives. In a maximum configuration, each expansion model can hold 256 disk drives.

3. Expansion models can contain *I/O enclosures* and *adapters* if they are the first expansion units that are attached to a Model 922, 932, 9A2, or 9B2. The second expansion model in a 922, 932, 9A2, or 9B2 configuration cannot have I/O enclosures and adapters, nor can any expansion unit that is attached to a Model 921 or 931. If the expansion unit contains I/O enclosures, the enclosures provide connectivity between the adapters and the processors. The adapters contained in the I/O enclosures can be either device or host adapters.

DS8100 (Model 921 and Model 931)

The IBM System Storage DS8100, which is Model 921 and Model 931, offers many features.

These features include:
- Dual 2-way processor complex
- Up to 128 disk drives, for a maximum capacity of 64 TB
- Up to 128 GB of processor memory (cache)
- Up to 16 fibre channel/FICON or ESCON® host adapters

The DS8100 model can support one expansion frame. With one expansion frame, you can expand the capacity of the Model 921 or Model 931 as follows:
- Up to 384 disk drives, for a maximum capacity of 192 TB

Note: IBM service representatives can upgrade a Model 921 or Model 931 in the field when you order a model conversion to a Model 922, Model 932, Model 9A2, or Model 9B2. There are no available model conversions from Models 92*x*/9A*x* to Models 93*x*/9B*x*.

Figure 3 on page 6 shows the maximum configuration of a Model 921 or Model 931, which is the 921 or the 931 base model plus one 92E expansion model.

Base Model
128 Drives

Expansion Model
256 Drives

Fan
Sense
RPC

Fans/Plenum

Fan
Sense

Fans/Plenum

Disk Drive
Set

Disk Drive
Set

Disk Drive
Set

Disk Drive
Set

PPS

Disk Drive
Set

PPS

Disk Drive
Set

Disk Drive
Set

Disk Drive
Set

Management Console
Keyboard Display
Ethernet Switches

Disk Drive
Set

PPS

Processor
2-way

PPS

Disk Drive
Set

Processor
2-way

Disk Drive
Set

Disk Drive
Set

Battery

I/O
Enclosures
Adapters

I/O
Enclosures
Adapters

Battery

I/O
Enclosures
Adapters

I/O
Enclosures
Adapters

1w2rzq

Figure 3. Maximum configuration for Model 921 or Model 931

DS8300 (Models 922, 932, 9A2, and 9B2)

IBM System Storage DS8300 models (Models 922, 932, 9A2, and 9B2) offer higher performance and capacity than the DS8100. Models 9A2 and 9B2 also enable you to create two storage system LPARs (images) within the same storage unit.

All DS8300 models offer the following features:

- Dual 4-way processor complex
- Up to 128 disk drives, for a maximum capacity of 64 TB
- Up to 256 GB of processor memory (cache)
- Up to 16 fibre-channel/FICON or ESCON host adapters

The DS8300 models can support either one or two expansion frames. With expansion frames, you can expand the Models 922, 932, 9A2, and 9B2 as follows:

- With one expansion frame, you can support the following expanded capacity and number of adapters:
  - Up to 384 disk drives, for a maximum capacity of 192 TB
  - Up to 32 fibre-channel/FICON or ESCON host adapters
- With two expansion frames, you can support the following expanded capacity:
  - Up to 640 disk drives, for a maximum capacity of 320 TB

Figure 4 on page 7 shows the maximum configuration of a Model 922, 932, 9A2, or 9B2. All of these models can attach up to two expansion models. Models 922 and

932 can attach to the 92E expansion models. Models 9A2 and 9B2 can attach to the 9AE expansion models.
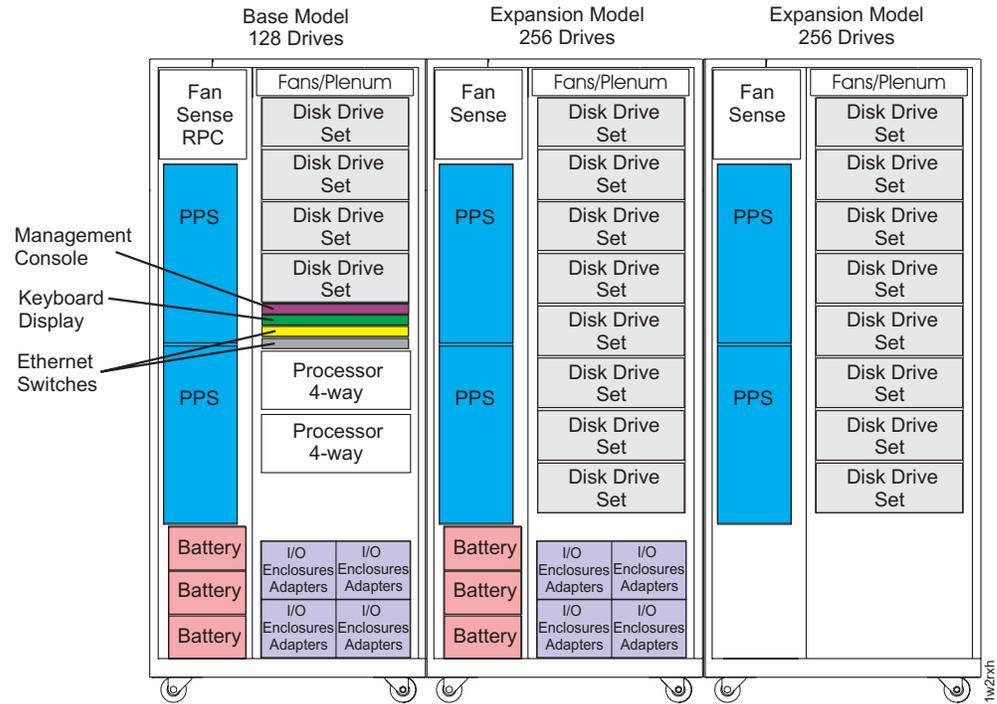
Figure 4. Maximum configuration for Model 922, 932, 9A2, or 9B2

Model comparison

DS8000 models vary on the processor types that they use, their disk capacity, and other supported features.

Table 2 compares the various supported features that are available on different DS8000 model configurations.

Table 2. DS8000 model comparison chart

Base model	Images (logical partitions)	Expansion models	Processor type	Disk drives	Processor memory	Host adapters
Model 921/931	1 image	None	2-way	Up to 128 disks (maximum capacity of 64 TB)	Up to 128 GB	Up to 16 host adapters
		With 1 expansion model (92E)	2-way	Up to 384 disks (maximum capacity of 192 TB)	Up to 128 GB	Up to 16 host adapters

Table 2. DS8000 model comparison chart (continued)

Base model	Images (logical partitions)	Expansion models	Processor type	Disk drives	Processor memory	Host adapters
Model 922/932	1 image	None	4-way	Up to 128 disks (maximum capacity of 64 TB)	Up to 256 GB	Up to 16 host adapters
		With 1 expansion model (92E)	4-way	Up to 384 disks (maximum capacity of 192 TB)	Up to 256 GB	Up to 32 host adapters
		With 2 expansion models (92E)	4-way	Up to 640 disks (maximum capacity of 320 TB)	Up to 256 GB	Up to 32 host adapters
Model 9A2/9B2	2 images	None	4-way	Up to 128 disks (maximum capacity of 64 TB)	Up to 256 GB	Up to 16 host adapters
		With 1 expansion model (9AE)	4-way	Up to 384 disks (maximum capacity of 192 TB)	Up to 256 GB	Up to 32 host adapters
		With 2 expansion models (9AE)	4-way	Up to 640 disks (maximum capacity of 320 TB)	Up to 256 GB	Up to 32 host adapters

Note: IBM service representatives can perform the conversion in the field when you order one of the following model conversions:

- Model 921 to 922
- Model 921 to 9A2
- Model 931 to 932
- Model 931 to 9B2
- Model 9A2 to 922
- Model 922 to 9A2
- Model 932 to 9B2
- Model 9B2 to 932
- Model 92E to 9AE
- Model 9AE to 92E

DS8000 physical footprint

The physical footprint dimensions, caster locations, and cable openings for a DS8000 unit help you plan your installation site.

Figure 5 shows the overall physical footprint of a DS8000 unit.
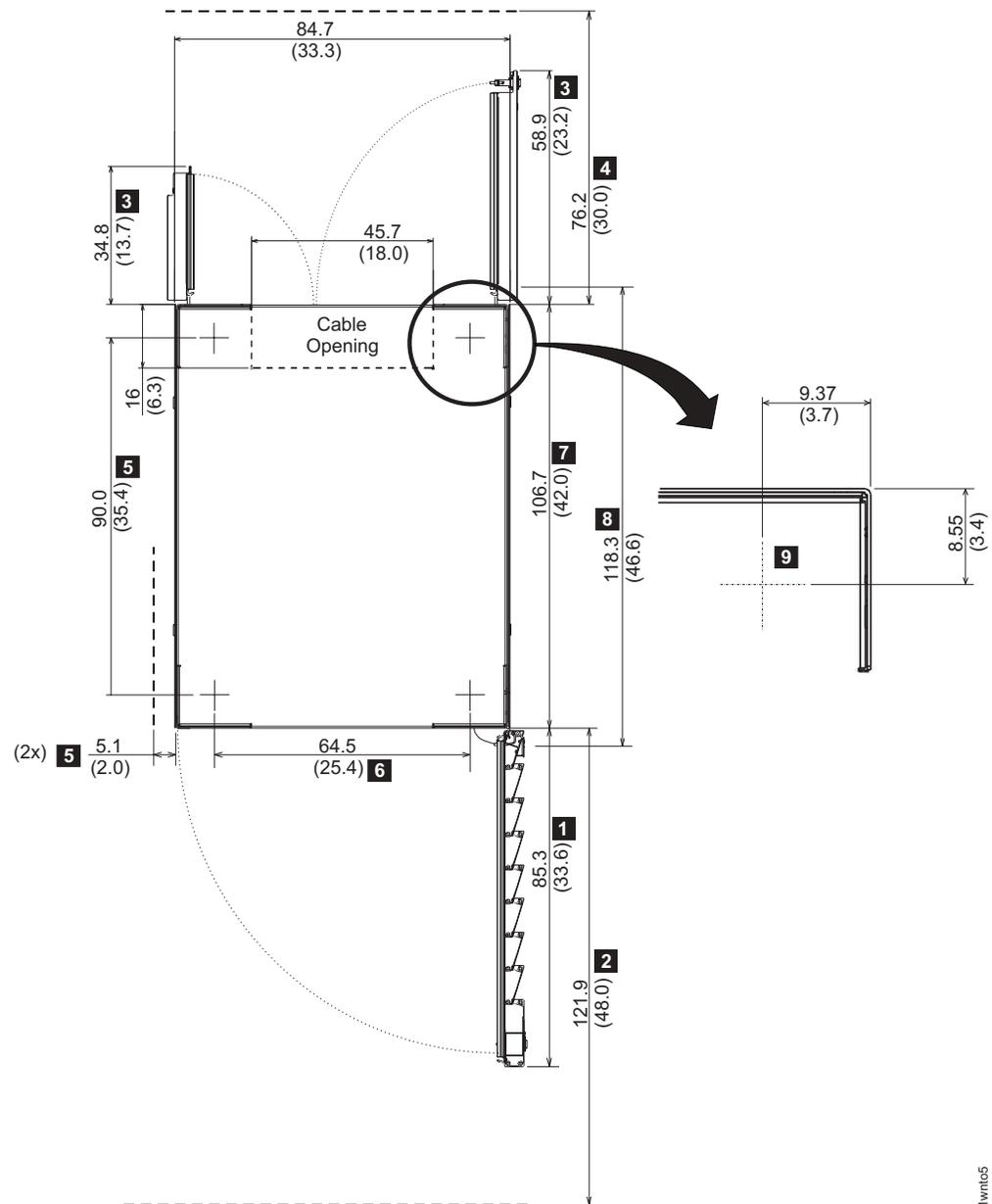
Figure 5. DS8000 physical footprint. Dimensions are in centimeters (inches).

The following dimensions are labeled on Figure 5:
1. Front cover width
2. Front service clearance
3. Back cover widths
4. Back service clearance
5. Clearance to allow front cover to open
6. Distance between casters
7. Depth of frame without covers
8. Depth of frame with covers
9. Minimum dimension between casters and outside edges of frames

Storage complexes

A storage complex is the storage unit plus the management consoles that manage it.

Each storage complex must have an internal management console that resides within the base model of the storage unit. You also can attach an external management console to the storage complex for redundancy.

IBM System Storage Management Console

The IBM System Storage management console is the focal point for configuration, copy services management, and maintenance activities.

The management console is a dedicated workstation that is physically located (installed) inside your DS8100 and DS8300 and can automatically monitor the state of your system, notifying you and IBM when service is required. The management console also can be connected to your network to enable centralized management of your system using the IBM System Storage DS command-line interface or the storage management software that uses the IBM System Storage DS open API.

The first management console in a storage complex is always internal to the 2107/242x. To provide continuous availability of customer access to the management console functions, having a second management console is recommended. This second management console can be provided in two ways:

- **External** (outside the 2107/242x) - This console is generally installed in the customer-provided rack. It uses the same hardware as the internal management console.
- **Internal** (a second management console that resides within a second 2107/242x) - This console can be cabled together with the primary internal management console of the first 2107/242x.

The management console is the workstation the DS Storage Manager software is installed on. This console is used to configure and manage the DS8000 series system.

DS8000 Performance features

The DS8000 series is designed to provide you with high-performance, connectivity, and reliability allowing your workload to be easily consolidated into a single storage subsystem.

The following list provides an overview of some of the features that are associated with the DS8000 series:

POWER5+ processor technology
> The DS8000 features IBM POWER5+ server technology. Compared with the current IBM POWER5 processor, the POWER5+ processor allows up to a 15% performance improvement in I/O operations per second in transaction processing workload environments. The POWER5+ processor is included only in the 93x/9Bx models, and it is an optional feature in the 92x/9Ax models.

Industry standard fibre-channel disk drives
> The DS8000 series offers a selection of fibre-channel disk drives, including 300 GB fibre channel drives and 500 GB fibre-channel ATA (FATA) disk drives that allow a DS8100 to scale up to a capacity of 192 TB and a

DS8300 to scale up to a capacity of 320 TB. The 500 GB FATA disk drives are lower cost disk drives that are designed for applications that require disk drive duty cycles that are equal to or less than 20%. If you use the FATA disk drives for applications that require duty cycles greater than 20%, your application is likely to experience limited array throughput and reduced performance. The 500 GB FATA disk drives are designed to support applications that use fixed-content or reference-only data, applications that are used for data archival operations, or near-line applications that require large amounts of data. Intermix of the FATA disk drive sets and fibre-channel disk drive sets is not supported within a disk enclosure or at creation. However, intermix on the same DA loop of enclosures with different drive types is supported if the drives within each enclosure are the same.

Four-port fibre-channel/FICON adapters
The DS8000 series offers enhanced connectivity with four-port fibre-channel/FICON host adapters. Four GB fibre-channel/FICON host support offers improvement that is up to 50 percent of the MB/second throughput performance for a single port. This improved performance enables cost savings by reducing the number of required host ports. These 4 GB host adapters are offered in longwave and shortwave. They auto-negotiate to either 4 GB or 2 GB link speeds. This flexibility provides benefits that are offered by higher performance 4 GB SAN-based solutions, while maintaining compatibility with existing 2 GB infrastructures.

HOST attachments
The DS8100 offers up to 16 host adapters (64 FCP/FICON ports) and the DS8300 offers up to 32 host adapters (128 FCP/FICON ports), further increasing your ability to share your disk storage.

IBM Standby Capacity on Demand
The IBM Standby Capacity on Demand (Standby CoD) offering allows the installation of inactive disk drives that can be easily activated as business needs require. With this offering, up to four Standby CoD disk drive sets (64 disk drives) can be factory- or field-installed into your system. To activate, you logically configure the disk drives for use—a nondisruptive activity that does not require intervention from IBM. Upon activation of any portion of the Standby CoD disk drive set, you must place an order with IBM to initiate billing for the activated set. At that time, you can also order replacement Standby CoD disk drive sets. 500 GB, 7 200 rpm fibre-channel ATA (FATA) Standby Capacity on Demand (Standby CoD) disk drive sets are available as part of the Standby CoD offering.

Online Information Center
The online Information Center is an information database that provides you the opportunity to quickly familiarize yourself with the major aspects of the DS8000 and to easily recognize the topics for which you might require more information. It provides information regarding user assistance for tasks, concepts, reference, user scenarios, tutorials, and other types of user information. Because the information is all in one place rather than across multiple publications, you can access the information that you need more efficiently and effectively.

RAID implementation

RAID implementation improves data storage reliability and performance.

Redundant array of independent disks (RAID) is a method of configuring multiple disk drives in a storage subsystem for high availability and high performance. The collection of two or more disk drives presents the image of a single disk drive to the system. In the event of a single device failure, data can be read or regenerated from the other disk drives in the array.

With RAID implementation, the DS8000 series offers fault-tolerant data storage by storing the data in different places on multiple disk drive modules (DDMs). By placing data on multiple disks, input/output operations can overlap in a balanced way to improve the basic reliability and performance of the attached storage devices.

Physical capacity for the DS8000 series can be configured as RAID 5, RAID 10, or a combination of both. RAID 5 can offer excellent performance for most applications, while RAID 10 can offer better performance for selected applications, in particular, high random write content applications in the open systems environment.

You can reconfigure RAID 5 disk groups as RAID 10 disk groups or vice versa.

RAID 5 overview

RAID 5 is a method of spreading volume data across multiple disk drives. The DS8000 series supports RAID 5 arrays.

RAID 5 increases performance by supporting concurrent accesses to the multiple DDMs within each logical volume. Data protection is provided by parity, which is stored throughout the drives in the array. If a drive fails, the data on that drive can be restored using all the other drives in the array along with the parity bits that were created when the data was stored.

RAID 10 overview

RAID 10 provides high availability by combining features of RAID 0 and RAID 1. The DS8000 series supports RAID 10 arrays.

RAID 0 increases performance by striping volume data across multiple disk drives. RAID 1 provides disk mirroring which duplicates data between two disk drives. By combining the features of RAID 0 and RAID 1, RAID 10 provides a second optimization for fault tolerance.

RAID 10 implementation provides data mirroring from one DDM to another DDM. RAID 10 stripes data across half of the disk drives in the RAID 10 configuration. The other half of the array mirrors the first set of disk drives. Access to data is preserved if one disk in each mirrored pair remains available. In some cases, RAID 10 offers faster data reads and writes than RAID 5 because it does not need to manage parity. However, with half of the DDMs in the group used for data and the other half used to mirror that data, RAID 10 disk groups have less capacity than RAID 5 disk groups.

DS8000 Interfaces

This section describes the following interfaces:
- IBM System Storage DS Storage Manager
- IBM System Storage DS Command-Line Interface (CLI)
- IBM System Storage DS Open application programming interface
- IBM TotalStorage Productivity Center for Disk

- IBM TotalStorage Productivity for Replication Manager

IBM System Storage DS Storage Manager

The IBM System Storage DS Storage Manager is an interface that is used to perform logical configurations and Copy Services management functions.

The DS Storage Manager software is installed on a computer (management console) that is provided with the DS8000.

You can install the DS Storage Manager as a GUI (graphical mode) or as an unattended (silent) mode installation for the supported operating systems. The unattended (silent) mode installation option allows you to run the installation program unattended. Use this method of installation to customize a response file and issue a command from a command prompt window. The response file is a template on the IBM System Storage Storage Manager CD. The DS Storage Manager can be accessed from any location that has network access using a Web browser. It offers you the following choices that are available with the applicable license management code:

Simulated configuration
> You install this component on your PC or the management console which provides the ability to create or modify logical configurations when your storage unit is disconnected from the network. After creating the configuration, you can save it and then apply it to a network attached storage unit at a later time.
>
> This simulated configuration tool is installed on your server and can be used for the configuration of a DS8000 series at initial installation.

Real-time configuration
> This component is preinstalled on your management console. It provides you with the ability to create logical configurations and use Copy Services features when your storage unit is attached to the network. This component provides you with real-time (online) configuration support.

Copy services
> This component allows you to process copy services functions.

The DS command-line interface

The IBM System Storage DS command-line interface (CLI) enables open systems hosts to invoke and manage FlashCopy and Metro and Global Mirror functions through batch processes and scripts.

The DS CLI provides a full-function set of commands that allows you to check your storage unit configuration and to perform specific application functions, when necessary. Many of the values that are used or reported with the DS CLI commands are hexadecimal.

The following list highlights a few of the specific types of functions that you can perform with the DS command-line interface:
- Check and verify your storage unit configuration
- Check the current Copy Services configuration that is used by the storage unit
- Create new logical storage and Copy Services configuration settings
- Modify or delete logical storage and Copy Services configuration settings

Notes:

1. You can have a maximum of 256 clients that are connected to the same server and this permits 256 DS CLI sessions. However, you must not start more than 100 DS CLI sessions simultaneously. Starting more than 100 DS CLI sessions simultaneously can result in connection problems.
2. You cannot install the DS CLI on a Windows 64-bit operating system.

DS open application programming interface

The IBM System Storage DS Open Application Programming Interface (API) is a nonproprietary storage management client application that supports routine LUN management activities, such as LUN creation, mapping and masking, and the creation or deletion of RAID 5 and RAID 10 volume spaces. The DS Open API supports these activities through the use of the Storage Management Initiative Specification (SMI-S), as defined by the Storage Networking Industry Association (SNIA).

The DS Open API helps integrate configuration management support into storage resource management (SRM) applications, which allow customers to benefit from existing SRM applications and infrastructures. The DS Open API also enables the automation of configuration management through customer-written applications. Either way, the DS Open API presents another option for managing storage units by complementing the use of the IBM System Storage DS Storage Manager web-based interface and the DS command-line interface.

You must implement the DS Open API through the IBM System Storage Common Information Model (CIM) agent, a middleware application that provides a CIM-compliant interface. The DS Open API uses the CIM technology to manage proprietary devices as open system devices through storage management applications. The DS Open API allows these storage management applications to communicate with a storage unit.

The DS Open API supports the IBM System Storage DS8000 and the IBM System Storage DS6000, and the IBM TotalStorage Enterprise Storage Server. It is available for the AIX, Linux, and Windows operating system environments and must be used on storage units that have fibre-channel ports.

IBM TotalStorage Productivity Center for Disk

IBM TotalStorage® Productivity Center for Disk (Disk Manager) is a storage management product that is designed for customers who want to reduce the complexities and costs of storage management, including the management of SAN-based storage.

The IBM TotalStorage Productivity Center allows you to manage storage area networks and heterogeneous storage from a single console. It lets you manage network storage components that are based on the Storage Management Initiative Specification, including
- IBM SAN Volume Controller
- IBM TotalStorage Enterprise Storage Server® (ESS)
- IBM System Storage disk storage units (DS4000, DS6000, and DS8000 series)

Disk Manager can do the following performance functions:
- Collect and store performance data and provides alerts
- Generate both standard and custom performance reports with the ability to graph data from those reports

- Help optimize storage allocation
- Provide volume contention analysis and recommend intelligent placement of new volumes

Through the use of data collection, threshold settings, and performance reports, performance can be monitored for the ESS, DS4000, DS6000, and DS8000, SAN Volume Controller, and other storage subsystems that support the SMI-S block service performance subprofile. The performance functions start with the data collection task, which captures performance statistics for the devices and stores the data in the database.

You can set thresholds for certain performance metrics depending on the type of device. Threshold checking is performed during data collection, and when performance is outside the specified bounds, alerts can be generated.

After performance data has been collected, you can configure Disk Manager to present graphical or text reports on the historical performance behavior of specified devices, or of specific internal components of these devices. The performance reports provide information on the performance metrics and can display performance data in graphical form.

For more information, visit the Multiple Device Manager Information Center from the IBM Publications Web site using the following URL:

http://publib.boulder.ibm.com/infocenter/tsmdmv11/index.jsp

IBM TotalStorage Productivity Center for Replication

IBM TotalStorage Productivity Center for Replication provides Copy Services functions such as the remote mirror and copy functions (Metro Mirror and Global Mirror) and the point-in-time function (FlashCopy).

TotalStorage Productivity Center for Replication provides a graphical interface that you can use for configuring and managing Copy Services functions across the DS8000 and Enterprise Storage Server (ESS) storage units. These data-copy services maintain consistent copies of data on source volumes that are managed by Replication Manager.

IBM TotalStorage Productivity Center for Replication V3.1 for FlashCopy, Metro Mirror, and Global Mirror support provided automation of administration and configuration of these services, operational control (starting, suspending, resuming), Copy Services tasks, and monitoring and managing of copy sessions.

TotalStorage Productivity Center for Replication is an option of the TotalStorage Productivity Center for Replication software program. If you are licensed for Copy Services functions and have the required Ethernet adapter pair (feature code 180x) that supports the communication between the storage units and Replication Manager, you can use TotalStorage Productivity Center for Replication to manage your data copy environment.

For more information, visit the Multiple Device Manager Information Center from the IBM Publications Web site using the following URL:

http://publib.boulder.ibm.com/infocenter/tsmdmv11/index.jsp

DS8000 hardware specifics

The DS8000 models offer a high degree of availability and performance through the use of redundant components that can be replaced while the system is operating. You can use the DS8000 models with a mix of different operating systems and clustered and nonclustered variants of the same operating systems.

Contributing to the high degree of availability and reliability are the structure of the DS8000 storage unit, the host systems it supports, and its processor memory and processor speeds.

Storage unit structure

The design of the storage unit, which contains the base model and the expansion models, contributes to the high degree of availability that is associated with the DS8000. The primary components that support high availability within the storage unit are the storage server, the processor complex, and the rack power control card.

Storage unit
> The storage unit contains a storage server and one or more storage (disk) enclosures that are packaged in one or more racks with associated power supplies, batteries, and cooling.

Storage server
> The storage server consists of two processor complexes, two or more I/O enclosures, and a pair of rack power control cards.

Processor complex
> A processor complex controls and manages the storage unit to perform the function of the storage server. The two processor complexes form a redundant pair such that if either processor complex fails, the remaining processor complex performs all storage server functions.

Rack power control card
> A redundant pair of rack power control (RPC) cards coordinate the power management within the storage unit. The RPC cards are attached to the service processors in each processor complex, the primary power supplies in each rack, and indirectly to the fan/sense cards and storage enclosures in each rack.

All DS8000 models include the IBM System Storage Multi-path Subsystem Device Driver (SDD). The SDD provides load balancing and enhanced data availability capability in configurations with more than one I/O path between the host server and the DS8000 series storage unit. Load balancing can reduce or eliminate I/O bottlenecks that occur when many I/O operations are directed to common devices using the same I/O path. The SDD can eliminate the single point of failure by automatically rerouting I/O operations when a path failure occurs.

Host systems attachment overview

The DS8000 storage unit provides a variety of host attachments so that you can consolidate storage capacity and workloads for open-systems hosts, S/390 hosts, and eServer™ zSeries hosts.

The DS8100 Models 921 and 931 support a maximum of 16 host adapters and 4 device adapter pairs, and the DS8300 Models 922, 932, 9A2, and 9B2 support a maximum of 32 host adapters and 8 device adapter pairs.

You can configure the storage unit for any of the following system adapter types and protocols:

- Fibre-channel adapters, for support of Fibre Channel Protocol (FCP) and fibre connection (FICON®) protocol
- Enterprise Systems Connection Architecture® (ESCON) adapters

For fibre-channel attachments, you can establish zones. The zones must contain a single port that is attached to a system adapter with the desired number of ports that are attached to the storage unit. By establishing zones, you reduce the possibility of interactions between system adapters in switched configurations. You can establish the zones by using either of two zoning methods:

- Port number
- Worldwide port name

You can configure switch ports that are attached to the storage unit in more than one zone. This enables multiple host system adapters to share access to the storage unit fibre-channel ports. Shared access to a storage unit fibre-channel port might come from host platforms that support a combination of bus adapter types and the operating systems.

Open-systems hosts with fibre-channel adapters

You can attach a DS8000 series to an open-systems host with fibre-channel adapters.

Fibre channel is a 1 Gbps, 2 Gbps, or 4 Gbps full-duplex, serial communications technology to interconnect I/O devices and host systems that are separated by tens of kilometers.

The IBM System Storage DS8000 series supports SAN connections of up to 2 Gbps with 2 Gb host adapters, and up to 4 Gbps with 4 Gb host adapters. The DS8000 series negotiates automatically and determines whether it is best to run at a 1 Gbps, 2 Gbps, or 4 Gbps link speed. The IBM System Storage DS8000 series detects and operates at the greatest available link speed that is shared by both sides of the system.

Note: 4 Gbps link speeds are only available with 4 Gbps fibre-channel adapter cards.

Fibre-channel technology transfers information between the sources and the users of the information. This information can include commands, controls, files, graphics, video, and sound. Fibre-channel connections are established between fibre-channel ports that reside in I/O devices, host systems, and the network that interconnects them. The network consists of elements like switches, bridges, and repeaters that are used to interconnect the fibre-channel ports.

Fibre channel overview for the DS8000

Each storage unit fibre-channel adapter has four ports, and each port has a unique worldwide port name (WWPN). You can configure a port to operate with the SCSI-FCP upper-layer protocol using the DS Storage Manager or the DS CLI. You can add fibre-channel shortwave and longwave adapters to a DS8000.

See the Interoperability Matrix at http://www.ibm.com/servers/storage/disk/ds8000/ for details on the host systems that support fibre-channel adapters.

Fibre channel adapters for SCSI-FCP support the following configurations:

- A maximum of 64 host adapter ports on DS8100 Models 921 and 931 and a maximum of 128 host ports on DS8300 Models 922, 932, 9A2, and 9B2
- A maximum of 506 logins per fibre-channel port which includes host ports and PPRC target and initiator ports
- Access to 63700 LUNs per target (one target per host adapter), depending on host type
- Either arbitrated loop, switched fabric, or point-to-point topologies

ESCON-attached S/390 and zSeries hosts overview

You can attach the DS8000 storage unit to the ESCON-attached S/390 and zSeries hosts.

With ESCON adapters, the storage unit provides the following configurations:
- A maximum of 32 host ports for DS8100 Models 921 and 931 and a maximum of 64 host ports for DS8300 Models 922, 932, 9A2, and 9B2
- A maximum of 64 logical paths per port
- Access to 16 control-unit images (4096 CKD devices) over a single ESCON port on the storage unit
- Zero to 64 ESCON channels; two per ESCON host adapter
- Two ESCON links with each link that supports up to 64 logical paths

  A DS8100 storage unit supports up to 16 host adapters that provide a maximum of 32 ESCON links per machine. A DS8300 storage unit supports up to 32 host adapters that provide a maximum of 64 ESCON links per machine.

Note: ESCON host channels limit the number of devices per channel to 1024. To fully access 4096 devices on a storage unit, it is necessary to connect a minimum of four ESCON host channels to the storage unit. You can access the devices through a switch to a single storage unit ESCON port. This method exposes four control-unit images (1024 devices) to each host channel.

The FICON bridge card in ESCON director 9032 Model 5 enables a FICON bridge channel to connect to ESCON host adapters in the storage unit. The FICON bridge architecture supports up to 16 384 devices per channel. This enables you to attach other control units or other storage units to the same host channel up to the limit that the host supports.

The storage unit supports the following operating systems for S/390 and zSeries hosts:
- Transaction Processing Facility (TPF)
- Virtual Storage Extended/Enterprise Storage Architecture (VSE/ESA™)
- z/OS®
- z/VM®
- Linux™

For details about models and the operating system versions and releases that the storage unit supports for these host systems, see the *Interoperability Matrix* at http://www.ibm.com/servers/storage/disk/ds8000/.

FICON-attached S/390 and zSeries hosts overview

This section describes how you can attach the DS8000 storage unit to FICON-attached S/390 and zSeries hosts.

Each storage unit fibre-channel adapter has four ports. Each port has a unique worldwide port name (WWPN). You can configure the port to operate with the FICON upper-layer protocol. For FICON, the fibre-channel port supports connections to a maximum of 509FICON hosts. On FICON, the fibre-channel adapter can operate with fabric or point-to-point topologies. With fibre-channel adapters that are configured for FICON, the storage unit provides the following configurations:

- Either fabric or point-to-point topologies
- A maximum of 64 host adapter ports on DS8100 Models 921 and 931, and a maximum of 128 host adapter ports on DS8300 Models 922, 932, 9A2, and 9B2
- A maximum of 509 logins per fibre-channel port
- A maximum of 8192 logins per storage unit
- A maximum of 1280 logical paths on each fibre-channel port
- Access to all 255 control-unit images (8000 CKD devices) over each FICON port
- A maximum of 512 logical paths per control unit image.

Note: FICON host channels limit the number of devices per channel to 16 384. To fully access 65 280 devices on a storage unit, it is necessary to connect a minimum of four FICON host channels to the storage unit. You can access the devices through a switch to a single storage unit FICON port. With this method, you can expose 64 control-unit images (16 384 devices) to each host channel.

The storage unit supports the following operating systems for S/390 and zSeries hosts:

- Transaction Processing Facility (TPF)
- Virtual Storage Extended/Enterprise Storage Architecture (VSE/ESA)
- z/OS
- z/VM
- z/VSE
- Linux

For details about models, versions of operating systems, and releases that the storage unit supports for these host systems, see the *Interoperability Matrix* at http://www.ibm.com/servers/storage/disk/ds8000/.

Processor memory

The DS8100 Models 921 and 931 offer up to 128 GB of processor memory. The DS8300 Models 922, 932, 9A2, and 9B2 offer up to 256 GB of processor memory. The nonvolatile storage (NVS) scales to the selected processor memory size, which can also help optimize performance.

Subsystem device driver for open-systems

The IBM System Storage Multi-path Subsystem Device Driver (SDD) supports open-systems hosts.

The Subsystem Device Driver (SDD) resides in the host server with the native disk device driver for the storage unit. It uses redundant connections between the host server and disk storage in the DS8000 series to provide enhanced performance and data availability.

Balancing the I/O load

You can generally maximize the performance of an application by spreading the I/O load across clusters, arrays, and device adapters in the storage unit.

During an attempt to balance the load within the storage unit, placement of application data is the determining factor. The following resources are the most important to balance, roughly in order of importance:

- Activity to the RAID disk groups. Use as many RAID disk groups as possible for the critical applications. Most performance bottlenecks occur because a few disks are overloaded. Spreading an application across multiple RAID disk groups ensures that as many disk drives as possible are available. This is extremely important for open-system environments where cache-hit ratios are usually low.
- Activity to the clusters. When selecting RAID disk groups for a critical application, spread them across separate clusters. Because each cluster has separate memory buses and cache memory, this maximizes the use of those resources.
- Activity to the device adapters. When selecting RAID disk groups within a cluster for a critical application, spread them across separate device adapters.
- Activity to the SCSI or fibre-channel ports. Use the IBM System Storage Multipath Subsystem Device Driver (SDD) or similar software for other platforms to balance I/O activity across SCSI or fibre-channel ports.

  Note: For information about SDD, see *IBM System Storage Multipath Subsystem Device Driver User's Guide*. This document also describes the product engineering tool, the ESSUTIL tool, which is supported in the pcmpath commands and the datapath commands.

- Activity to the adapter bays. When selecting SCSI ports to assign to a specific server, spread them across different adapter bays. Spreading across adapter-bay pairs 1 and 4 or adapter-bay pairs 2 and 3 also balances processor activity.

Storage consolidation

When you use a storage unit, you can consolidate data and workloads from different kinds of independent servers into a single shared resource.

You might mix production and test servers in an open systems environment or mix S/390 or zSeries and open systems hosts. In this kind of independent server environment, servers rarely, if ever, contend for the same resource.

Although sharing resources in the storage unit has advantages for storage administration and resource sharing, there are additional implications for workload planning. The benefit of sharing is that a larger resource pool (for example, disk drives or cache) is available for critical applications. However, you must ensure that uncontrolled or unpredictable applications do not interfere with critical work. This requires the same kind of workload planning that you use when you mix various types of work on a server.

If your workload is critical, consider isolating it from other workloads. To isolate the workloads, place the data as follows:

- On separate RAID disk groups. S/390 or zSeries and open-systems data are automatically placed on separate arrays, which reduces the contention for disk use.

- On separate device adapters.
- In separate storage unit clusters, which isolates use of memory buses, microprocessors, and cache resources. Before you make this decision, verify that the isolation of your data to a single cluster provides adequate data access performance for your application.

Count key data

In count-key-data (CKD) disk data architecture, the data field stores the user data.

Because data records can be variable in length, in CKD they all have an associated count field that indicates the user data record size. The key field enables a hardware search on a key. The commands used in the CKD architecture for managing the data and the storage devices are called channel command words.

Fixed block

In fixed block (FB) architecture, the data (the logical volumes) are mapped over fixed-size blocks or sectors.

With an FB architecture, the location of any block can be calculated to retrieve that block. This architecture uses tracks and cylinders. On a physical disk there are multiple blocks per track, and a cylinder is the group of tracks that exists under the disk heads at one point in time without performing a seek operation.

Logical volumes

A logical volume is the storage medium that is associated with a logical disk. It typically resides on one or more hard disk drives.

For the storage unit, the logical volumes are defined at logical configuration time. For count-key-data (CKD) servers, the logical volume size is defined by the device emulation mode and model. For fixed block (FB) hosts, you can define each FB volume (LUN) with a minimum size of a single block (512 bytes) to a maximum size of 2^{32} blocks or 2 TB.

A logical device that has nonremovable media has one and only one associated logical volume. A logical volume is composed of one or more extents. Each extent is associated with a contiguous range of addressable data units on the logical volume.

LUN calculation

The DS8000 series uses a volume capacity algorithm (calculation) to provide a logical unit number (LUN).

The following volume capacities are expressed in both binary (GB - 2^{30}) and decimal (GB - 10^9) conventions, independent of the capacity algorithm that is used to create the volume.

GB (2^{30}) = Bytes / 2^{30} = Bytes / 1 073 741 824

GB (10^9) = Bytes / 10^9 = Bytes / 1 000 000 000

Computer memory capacity is typically described in powers of 2; for example, MB(2^{20}), GB (2^{30}), TB (2^{40}). Computer storage capacity is typically described in powers of 10; for example, MB(10^{6}), GB(10^{9}), TB(10^{12}).

In the DS8000 family, physical storage capacities such as DDMs are generally expressed in powers of 10. Logical or effective storage capacities (logical volumes, ranks, extent pools) and processor memory capacities are expressed in powers of 2. Both of these conventions are used for logical volume effective storage capacities.

The logical volume capacity is accurate to 0.1 GB for either decimal or binary capacity convention. For logical volumes that are created with the decimal capacity algorithm, each decimal GB capacity value defines a unique volume size (the value that is used to create the volume). However, two decimal GB sizes might indicate the same binary GB size, because rounding to the nearest 0.1 GB is not sufficient to delineate all supported sizes. Similarly, two logical volumes with the same binary GB and decimal GB sizes are not necessarily the same size if they were created with a different capacity algorithm.

On open volumes with 512-byte blocks, you can determine the exact capacity of the volume in bytes by multiplying the number of blocks by 512. For open volumes with 520-byte blocks (such as iSeries™ volumes), you can determine the exact capacity of the volume in bytes by multiplying the number of blocks by 520. However, capacity of these volumes in bytes is expressed by multiplying the number of blocks by 512, because only 512 of the 520 bytes are used to store customer data.

On CKD volumes, the volume is created when a number of cylinders are specified. On DS8000, the basic allocation unit for CKD volumes is a CKD extent, which is exactly 1113 cylinders. The volume can be created with any number of integral cylinders in the range of 1 to 65 520 ('FFF0'X) cylinders, although volumes that are an exact multiple of 1113 cylinders do not waste any capacity in the last extent. The capacity of a CKD volume can be expressed in bytes, although the actual capacity of the volume varies depending on the format of every track on the volume. Every cylinder contains 15 tracks. A track with a 3390 track format is generally expressed as having a maximum capacity of 56 664 bytes. A track with a 3380 track format is generally expressed as having a maximum capacity of 47 476 bytes. The binary and decimal GB value that is displayed for CKD volumes is based on these capacities (for example: capacity of a volume with a 3390 track format in decimal GB = cylinders $\times$ 15 $\times$ 56782 / 10^{9}).

The logical volumes are created using one of the following three algorithms.

Binary Capacity Algorithm (B):

This algorithm provides LUNs that fully use the capacity in every extent and also are supported across the DS8000 family. The input to the GUI is the exact size of the volume in integral GB (2^{30}). The supported sizes are limited to integral multiples of the supported extent size and are further limited on larger LUNs to allow larger extent sizes in the future. The following sizes are valid:

1 to 64 GB (in 1 GB increments)

64 to 256 GB (in 4 GB increments)

256 to 1024 GB (in 16 GB increments)

1024 to 2048 GB (in 64 GB increments)

Decimal Capacity Algorithm (D):

This algorithm provides LUNs that are supported across the DS8000 family. The last extent on the volume might not be fully used because these sizes are not an integral multiple of the extent size.

You can calculate exact volume sizes as follows:

bytes = blocks $\times$ 512 = INT((INT($xxx.X \times 10^9$/512) + 63) / 64) $\times$ 64 $\times$ 512, where $xxx.X$ is the value that is input by the user to the configuration process that is specified in GB (10^9). That is, this value is rounded down to a block or rounded up to a 32 KB track size.

Note: When you invoke the Metro Mirror function between the ESS 2105 and the DS8000, consider using these volumes sizes. In many applications, the primary and secondary storage unit of a Metro Mirror relationship must be exactly the same size.

The following sizes are valid:

0.1 to 982.2 GB (in 0.1 GB [10^8] increments)

iSeries Capacity Algorithm (I):

This algorithm provides iSeries LUN sizes that are specified in decimal GBs (with the assumption that each logical block contains 512 bytes of data). The set that is allowed is the complete set that is supported by iSeries.

You can define storage unit LUNs as either protected or unprotected. You can create iSeries LUNs as either logically protected or unprotected. An unprotected LUN is available for OS/400® to mirror that volume (either internal or external) to another of equal capacity. Protected logical volumes do not use OS/400, or host-based, mirroring. All IBM iSeries physical volumes are RAID 5 or RAID 10 volumes and are protected within the storage unit.

OS/400 only supports certain fixed volume sizes; for example, model sizes of 8.5 GB, 17.5 GB, and 35.1 GB. Because these volume sizes are not multiples of 1 GB, some space is left unused depending on the chosen model. iSeries LUNs make available a 520-byte block to the host. The operating system uses 8 of these bytes; therefore, the usable space is still 512 bytes like other SCSI LUNs. The capacities that are quoted for the iSeries LUNs are normally 512-byte block storage capacity and are expressed in decimal GB (10^9). Convert these capacities to binary GB (2^{30}) to maximize the use of extents that are 1 GB (2^{30}).

Note: The supported logical volume sizes for load source units (LSUs) are 17.54 GB, 35.16 GB, 70.56 GB, and 141.1 GB. Logical volume sizes of 8.59 GB and 282.2 GB are not supported as external LSUs for iSeries.

provides models of storage capacity and disk volumes of the IBM iSeries systems.

Table 3. Capacity and models of disk volumes for IBM iSeries

Model Number (Unprotected)	Model Number (Protected)	Capacity	Expected Number of LBAs	iSeries OS Version Support
A81	A01	8.59 GB	16 777 216 (0x01000000)	Version 5 Release 2 and Version 5 Release 3
A82	A02	17.55 GB	34 275 328 (0x020B0000)	Version 5 Release 2 and Version 5 Release 3
A85	A05	35.17 GB	68 681 728 (0x04180000)	Version 5 Release 2 and Version 5 Release 3
A84	A04	70.56 GB	137 822 208 (0x08370000)	Version 5 Release 2 and Version 5 Release 3
A86	A06	141.12 GB	275 644 416 (0x106E0000)	Version 5 Release 3 and later
A87	A07	282.25 GB	551 288 832 (0x20DC0000)	Version 5 Release 3 and later

Data management features

The DS8000 storage unit is designed with the following management features that allow you to securely process and access your data according to your business needs even if it is 24 hours a day and 7 days a week.

Arrays across loops

The arrays across loops helps prevent data loss.

The storage unit provides arrays across loops. For RAID 10, arrays across loops provides mirroring across two loops, which prevents loss of the array during loop failure. For RAID 5, arrays across loops provides a higher throughput to the array because both loops on the device adapter are used in parallel.

Storage System LPARs (logical partitions)

The DS8300 Models 9A2 and 9B2 exploit LPAR technology, allowing you to run two separate storage server images.

Each Storage System LPAR has access to:
- 50 percent of the processors
- 50 percent of the processor memory
- Up to 16 host adapters
- Up to 320 disk drives (up to 96 TB of capacity)

With these separate resources, each Storage System LPAR can run the same or different versions of microcode, and can be used for completely separate production, test, or other unique storage environments within this single physical system. This may enable storage consolidations where separate storage subsystems were previously required, helping to increase management efficiency and cost effectiveness.

Parallel access volumes

Parallel access volumes (PAV) allow your system to access volumes in parallel when you use an S/390 or zSeries host.

A PAV capability represents a significant performance improvement by the storage unit over traditional I/O processing. With PAVs, your system can access a single volume from a single host with multiple concurrent requests.

You must configure both your storage unit and operating system to use PAVs. You can use the logical configuration definition to define PAV-bases, PAV-aliases, and their relationship in the storage unit hardware. This unit address relationship creates a single logical volume, allowing concurrent I/O operations.

Static PAV associates the PAV-base address and its PAV aliases in a predefined and fixed method. That is, the PAV-aliases of a PAV-base address remain unchanged. Dynamic PAV, on the other hand, dynamically associates the PAV-base address and its PAV aliases. The device number types (PAV-alias or PAV-base) must match the unit address types as defined in the storage unit hardware.

You can further enhance PAV by adding the IBM HyperPAV feature. IBM HyperPAV associates the volumes with either an alias address or a specified base logical volume number. When a host system requests IBM HyperPAV processing and the processing is enabled, aliases on the logical subsystem are placed in an IBM HyperPAV alias access state on all logical paths with a given path group ID. IBM HyperPAV is only supported on FICON channel paths.

PAV can improve the performance of large volumes. You get better performance with one base and two aliases on a 3390 Model 9 than from three 3390 Model 3 volumes with no PAV support. With one base, it also reduces storage management costs that are associated with maintaining large numbers of volumes. The alias provides an alternate path to the base device. For example, a 3380 or a 3390 with one alias has only one device to write to, but can use two paths.

The storage unit supports concurrent or parallel data transfer operations to or from the same volume from the same system or system image for S/390 or zSeries hosts. An S/390 with PAV software support enables multiple users and jobs to simultaneously access a logical volume. Read and write operations can be accessed simultaneously to different domains. (The domain of an I/O operation is the specified extents to which the I/O operation applies.)

IBM System Storage Resiliency Family

IBM System Storage Resiliency Family is a set of products and features that can help you implement storage solutions to keep your business running 24 hours a day, 7 days a week. This set of products provide disaster recovery, data migration, and data duplication functions.

As a part of the IBM System Storage Resiliency family, the DS8000 supports Copy Service functions that contribute to the protection of your data. These functions are also supported on the IBM TotalStorage Enterprise Storage Server.

The following IBM System Storage Resiliency family functions are available as optional features:
- Point-in-time copy, which includes IBM System Storage FlashCopy

The FlashCopy function enables you to make point-in-time, full volume copies of data, so that the copies are immediately available for read or write access. For zSeries environments, you can also use FlashCopy function to perform data set level copies of your data.

- Remote mirror and copy, which includes the following functions:
  - IBM System Storage Metro Mirror (previously known as Synchronous PPRC)

    Metro Mirror provides real-time mirroring of logical volumes between two DS8000 storage units that can be located up to 300 km from each other. It is a synchronous copy solution where write operations are completed on both copies (local and remote site) before they are considered to be done.
  - IBM System Storage Global Copy (previously known as PPRC Extended Distance)

    Global Copy is a nonsynchronous long-distance copy function where incremental updates are sent from the local to the remote site on a periodic basis.
  - IBM System Storage Global Mirror (previously known as Asynchronous PPRC)

    Global Mirror is a long-distance remote copy function across two sites using asynchronous technology. Global Mirror processing is designed to provide support for virtually unlimited distance between the local and remote sites, with the distance typically limited only by the capabilities of the network and the channel extension technology.
  - IBM System Storage Metro/Global Mirror (a combination of Metro Mirror and Global Mirror)

    Metro/Global Mirror is a three-site remote copy solution, which uses synchronous replication to mirror data between a local site and an intermediate site, and asynchronous replication to mirror data from an intermediate site to a remote site.
- Remote mirror and copy for z/OS, which includes IBM System Storage z/OS Global Mirror is available only for zSeries environments

The point-in-time and remote mirror and copy features are supported across various server environments such as zSeries, pSeries®, iSeries and servers from Sun and Hewlett-Packard.

You can manage these functions through a command-line interface called the DS CLI and a Web-based interface called the DS Storage Manager. The DS Storage Manager allows you to set up and manage the following types of data-copy functions from any point where network access is available:

Point-in-time copy (FlashCopy)

The FlashCopy function enables you to make point-in-time, full volume copies of data, with the copies immediately available for read or write access. For zSeries environments, you can also use the FlashCopy function to perform data set level copies of your data. You can use the copy with standard backup tools that are available in your environment to create backup copies on tape.

FlashCopy is an optional function. To use it, you must purchase one of the point-in-time 2244/239x function authorization features.

The FlashCopy function creates a copy of a source volume on the target volume. This copy is called a point-in-time copy. When you initiate a FlashCopy operation,

a FlashCopy relationship is created between a source volume and target volume. A FlashCopy relationship is a *mapping* of the FlashCopy source volume and a FlashCopy target volume. This mapping allows a point-in-time copy of that source volume to be copied to the associated target volume. The FlashCopy relationship exists between this volume pair from the time that you initiate a FlashCopy operation until the storage unit copies all data from the source volume to the target volume or you delete the FlashCopy relationship, if it is a persistent FlashCopy.

One of the main benefits of the FlashCopy function is that the point-in-time copy is immediately available for creating a backup of production data. The target volume is available for read and write processing so it can be used for testing or backup purposes. Data is physically copied from the source volume to the target volume using a background process. (A FlashCopy operation without a background copy is also possible, which allows only data that is modified on the source to be copied to the target volume.) The amount of time that it takes to complete the background copy depends on the following criteria:

- The amount of data being copied
- The number of background copy processes that are occurring
- The other activities that are occurring on the storage units

The FlashCopy function supports the following copy options:

Consistency groups
> Creates a consistent point-in-time copy of multiple volumes, with negligible host impact. You can enable FlashCopy consistency groups from the DS CLI.

Change recording
> Activates the change recording function on the volume pair that is participating in a FlashCopy relationship. This enables a subsequent refresh to the target volume.

Establish FlashCopy on existing Metro Mirror source
> Allows you to establish a FlashCopy relationship where the target volume is also the source of an existing remote mirror and copy source volume. This enables you to create full or incremental point-in-time copies at a local site and then use remote mirroring commands to copy the data to the remote site.

Fast reverse
> Reverses the FlashCopy relationship without waiting for the finish of the background copy of the previous FlashCopy. This option applies to the Global Mirror mode.

Inhibit writes to target
> Ensures that write operations are inhibited on the target volume until a refresh FlashCopy operation is complete.

Multiple Relationship FlashCopy
> Allows a source volume to have multiple (up to 12) target volumes at the same time.

Persistent FlashCopy
> Allows the FlashCopy relationship to remain even after the FlashCopy operation completes. You must explicitly delete the relationship.

Refresh target volume

Provides the ability to refresh a FlashCopy relationship, without recopying all tracks from the source volume to the target volume.

Resynchronizing FlashCopy volume pairs

Provides the ability to update an initial point-in-time copy of a source volume without having to recopy your entire volume.

Reverse restore

Reverses the FlashCopy relationship and copies data from the target volume to the source volume.

Remote mirror and copy

The remote mirror and copy feature is a flexible data mirroring technology that allows replication between a source volume and a target volume on one or two disk storage units. You can also issue remote mirror and copy operations to a group of source volumes on one logical subsystem (LSS) and a group of target volumes on another LSS. (An LSS is a logical grouping of up to 256 logical volumes for which the volumes must have the same disk format, either count key data or fixed block.)

Remote mirror and copy is an optional feature that provides data backup and disaster recovery. To use it, you must purchase at least one of the remote mirror and copy 2244/239x function authorization features. DS8000 storage units can participate in remote mirror and copy solutions with the DS6000 series, ESS Model 750, and ESS Model 800.

The remote mirror and copy feature provides synchronous (Metro Mirror) and asynchronous (Global Copy) data mirroring. The main difference is that the Global Copy feature can operate at very long distances, even continental distances, with minimal impact on applications. Distance is limited only by the network and channel extenders technology capabilities. The maximum supported distance for Metro Mirror is 300 km.

With Metro Mirror, application write performance is dependent on the available bandwidth. Global Copy allows you to better use your available bandwidth capacity, therefore allowing you to include more of your data to be protected.

The enhancement to Global Copy is Global Mirror, which uses Global Copy and the benefits of FlashCopy to form consistency groups. (A consistency group is a set of volumes that contain consistent and current data to provide a true data backup at a remote site.) Global Mirror uses a master storage unit (along with optional subordinate storage units) to internally, without external automation software, manage data consistency across volumes using consistency groups.

Consistency groups can also be created using the freeze and run functions of Metro Mirror. The freeze and run functions, when used with external automation software, provide data consistency for multiple Metro Mirror volume pairs.

The following sections describe the remote mirror and copy functions.

Synchronous mirroring (Metro Mirror)

Provides real-time mirroring of logical volumes (a source and a target) between two storage units that can be located up to 300 km from each other. With Metro Mirror copying, the source and target volumes can be on

the same storage unit or on separate storage units. You can locate the storage unit at another site, some distance away.

Metro Mirror is a synchronous copy feature where write operations are completed on both copies (local and remote site) before they are considered to be complete. Synchronous mirroring means that a storage server constantly updates a secondary copy of a volume to match changes made to a source volume.

The advantage of synchronous mirroring is that there is minimal host impact for performing the copy. The disadvantage is that since the copy operation is synchronous, there can be an impact to application performance because the application I/O operation is not acknowledged as complete until the write to the target volume is also complete. The longer the distance between primary and secondary storage units, the greater this impact to application I/O, and therefore, application performance.

Asynchronous mirroring (Global Copy)
Copies data nonsynchronously and over longer distances than is possible with the Metro Mirror feature. When operating in Global Copy mode, the source volume sends a periodic, incremental copy of updated tracks to the target volume instead of a constant stream of updates. This causes less impact to application writes for source volumes and less demand for bandwidth resources, while allowing a more flexible use of the available bandwidth.

The updates are tracked and periodically copied to the target volumes. As a consequence, there is no guarantee that data is transferred in the same sequence that was applied to the source volume. To get a consistent copy of your data at your remote site, you must periodically switch from Global Copy to Metro Mirror mode, then either stop the application I/O or freeze data to the source volumes using a manual process with freeze and run commands. The freeze and run functions can be used with external automation software such as Geographically Dispersed Parallel Sysplex (GDPS), which is available for z/Series environments, to ensure data consistency to multiple Metro Mirror volume pairs in a specified logical subsystem.

Common options for Metro Mirror and Global Copy include the following modes:

Suspend and resume
If you schedule a planned outage to perform maintenance at your remote site, you can suspend Metro Mirror or Global Copy processing on specific volume pairs during the duration of the outage. During this time, data is no longer copied to the target volumes. Because the primary storage unit keeps track of all changed data on the source volume, you can resume operations at a later time to synchronize the data between the volumes.

Copy out-of-synchronous data
You can specify that only data that was updated on the source volume while the volume pair was suspended be copied to its associated target volume.

Copy an entire volume or not copy the volume
You can copy an entire source volume to its associated target volume to guarantee that the source and target volume contain the same data. When you establish volume pairs and elect not to copy a volume, a relationship is established between the volumes but no

data is sent from the source volume to the target volume. In this case, it is assumed that the volumes contain exactly the same data and are consistent, so copying the entire volume is not necessary or required. Only new updates are copied from the source to target volumes.

Global Mirror

Provides a long-distance remote copy across two sites using asynchronous technology. Global Mirror processing is most often associated with disaster recovery or disaster recovery testing. However, it can also be used for everyday processing and data migration.

The Global Mirror function mirrors data between volume pairs of two storage units over greater distances without affecting overall performance. It also provides application-consistent data at a recovery (or remote) site in case of a disaster at the local site. By creating a set of remote volumes every few seconds, the data at the remote site is maintained to be a point-in-time consistent copy of the data at the local site.

Global Mirror operations periodically invoke point-in-time FlashCopy operations at the recovery site, at regular intervals, without disrupting the I/O to the source volume, thus giving a continuous, near up-to-date data backup. By grouping many volumes into a session, which is managed by the master storage unit, you can copy multiple volumes to the recovery site simultaneously while maintaining point-in-time consistency across those volumes. (A session contains a group of source volumes that are mirrored asynchronously to provide a consistent copy of data at the remote site. Sessions are associated with Global Mirror relationships and are defined with an identifier [session ID] that is unique across the enterprise. The ID identifies the group of volumes in a session that are related and that can participate in the Global Mirror consistency group.)

Metro/Global Mirror

Provides a three-site, long distance disaster recovery replication that combines Metro Mirror with Global Mirror replication for both zSeries and open systems data. Metro/Global Mirror uses synchronous replication to mirror data between a local site and an intermediate site, and asynchronous replication to mirror data from an intermediate site to a remote site.

In a three-site, Metro/Global Mirror, should an outage occur, a backup site is maintained regardless of which one of the sites is lost. Suppose an outage occurs at the local site, Global Mirror continues to mirror updates between the intermediate and remote sites, maintaining the recovery capability at the remote site. If an outage occurs at the intermediate site, data at the local storage unit is not affected. If an outage occurs at the remote site, data at the local and intermediate sites is not affected. Applications continue to run normally in either case.

With the incremental resynchronization function enabled on a Metro/Global Mirror configuration, should the intermediate site be lost, the local and remote sites can be connected, and only a subset of changed data is copied between the volumes at the two sites. This reduces the amount of data that needs to be copied from the local site to the remote site and the time it takes to do the copy.

z/OS Global Mirror

In the event of workload peaks, which may temporarily overload the z/OS Global Mirror configuration's bandwidth, the enhanced z/OS Global

Mirror function initiates a z/OS Global Mirror suspension preserving primary site application performance. If you are installing new high-performance z/OS Global Mirror primary storage subsystems, this function provides improved capacity and application performance during heavy write activity. This enhancement can also allow z/OS Global Mirror to be configured to tolerate longer periods of communication loss with the primary storage subsystems, allowing the z/OS Global Mirror to stay active despite transient channel path recovery events. In addition, this enhancement can provide fail-safe protection against application system impact related to unexpected data mover system events.

The z/OS Global Mirror function is an optional function. To use it, you must purchase the remote mirror for z/OS 2244/239x function authorization feature.

Disaster recovery using Copy Services

One of the main reasons for using Copy Services functions is to prepare for a possible disaster by backing up, copying, and mirroring your data both at the local (production) and remote sites.

Having a disaster recovery plan can ensure that critical data is recoverable at the time of a disaster. Because most disasters are unplanned, your disaster recovery plan must provide a way that allows you to recover your applications quickly, and more importantly, to access your data. Consistent data to the same point-in-time across all storage units is vital before you can recover your data at a backup (normally your remote) site.

Most users use a combination of remote mirror and copy and point-in-time copy (FlashCopy) features to form a comprehensive enterprise solution for disaster recovery. In an event of a planned event or unplanned disaster, you can use failover and failback modes as part of your recovery solution. Failover and failback modes help to reduce the time that is required to synchronize remote mirror and copy volumes after you switch between the local (or production) and the intermediate or remote sites during planned and unplanned outages. Although failover transmits no data, it changes the status of a device, and the status of the secondary volume changes to a suspended primary volume. The Failback command transmits data and can go in either direction depending on which device the Failback command is issued to.

Recovery procedures that include failover and failback modes use remote mirror and copy functions, such as Metro Mirror, Global Copy, Global Mirror, Metro/Global Mirror, and FlashCopy.

Note: See the *IBM System Storage DS8000 Command-Line Interface User's Guide* for specific disaster recovery tasks.

Data consistency can be achieved using the following methods:

Manually using external software (without Global Mirror)
If you use Metro Mirror, Global Copy, and FlashCopy functions to create a consistent and restartable copy at your recovery site, you must do a manual and periodic suspend operation at your local site. This means using *freeze and run* commands together with external automated software and then using the FlashCopy function to make a consistent copy of your target volume for backup or recovery purposes. (Automation software is not provided with the storage unit; it must be supplied by the user.)

Note: Freezing of the data is done at the same point-in-time across all links and all storage units.

Automatically (with Global Mirror and FlashCopy)

If you use a two-site Global Mirror or a three-site Metro/Global Mirror configuration, the process to create a consistent and restartable copy at your intermediate or remote site is done using an automated process, with minimal or no interruption to your applications. Global Mirror operations automate the process of continually forming consistency groups. It combines Global Copy and FlashCopy operations to provide consistent data at the remote site. A master storage unit (along with subordinate storage units) internally manages data consistency using consistency groups within a Global Mirror configuration. Consistency groups can be created many times per hour to increase the currency of data that is captured in the consistency groups at the remote site.

Note: A consistency group is a collection of volumes (grouped in a session) across multiple storage units that are managed together in a session during the creation of consistent copies of data. The formation of these consistency groups is coordinated by the master storage unit, which sends commands over remote mirror and copy links to its subordinate storage units.

In a two-site Global Mirror configuration, if you have a disaster at your local site and have to start production at your remote site, you can use the consistent point-in-time data from the consistency group at your remote site to recover when the local site is operational.

In a three-site Metro/Global Mirror configuration, if you have a disaster at your local site and you must start production at either your intermediate or remote site, you can use the consistent point-in-time data from the consistency group at your remote site to recover when the local site is operational.

Comparison of licensed functions

A key decision that you must make in planning for a disaster is deciding which licensed functions to use to best suit your environment.

Table 4 provides a brief summary of the characteristics of the Copy Services features that are available for the storage unit.

Table 4. Comparison of licensed functions

Licensed function	Description	Advantages	Considerations
Metro/Global Mirror	Three-site, long distance disaster recovery replication	A backup site is maintained regardless of which one of the sites is lost.	Recovery point objective (RPO) might grow if bandwidth capability is exceeded.
Metro Mirror	Synchronous data copy at a distance	No data loss, rapid recovery time for distances up to 300 km.	Slight performance impact.

Table 4. Comparison of licensed functions (continued)

Licensed function	Description	Advantages	Considerations
Global Copy	Continuous copy without data consistency	Nearly unlimited distance, suitable for data migration, only limited by network and channel extenders capabilities.	Copy is normally fuzzy but can be made consistent through synchronization.
Global Mirror	Asynchronous copy	Nearly unlimited distance, scalable, and low RPO. The RPO is the time needed to recover from a disaster; that is, the total system downtime.	RPO might grow when link bandwidth capability is exceeded.
z/OS Global Mirror	Asynchronous copy controlled by z/OS host software	Nearly unlimited distance, highly scalable, and very low RPO.	Additional host server hardware and software is required. The RPO might grow if bandwidth capability is exceeded or host performance might be impacted.

Logical configuration overview

Before you configure your DS8000 series, it is important to understand IBM terminology for storage concepts and the storage hierarchy.

In the storage hierarchy, you begin with a disk. Logical groupings of eight disks form an array site. Logical groupings of one array site form an array. After you define your array storage type as CKD or fixed block, you can create a rank. A rank is divided into a number of fixed-size extents. If you work with an open-systems host, an extent is 1 GB. If you work with IBM eServer zSeries or S/390 systems, an extent is the size of an IBM 3390 Mod 1 disk drive.

After you create ranks, your physical storage can be considered virtualized. Virtualization dissociates your physical storage configuration from your logical configuration, so that volume sizes are no longer constrained by the physical size of your arrays.

The available space on each rank is divided into extents. The extents are the building blocks of the logical volumes. An extent is striped across all disks of an array.

Extents of the same storage type are grouped together to form an extent pool. Multiple extent pools can create storage classes that provide greater flexibility in storage allocation through a combination of RAID types, DDM size, DDM speed, and DDM technology. This allows a differentiation of logical volumes by assigning them to the appropriate extent pool for the desired characteristics. Different extent sizes for the same device type (for example, count-key-data or fixed block) can be supported on the same storage unit, but these different extent types must be in different extent pools.

A logical volume is composed of one or more extents. A volume group specifies a set of logical volumes. By identifying different volume groups for different uses or functions (for example, SCSI target, FICON/ESCON control unit, remote mirror and copy secondary volumes, FlashCopy targets, and Copy Services), access to the set of logical volumes that are identified by the volume group can be controlled. Volume groups map hosts to volumes. Figure 6 on page 35 shows a graphic representation of the logical configuration sequence.

When volumes are created, you must initialize logical tracks from the host before the host is allowed read and write access to the logical tracks on the volumes. An internal volume initialization process allows quicker access to logical volumes that are used as host volumes and source volumes in Copy Services relationships, such as FlashCopy or Remote Mirror and Copy relationships. Volumes are not available as target volumes for Copy Services relationships until the volumes have been fully initialized. After volume initialization is complete and successful, you can use the target volumes to establish Copy Services relationships. Initialization requests can fail if the initialization is performed on volumes that are participating in existing Copy Services relationships.
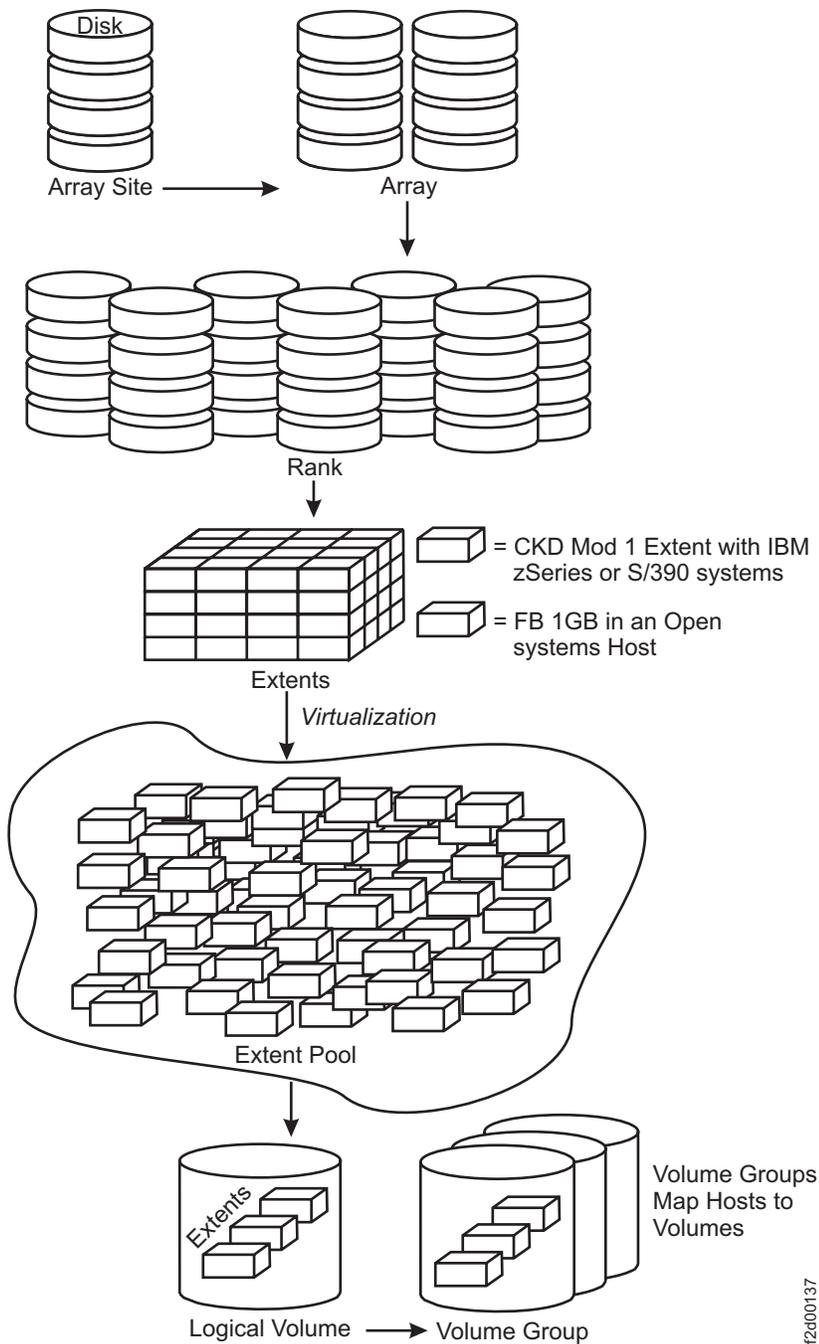
Figure 6. Logical configuration sequence

The storage management software can be used in real-time or simulated modes. When you are connected to storage devices over your network, you can use the Real-time Manager to manage your hardware or configure your storage. When you want to work offline, you can use the Simulated Manager to create or import a configuration. This lets you export a configuration that you have already created to a system when it reaches your site.

DS8000 limitations

The following list describes known limitations for the DS8000.

- An intermix of 242x hardware machine types (warranty machine types) is not supported within one storage unit. For example, you cannot have a storage unit composed of a 2421 Model 931 (one-year warranty) and a 2423 Model 92E (three-year warranty). The only exception is that 2424 models can be intermixed with 2107 models. For example, you can have a storage unit composed of a 2107 Model 932 and a 2424 Model 92E.
- The 65 520 cylinder 3390 volume is not supported with z/OS Global Mirror.
- The amount of physical capacity within a 2107/242x system that can be logically configured for use will be enforced by the 2107/242x licensed machine code (LMC) to maintain compliance with the extent of IBM authorization established for licensed functions activated on the machine. The 2107/242x LMC will not allow the logical configuration of physical capacity beyond the extent of IBM authorization (except when activating Standby CoD capacity).
- The 500 GB FATA 7 200 rpm disk drives support various fixed content, data archival, reference data, and near-line applications that require large amounts of data at low cost. They are not intended for use in applications that require drive duty cycles greater than 20%. To intermix the FATA disk drive sets and fibre-channel disk drive sets is not supported within a disk enclosure or at creation. However, intermixing on the same DA loop of enclosures with different drive types is supported if the drives within each enclosure are the same.
- The deactivation of an activated licensed function, a lateral change, and the reduction in the license scope are all disruptive activities and require a machine IML (Models 921, 922, 931, and 932) or reboot of the affected image (Model 9A2 and 9B2). A lateral change is defined as changing the license scope from fixed block (FB) to count key data (CKD) or from CKD to FB. A reduction is defined as changing the license scope from all physical capacity (ALL) to only FB or only CKD capacity.
- The following activities are disruptive:
  - Addition of the Earthquake Resistance Kit feature 1906.
  - Addition of the 150x POWER5+ features.
  - All model conversions. In addition, data may not be preserved during the model conversion.
  - Field attachment of the first expansion unit (Model 92E) to a base unit (Model 922 or 932).
  - Field attachment of the first expansion unit (Model 9AE) to a base unit (Model 9A2 or 9B2).
  - Removal of an expansion unit model from the base unit model. Data may not be preserved during this activity.
- Some DS8000 functions are not available or supported in all environments. You can find current information about supported environments, prerequisites, and minimum operating systems levels at the following IBM Web site:

  http://www.ibm.com/servers/storage/disk/ds8000/

DS8000 model conversion limitations

The following are limitations of model conversions:
- Conversions between 242x machine types (warranty machine types) is not supported.
- Conversions from a Model 921 to 922 preserve the data, and logical configuration and data is backed up as a precautionary measure.
- All other model conversions require that your data and logical configuration be removed from the machine.

| • Installation time for a conversion without an expansion unit (Model 92E or 9AE)
| is 10 to 12 hours. Installation time for a conversion with an expansion unit is 14
| hours.
| • All model conversions require dial-in capabilities for remote support during the
| upgrade.

Virtual Private Network

A virtual private network (VPN) is a private network that securely connects corporate networks across the Internet to remote offices and users.

A VPN enables you to send data between two computers across a shared or public internetwork in a manner that emulates the properties of a point-to-point private link. A VPN provides user authentication, data encryption, and data integrity to ensure the security of the data while in transit across private networks and the Internet.

VPNs securely convey information across the Internet by connecting remote users, branch offices, and business partners into an extended corporate network. Many companies are replacing their existing telecommunications infrastructure with VPNs, by implementing secure IP tunnels across the Internet between corporate sites as well as to business partners and remote users.

Because security is a critical issue for companies worldwide, VPN connections provide a secure infrastructure that require systems to work together to mitigate the risk of malicious activity from both external and internal sources. Any connection from your network to the public Internet raises some of the following security concerns:

• Infection by viruses

• Intrusion by hackers

• Accessibility of your data from a remote support site

• Authorization of remote users to access your machine when a remote connection is opened

IBM VPN connections, along with the security features that are built into the DS8000 storage unit, make it possible to access IBM service representatives who can assist you in resolving complex problems without the risks that are associated with a connection to an external network. For information about the IBM VPN implementation including technical details, access the following Web site:

http://www-1.ibm.com/support/docview.wss?rs=1114&uid=ssg1S1002693

Chapter 2. Planning the physical configuration

This chapter helps you plan the physical configuration of your DS8000 storage unit.

Physical configuration planning is your responsibility. Your disk marketing specialist can help you plan and select the DS8000 physical configuration and features.

This chapter includes the following information:
- Explanations of each feature that you can order to complete the physical configuration for each DS8000 model you order.
- Feature codes to use when you order each feature.
- Configuration rules and guidelines

Overview of physical configurations

When you order your DS8000 models, you can use the DS8000 feature codes to customize the physical configuration of your model.

You must follow established configuration rules to create a valid configuration—not just for the model itself, but also for the storage unit of which the model is a part. A storage unit can consist of a standalone base model or it can contain the base model plus expansion units.

The following table provides the storage unit configuration ranges for each base model. All configurations shown on this table use 3-phase power.

Storage unit configuration		Physical storage capacity (See Note 1)	Processor memory	Host adapters
Base model	Attached expansion models			
921/931 (See Note 2)	(none)	1.1 - 64 TB	16 - 128 GB	2 - 16
	one 92E unit	2.2 - 192 TB	16 - 128 GB	2 - 16
922/932	(none)	1.1 - 64 TB	32 - 256 GB	2 - 16
	one 92E unit	2.2 - 192 TB	32 - 256 GB	2 - 32
	two 92E units	3.3 - 320 TB	32 - 256 GB	2 - 32
9A2/9B2	(none)	2.2 - 64 TB	32 - 256 GB	4 - 16
	one 9AE unit	3.3 - 192 TB	32 - 256 GB	4 - 32
	two 9AE units	4.4 - 320 TB	32 - 256 GB	4 - 32

Notes:

1. You can order a mix of 73 GB, 146 GB, disk drive sets that comprise the physical capacity of the storage unit. Some configuration rules apply for intermixing.
2. You can attach only one expansion unit on a Model 921 or 931.

Note: An intermix of 242x hardware machine types (warranty machine types) is not supported within one storage unit. For example, you cannot have a storage unit composed of a 2421 Model 931 (one-year warranty) and a 2423 Model 92E (three-year warranty). The only exception is that 2424 models can

be intermixed with 2107 models. For example, you can have a storage unit composed of a 2107 Model 932 and a 2424 Model 92E.

Configuration notes for Models 9A2 and 9B2

Because Models 9A2 and 9B2 contain two images, some features require that you use separate feature codes to designate the feature on image 1 and the feature on image 2.

When you order, you will specify either an A location feature or a B location feature. On Figure 7, the A physical locations correlate to image 2 and the B locations correlate to image 1.
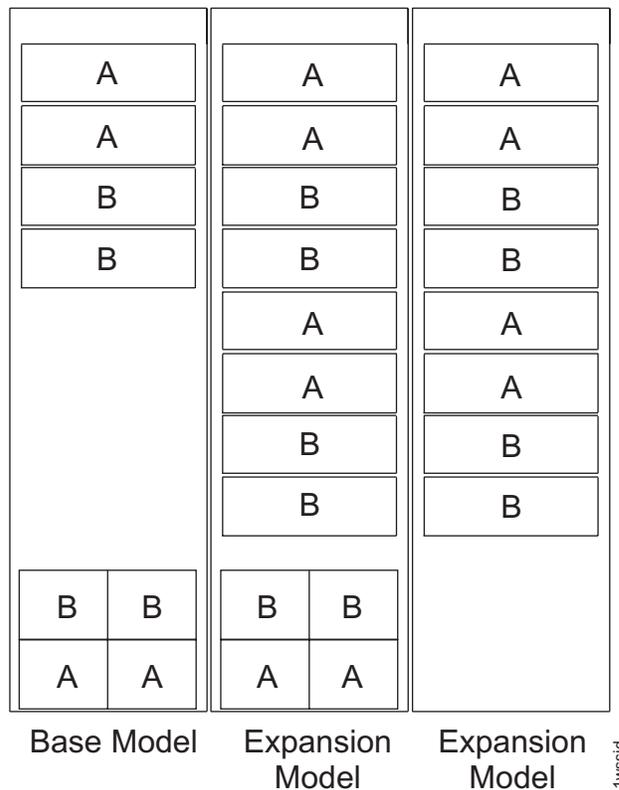
Figure 7. Physical locations A and B on the 9A2 and 9B2 base models and the 9AE expansion models

Configuration controls

DS8000 models ship with indicator features that control the physical configuration at the storage unit level.

These indicator features are for administrative use only. They help ensure that each storage unit (the base model plus any expansion units) has a valid configuration. There is no charge for these features.

DS8000 models can include the following indicators:

*   **Expansion model position indicators**

    Expansion model position indicators flag base models that have attached expansion models. They also flag the position of each expansion model within the storage unit. For example, a position 1 indicator flags the expansion model as the first expansion unit within the storage unit, while a position 2 indicator

flags the expansion model as the second expansion unit. In a valid storage unit configuration (base rack of 922, 932, 9A2, or 9B2), the first expansion unit can support more features than the second expansion unit.

- **Standby CoD indicators**

  Each base model will contain a Standby CoD indicator that indicates whether the storage unit takes advantage of the Standby Capacity on Demand (Standby CoD) offering.

- **Other indicators**

  If applicable, models also include other indicators. These include operating system indicators, which indicate that the model will be used in a particular IBM eServer or Linux environment.

Determining physical configuration features

Use these steps as a general guideline for determining and then ordering the feature codes that you need to customize your storage unit.

1. Calculate your overall storage needs. Consider the licensed functions, such as FlashCopy and Remote Mirror and Copy functions, that you must use to ensure continuous data availability and to implement the necessary disaster recover recovery requirements set by your management.

   Note: If you are activating features for any of the licensed functions, such as Copy Services, all the features must have the same capacity, including the operating environment license feature.

2. Determine the DS8000 models that will compose your storage unit. Consider both base and expansion models.

3. Determine the management console configuration that will support the storage unit using the following steps:

   a. Order one internal management console for each storage unit. The internal management console feature code must be ordered for the base model within the storage unit.

   b. Decide whether you will install an external management console for the storage unit. Adding an external management console helps to ensure that you maintain a highly available environment.

4. For each base and expansion model, determine the disk storage features that you need.

   a. Select the disk drive set feature codes and determine the amount of each feature code that you must order for each model.

   b. Select the disk enclosure feature codes and determine the amount that you must order to enclose the disk drive sets that you are ordering.

   c. Select the disk cable feature codes and determine the amount that you need of each.

5. Determine the I/O adapter features that you need for your storage unit.

   a. Select the device and host adapters feature codes to order and determine which model will contain the adapters. Remember that all base models can contain adapters, but only the first expansion models that are attached to Models 922, 932, 9A2, and 9B2 can contain adapters.

   b. For each model that will contain adapters, determine the number of each I/O enclosure feature codes that you must order.

   c. Select the cables that you must have to support the adapters.

6. Based on the disk storage and adapters that the base model and expansion models support, determine the appropriate processor memory feature code that is needed by each base model.
7. Decide which power features that you must order to support each model.
8. Review the other optional features and determine which feature codes to order.

Management console features

Management consoles are required features for your storage unit configuration.

Customize your management consoles by specifying the following different features:
- An external management console as well as the required internal management console
- Management console keyboards
- Management console external line cords

Internal and external management consoles

Management consoles are the focal point for configuration, copy services management, and maintenance for a DS8000 series.

The management console is a dedicated workstation that is physically located (installed) inside your storage unit and it can proactively monitor the state of your system, notifying you and IBM when service is required. It also can be connected to your network for centralized management of your system using the IBM System Storage DS Command Line Interface or using storage management software through the IBM System Storage DS Open API. An external management console is available as a optional feature and as a redundant management console for environments with high-availability requirements. If you use Copy Services, a redundant management console configuration is especially important.

Each management console feature looks similar to a laptop. It consists of a workstation processor, keyboard, monitor, modem, and Ethernet cables. The Ethernet cables included with each management console feature connect the management console to the storage unit.

The internal management console is installed (physically located) inside a base model. The external management console must be installed in an external 19 in. system rack. This rack can be an IBM rack or a non-IBM rack. The rack must conform to the required specifications. When you order an external management console, the hardware that you need to install the management console into the rack is shipped with it.

Tip: To ensure that IBM service representative can quickly and easily access an external management console, place the external management console rack within 15.2 m (50 ft.) of the storage units that are connected to it.

Notes:
1. To help preserve console function, the external and the internal MCs are not available as a general purpose computing resource.
2. The external MC satisfies all applicable requirements of Section 508 of the Rehabilitation Act, as long as assistive technology properly inter-operates with it.

Feature codes for internal and external management consoles

Use the management console feature codes to order up to two management consoles for each DS8000 storage unit.

Table 5 lists the management console feature codes.

Table 5. Management console feature codes

Feature Code	Description	Comments
1100	Management Console - Internal	To be installed in a Model 921, 922, 931, 932, 9A2, and 9B2.
1110	Management Console - External	To be installed in an external IBM or a non-IBM rack. (Models 921, 922, 931, 932, 9A2, and 9B2)

Management console keyboard

You must specify the type of keyboard you want on your management console.

For each type of MC (internal or external), you can select a keyboard that supports one of the following languages:
- U.S. English
- Japanese

Feature codes for management console keyboards

Use the management console keyboard feature codes to specify the keyboard that comes with each internal and external management console.

Table 6 lists the keyboard feature codes.

Table 6. Management console keyboard feature codes

Feature Code	Keyboard	Language
9100	Internal management console	U.S. English
9101	Internal management console	Japanese
9110	External management console	U.S. English
9111	External management console	Japanese

Management console external line cord

If using an external management console, you must select an external line cord that is specific to your country, voltage, and amperage needs.

The line cord supplies external power to the external management console (Feature Code #1110).

Feature codes for management console external line cords

Use the management console external line cord feature codes to specify a line cord when using an external management console.

Table 7 lists the external line cord feature codes.

Table 7. Management console external line cord feature codes

Feature Code	Description (V = volts, A = amperes)	Country or region
1170	MC line cord standard rack	All
1171	MC line cord group 1	United States, Canada, Bahamas, Barbados, Bermuda, Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Japan, Japan (PDS), Mexico, Netherlands Antilles, Panama, Philippines, Saudi Arabia, Surinam, Taiwan, Trinidad, Venezuela
1172	MC line cord group 2 (250 V, 15 A)	Brazil
1173	MC line cord group 3 (250 V, 16 A)	Belgium, Finland, France, Indonesia
1174	MC line cord group 4 (250 V, 10 A)	Denmark
1175	MC line cord group 5 (250 V, 13 A)	United Kingdom
1176	MC line cord group 6 (250 V, 6 A to 16 A)	Israel
1177	MC line cord group 7 (250 V, 10 A)	Switzerland
1178	MC line cord group 8 (250 V, 16 A)	Pakistan, South Africa
1179	MC line cord group 9 (250 V, 10 A and 16 A)	Chile, Italy
1180	MC line cord group 10 (250 V, 10 A)	Australia, New Zealand
1181	MC line cord group 11 (250 V, 15 A)	Thailand
1182	MC line cord group 12 (250 V, 10 A)	Argentina, Uruguay
1183	MC line cord group 13 (250 V, 10 A)	People's Republic of China
1184	MC line cord group 14 (250 V, 10 A)	India
1185	MC line cord group 15 (250 V, 10 A)	Brazil
1186	MC line cord group 16 (250 V, 10 A)	Korea
1187	MC line cord group 17 (250 V, 10 A)	Taiwan
1188	MC line cord group 18 (250 V, 10 A)	Japan
1189	MC line cord group 19 (250 V, 10 A)	US Chicago

Configuration rules for management consoles

You must order an internal management console each time you order a base model (Models 921, 922, 931, 932, 9A2, and 9B2).

You can also order a second management console for the storage unit. The second management console must be an external management console.

You must specify one keyboard feature with each management console that you order. Keyboard features specify the language and whether the keyboard is installed on an internal or external management console.

When you order an internal or external management console, the necessary Ethernet cables that attach it to the storage unit are included.

Storage features

You must select the storage features that you want on your DS8000 storage units.

The storage features are separated into the following categories:
- Disk drive set features and disk enclosure features
- Standby Capacity on Demand features
- Disk enclosure filler features
- Device adapter features
- Disk drive cable features

Disk drives and disk enclosures

Disk drives and disk enclosures are required parts of your DS8000 storage unit configuration.

Each disk enclosure feature contains a pair (2) of disk enclosures. The pair of enclosures can hold two disk drive features. Each disk drive feature contains 16 disk drives. When installed, each disk drive feature is installed across both disk enclosures. Eight drives are installed in one enclosure and eight drives in the other enclosure.

Note: Keep in mind the following storage installation requirements when you plan your configuration:
- Storage features are installed starting at the top of the unit and working down, within any given unit.
- Models 9A2 and 9B2 have A and B physical locations for disk enclosures and disk drive sets. Location A corresponds to image 2 and location B corresponds to image 1. When you increase the storage capacity for a particular image, you must install the disk enclosures and disk drive sets starting at the top open location for that image.

Figure 8 on page 46 shows valid and not valid configurations for disk drive set features.
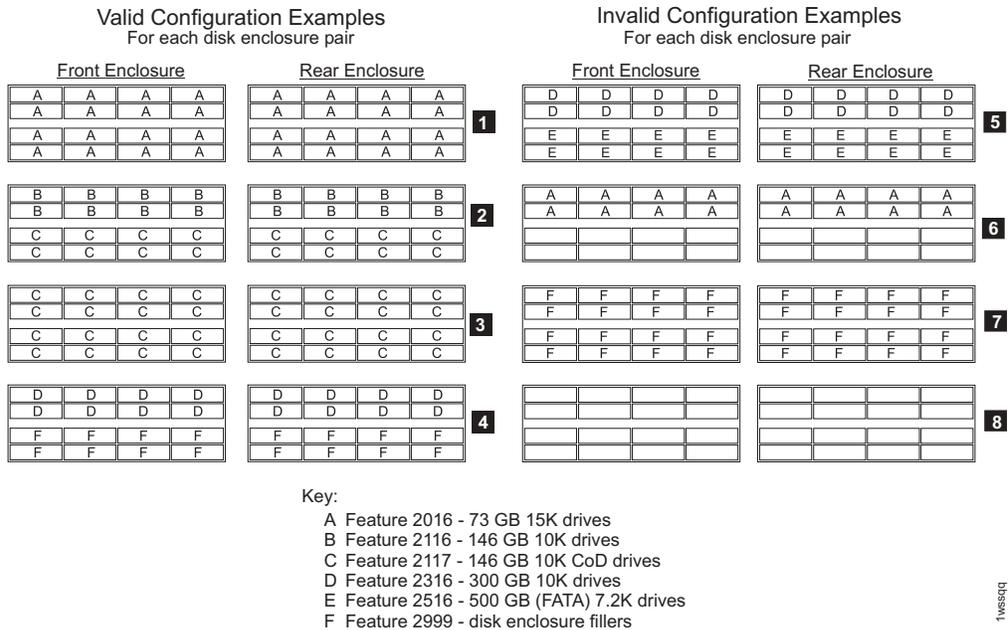
Figure 8. Examples of valid and invalid disk drive feature configurations.

The left column in n (1 - 4) shows valid configurations and the right column (5 - 8) shows invalid configurations. The following notes apply to the figure:

1 Two features of exactly the same type (capacity and speed) is valid.

2 One regular disk drive feature and one Standby CoD disk drive feature: both features of the same type is valid.

3 Two Standby CoD disk features of the same type is valid.

4 One regular disk drive feature and a filler feature is valid.

5 You cannot mix disk drive features of different types (capacity and speed).

6 You cannot have a disk enclosure pair that contains only one disk feature. In a valid configuration, the disk enclosure pair must always contain two disk features (whether disk drives or fillers).

7 You cannot have a disk enclosure pair with two filler features.

8 You cannot have an empty disk enclosure pair.

Feature codes for disk drives

Use the disk drive feature codes to order the disk drive sets for your storage unit.

Each disk drive set provides 16 disk drives. Table 8 provides the various disk drive sets that you can order (based on disk size and rpm), and the feature codes to use.

Table 8. Disk drive set feature codes

Feature Code	Size and description of disk drive set (See Note)	Disk speed in rpm (K = 1000)	DS8000 Models
2016	73 GB	15K	921, 931, 922, 932, 92E
2026	73 GB–A locations	15K	9A2, 9B2, 9AE
2036	73 GB–B locations	15K	9A2, 9B2, 9AE
2116	146 GB	10K	921, 931, 922, 932, 92E
2126	146 GB–A locations	10K	9A2, 9B2, 9AE

Table 8. Disk drive set feature codes (continued)

Feature Code	Size and description of disk drive set (See Note)	Disk speed in rpm (K = 1000)	DS8000 Models
2136	146 GB–B locations	10K	9A2, 9B2, 9AE
2216	146 GB	15K	921, 931, 922, 932, 92E
2226	146 GB–A locations	15K	9A2, 9B2, 9AE
2236	146 GB–B locations	15K	9A2, 9B2, 9AE
2316	300 GB	10K	921, 931, 922, 932, 92E
2326	300 GB–A locations	10K	9A2, 9B2, 9AE
2336	300 GB–B locations	10K	9A2, 9B2, 9AE
2516	500 GB (FATA)	7.2K	921, 931, 922, 932, 92E
2526	500 GB (FATA)–A locations	7.2K	9A2, 9B2, 9AE
2536	500 GB (FATA)–B locations	7.2K	9A2, 9B2, 9AE

Notes:

1. The feature codes that apply to Models 9A2, 9B2, 9AE must be used for specific physical locations within the storage unit. The A locations support image 2, while the B locations support image 1.

2. Base models (Models 921, 922, 931, 932, 9A2, and 9B2) require that you have installed a minimum of one regular disk drive feature installed on each image. Because Models 921, 922, 931, and 932 have only one image, they require one regular disk drive feature per machine. Because Models 9A2 and 9B2 have two images, you must have at least two regular disk drive features installed on the machine (one per image).

3. The 500 GB FATA disk drives are lower cost disk drives that are designed for applications that require disk drive duty cycles that are equal to or less than 20%. If you use the FATA disk drives for applications that require duty cycles greater than 20%, your application is likely to experience limited array throughput and reduced performance. The 500 GB FATA disk drives are designed to support applications that use fixed-content or reference-only data, applications that are used for data archival, or near-line applications that require large amounts of data. Intermixing FATA disk drive sets and fibre-channel disk drive sets is not supported within a disk enclosure.

Feature codes for disk enclosures

Use disk enclosure feature codes to order the disk enclosures for your storage unit.

Table 9 describes the feature codes.

Table 9. Disk enclosure feature codes

Feature Code	Description (See Note)	Models	Corequisite
1210	Disk enclosure pair	921, 922, 92E, 931, 932	For Models 92E, feature code 1020 (power module second pair) also is required when the quantity of feature 1210 exceeds four.
1220	Disk enclosure pair–A locations	9A2, 9AE, 9B2	For Models 9A2 and 9B2, feature code 1020 (power module second pair) also is required when the quantity of feature 1220 and 1230 exceeds four in any combination.
1230	Disk enclosure pair–B locations	9A2, 9AE, 9B2	

Table 9. Disk enclosure feature codes (continued)

Feature Code	Description (See Note)	Models	Corequisite
Notes:			
1. The feature codes that apply to Models 9A2, 9AE, 9B2 must be used for specific physical locations within the storage unit. The A locations support image 2, while the B locations support image 1.			
2. Each disk enclosure feature can contain one disk enclosure filler feature, provided that the model meets the minimum requirement of regular disk drives. Any disk enclosure filler must be removed when regular disk drive or Standby CoD disk drive features are added to the model.			

Disk drive power module

A disk drive power module second pair is required when more than 128 disk drives are installed.

Table 10 describes the power modules.

Table 10. Power module - second pair

Feature Code	Description	Models	Corequisite
1020	Power module - second pair	92E	Required when the quantity of feature code 1210 exceeds four.
1020	Power module - second pair	9AE	Required when the quantity of feature codes 1220 and 1230 exceeds four in any combination.

Standby CoD disk sets

You can use the IBM Standby Capacity On Demand (Standby CoD) offering by ordering Standby CoD disk sets.

A Standby CoD disk set contains 16 disk drives of the same capacity and rpm (7 200, 10 000, or 15 000 rpm).

When you initially order Standby CoD disk drive features, you must sign a Standby CoD agreement. Each subsequent order for Standby CoD features requires a supplement to the agreement.

To activate Standby CoD disk drives (and exchange them for regular disk drives), you must order a feature exchange. This results in the removal of the Standby CoD feature and the addition of the corresponding regular disk drive feature of the same capacity and speed. The transaction is invoiced at the differential price between the features removed and added.

Feature codes for Standby CoD disk drives

Use the Standby Capacity On Demand (Standby CoD) feature codes to order Standby CoD disk sets for your storage unit.

Each disk set feature provides 16 Standby CoD drives. Table 11 on page 49 provides the various Standby CoD disk sets that you can order (based on disk size and rpm), and the feature codes to use.

Table 11. Feature codes for Standby CoD disk drive sets (16 disk drives per set)

Feature Code	Size and description of CoD disk drive set (See Note)	Disk speed in rpm (K = 1000)	Models
2017	73 GB	15K	921, 931, 922, 932, 92E
2027	73 GB–A locations	15K	9A2, 9B2, 9AE
2037	73 GB–B locations	15K	9A2, 9B2, 9AE
2117	146 GB	10K	921, 931, 922, 932, 92E
2127	146 GB–A locations	10K	9A2, 9B2, 9AE
2137	146 GB–B locations	10K	9A2, 9B2, 9AE
2217	146 GB	15K	921, 931, 922, 932, 92E
2227	146 GB–A locations	15K	9A2, 9B2, 9AE
2237	146 GB–B locations	15K	9A2, 9B2, 9AE
2317	300 GB	10K	921, 931, 922, 932, 9A2, 9B2, 9AE
2327	300 GB–A locations	10K	9A2, 9B2, 9AE
2337	300 GB–B locations	10K	9A2, 9B2, 9AE
2517	500 GB (FATA)	7.2K	921, 931, 922, 932, 92E
2527	500 GB (FATA)–A locations	7.2K	9A2, 9B2, 9AE
2537	500 GB (FATA)–B locations	7.2K	9A2, 9B2, 9AE

Notes:

1. The feature codes that apply to Models 9A2, 9B2, 9AE must be used for specific physical locations within the storage unit. The A locations support image 2, while the B locations support image 1.

2. A regular disk drive feature and a Standby CoD disk drive feature can be installed on the same storage unit by using the following rules:

   - If a regular disk drive feature and a Standby CoD disk drive feature are contained within the same disk enclosure feature, they must be the same type (capacity and speed).

   - The maximum number of Standby CoD disk drive features that you can have on a storage unit is four.

   - You must balance the number of Standby CoD disk drive features on the storage unit with regular disk drive features. Use the following rules:

     – One Standby CoD feature requires a minimum quantity of two regular disk drive features.

     – Two Standby CoD features requires a minimum quantity of four regular disk drive features.

     – Three Standby CoD features requires a minimum quantity of four regular disk drive features.

     – Four Standby CoD features requires a minimum quantity of eight regular disk drive features.

3. The 500 GB FATA disk drives support various fixed content, data archival, reference data, and near-line applications that require large amounts of data at low cost. They are not intended for use in applications that require drive utilization duty cycles greater than 20%. Intermix of the FATA disk drive sets and fibre-channel disk drive sets is not supported within a disk enclosure.

Disk enclosure fillers

Disk enclosure fillers fill empty disk drive slots in disk enclosures.

One disk enclosure filler feature provides a set of 16 disk enclosure fillers.

Feature code for disk enclosure fillers

Use the disk enclosure filler feature code to order filler sets for the disk enclosure when you have one regular or Standby CoD disk feature in the enclosure.

A disk enclosure filler set includes 16 fillers. The following feature code can be used on all models.

2999   Disk enclosure filler set

Device adapters

Device adapters provide the connection between storage devices and the storage facility images through I/O ports.

Device adapters are ordered and installed in pairs. A device adapter pair supports two independent paths to all of the disk drives served by the pair. The two paths connect to two different network fabrics to provide fault tolerance and to help ensure availability. The physical links allow two read operations and two write operations to be performed simultaneously around the fabric.

Feature codes for device adapters

Use these feature codes to order device adapters for your storage unit.

Each device adapter feature includes a pair of device adapters. Table 12 shows the feature codes to use and the applicable models for each feature code.

Table 12. Device adapter feature codes

Feature code	Device adapter types (see note)	Models
3011	Device adapter pair	921, 922, 92E, 931, 932
3021	Device adapter pair–A locations	9A2, 9AE, 9B2
3031	Device adapter pair–B locations	9A2, 9AE, 9B2
Note: The feature codes that apply to Models 9A2, 9AE, 9B2 must be used for specific physical locations within the storage unit. The A locations support image 2, while the B locations support image 1.		

Table 13 on page 51 shows the required quantity of feature code 3011 for your Model 921, 922, 931, 932, or 9B2. The required quantity of this feature is based on the number of disk enclosure pair features (feature code 1210) that are installed in the base model (Models 921, 922, 931, and 932) and, if attached, in the expansion unit (Models 92E). Because a Model 92E that is attached to a Model 921, 931, 932, or 9B2 does not support I/O enclosure pairs, the device adapters for disk enclosures that are installed in the Model 92E must be ordered on and installed in the Model 921 or 931. Likewise, a second Model 92E (identified with feature code 0222 or 0322) that is attached to a Model 922 does not support I/O enclosure pairs. The device adapters for disk enclosures that are installed in the second Model 92E must be ordered on and installed in the Model 922.

Table 13. Required quantities of feature code 3011

Quantity of feature code 1210 currently installed on Model 921, 922, 931, or 932	Quantity of feature code 1210 currently installed on Model 92E (with feature code 0222 or 0322, if attached to Model 922 or 932)	Required quantity of feature code 3011 on Model 921, 922, 931, or 932
1 - 2	0	1
1 - 2	1 - 2	2
1 - 2	3 - 4	3
1 - 2	5 - 6	3
1 - 2	7 - 8	4
3 - 4	0	2
3 - 4	1 - 2	3
3 - 4	3 - 4	4
3 - 4	5 - 6	4
3 - 4	7 - 8	4
Note: The device adapters for disk enclosures that are installed in the first Model 92E (identified with feature code 0221 or 0321) that is attached to a Model 922 or 932 are ordered on and installed in that Model 92E. Therefore, do not use the quantity of feature code 1210 that is installed in the first Model 92E to determine the required quantity of feature code 3011 for the Model 922 or 932.		

Table 14 shows the required quantity of feature code 3021 for your Model 9A2 or 9B2. The required quantity of this feature is based on the number of disk enclosure pair features (feature code 1220) that are installed in the Model 9A2 or 9B2 and, if attached, in the second Model 9AE expansion unit (identified with feature code 0232 or 0332). Because the second Model 9AE do not support I/O enclosure pairs, the device adapters for disk enclosures that are installed in the second Model 9AE must be ordered on and installed in the Model 9A2 or 9B2.

Table 14. Required quantities of feature code 3021

Quantity of feature code 1220 currently installed on Model 9A2 or 9B2	Quantity of feature code 1220 currently installed on Model 9AE (with feature code 0232 or 0332)	Required quantity of feature code 3021 on Model 9A2 or 9B2
1 - 2	0	1
1 - 2	1 - 2	2
1 - 2	3 - 4	2
Note: The device adapters for disk enclosures that are installed in the first Model 9AE (identified with feature code 0231 or 0331) are ordered on and installed in that Model 9AE. Therefore, do not use the quantity of feature code 1220 that is installed in the first Model 9AE to determine the required quantity of feature code 3021 for the Model 9A2.		

Table 15 on page 52 shows the required quantity of feature code 3031 for your Model 9A2 or 9B2. The required quantity of this feature is based on the number of disk enclosure pair features (feature code 1230) that are installed in the Model 9A2 or 9B2 and, if attached, in the second Model 9AE expansion unit (identified with feature code 0232 or 0332). Because the second Model 9AE do not support I/O enclosure pairs, the device adapters for disk enclosures that are installed in the

second Model 9AE must be ordered on and installed in the Model 9A2 or 9B2.

Table 15. Required quantities of feature code 3031

Quantity of feature code 1230 currently installed on Model 9A2 or 9B2	Quantity of feature code 1230 currently installed on Model 9AE (with feature code 0232 or 0332)	Required quantity of feature code 3031 on Model 9A2 or 9B2
1 - 2	0	1
1 - 2	1 - 2	2
1 - 2	3 - 4	2
Note: The device adapters for disk enclosures that are installed in the first Model 9AE (identified with feature code 0231 or 0331) are ordered on and installed in that Model 9AE. Therefore, do not use the quantity of feature code 1230 that is installed in the first Model 9AE to determine the required quantity of feature code 3031 for the Model 9A2 or 9B2.		

Disk drive cables

You must order at least one disk cable set to connect the disk drives to the device adapters.

The disk drive cable feature provides you with a complete set of fibre channel cables to connect all the disk drives that are supported by the model to their appropriate device adapters.

Disk drive cable groups have the following configuration guidelines:
* The minimum number of disk drive cable group features for each model is one.
* The disk drive cable groups must be ordered as follows:
  – If the disk drives connect to device adapters within the same base model, order disk drive cable group 1.
  – If the disk drives connect to device adapters within the same expansion model, order disk drive cable group 2.
  – If the disk drives are in a Model 92E that is attached to a Model 921, order disk drive cable group 3.
  – If the disk drives are in a second expansion unit (position 2 expansion unit), order disk drive cable group 4.

Feature codes for disk drive cables

Use the disk drive cable feature codes to order the cable groups for each DS8000 model.

Table 16 shows the feature codes to use and the connection type that is supported by each group.

Table 16. Disk drive cable feature codes

Feature Code	Disk Drive Cable Group	Connection Type
1211	Disk drive cable group 1	Connects the disk drives to the device adapters within the same base model. Can be used for Models 921, 922, 931, 932, 9A2, and 9B2.
1212	Disk drive cable group 2	Connects the disk drives to the device adapters within the same expansion model. Used for Models 92E, 9AE when they are the first expansion unit (position 1 expansion unit) within the storage unit.

Table 16. Disk drive cable feature codes (continued)

Feature Code	Disk Drive Cable Group	Connection Type
1213	Disk drive cable group 3	Connects the disk drives from a Model 92E to the device adapters in a Model 921 or 931.
1214	Disk drive cable group 4	Connects the disk drives from a second expansion unit (position 2 expansion unit) to the base model. Specifically connects the second Model 92E to the device adapters in the base Model 922 or 932, or connects the second Model 9AE to the device adapters in the base Model 9A2 or 9B2.

Configuration rules for storage features

Use the following general configuration rules and ordering information to help you order storage features.

You must order at least one disk enclosure feature for each base unit (Model 921, 922, 931 or 932) that you order, with the exception of a Model 9A2 or 9B2, which requires two disk enclosure features (one for each image).

Each disk enclosure feature must contain one of the following disk features:
- Regular disk drives
- Standby CoD disk drives
- Disk enclosure fillers

If the disk enclosure contains regular or Standby CoD disk drives, the disk drive features must be of the same capacity and speed.

The following examples illustrate the configuration rules for each model.

Figure 9 on page 54 shows that only one disk enclosure pair feature is required on Model 921 or 931 when you order a Model 92E expansion unit.
- Model 921 or 931 requires a minimum of 16 disk drives.
- Model 92E requires no disk drives.
- One device adapter pair is required.
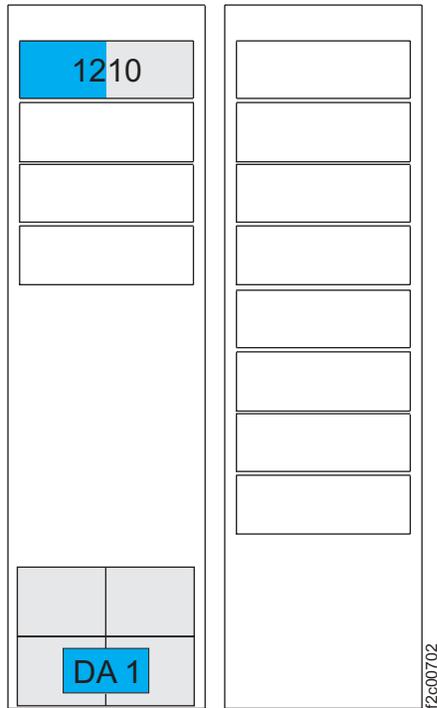
Figure 9. Minimum configuration rules for Model 921 or 931 + 92E

Figure 10 on page 55 shows that only one disk enclosure pair feature is required on Model 922 or 932 when you order the first Model 92E expansion unit.

- Model 922 or 932 requires a minimum of 16 disk drives.
- Model 92E requires no disk drives.
- One device adapter pair is required.
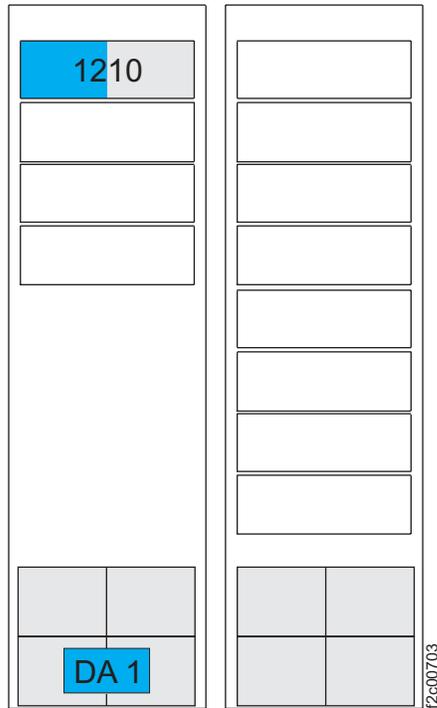
Figure 10. Minimum configuration rules for Model 922 or 932 + 92E

Figure 11 on page 56 shows that no disk enclosure pair features are required on the first Model 92E expansion unit when you order a second Model 92E expansion unit for Model 922 or 932.

- Model 922 or 932 requires a minimum of 16 disk drives.
- The first Model 92E requires no disk drives.
- The second Model 92E requires no disk drives.
- One device adapter pair is required.
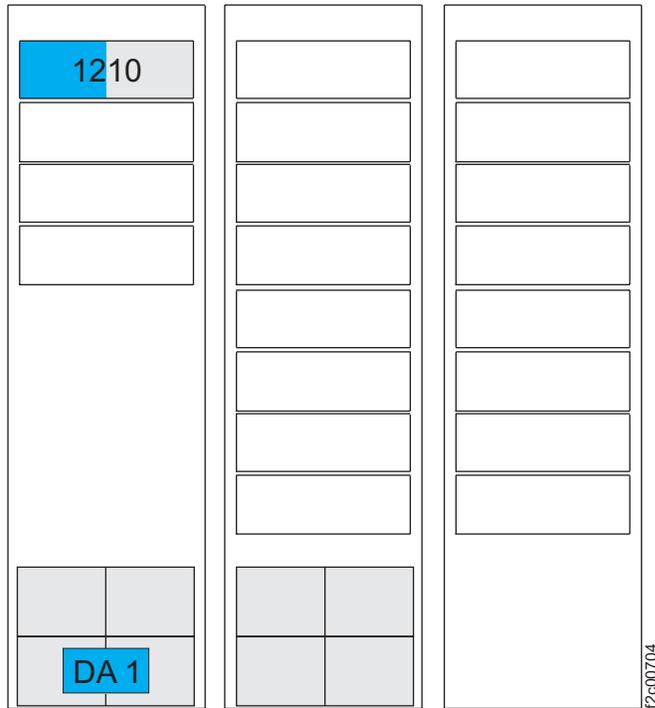
Figure 11. Minimum configuration rules for Model 922 or 932 + 92E + 92E

Figure 12 on page 57 shows that two disk enclosure pair features are required on Model 9A2 or 9B2 when you order the first Model 9AE expansion unit.

- Model 9A2 or 9B2 requires a minimum of 32 disk drives.
- Model 92E requires no disk drives.
- Two device adapter pairs are required.
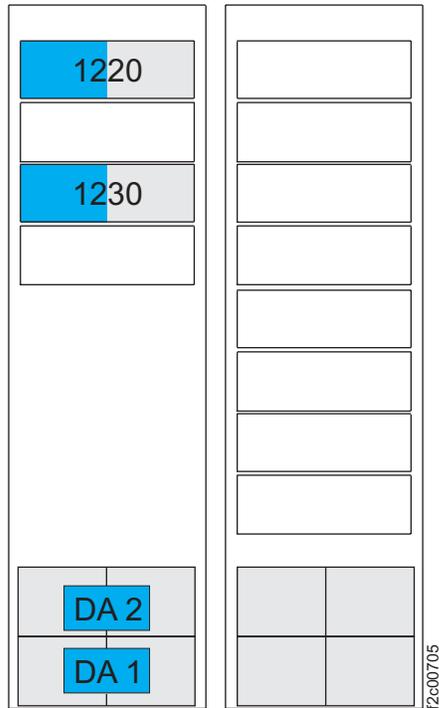
Figure 12. Minimum configuration rules for Model 9A2 or 9B2 + 9AE

Figure 13 on page 58 shows that no disk enclosure pair features are required on the first Model 9AE when you order a second Model 9AE expansion unit for Model 9A2 or 9B2.

- Model 9A2 or 9B2 requires a minimum of 32 disk drives.
- The first Model 92E requires no disk drives.
- The second Model 92E requires no disk drives.
- Two device adapter pairs are required.
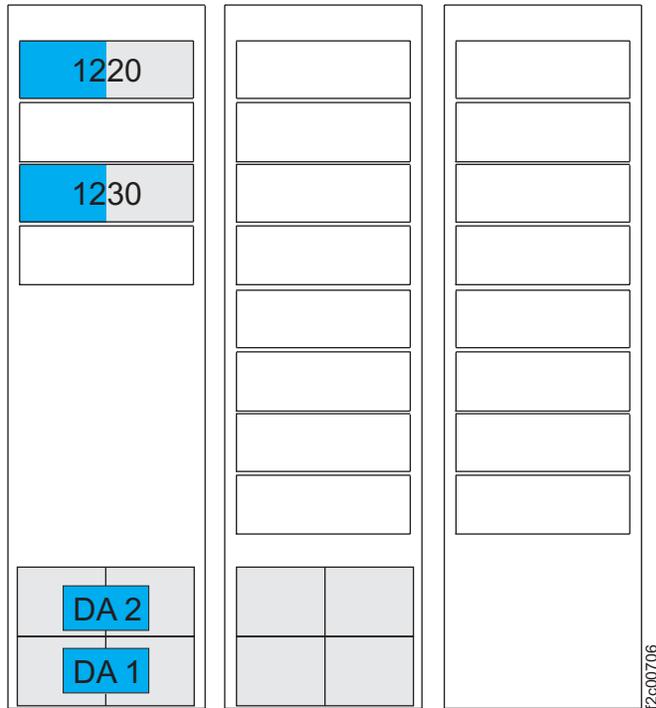
Figure 13. Minimum configuration rules for Model 9A2 or 9B2 + 9AE + 9AE

Configuration examples for storage features

Figure 14 shows how storage features, such as disk enclosures, are installed from the top to the bottom of each base or expansion model. A model does not need to be filled before you can begin adding storage features to the next model in the storage unit.
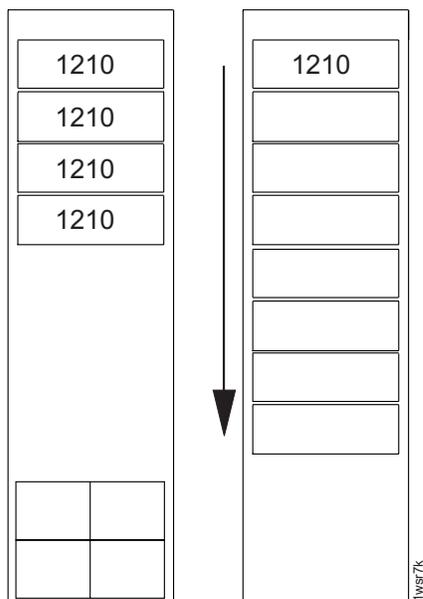
Figure 14. Storage features are installed from the top to the bottom of the model.

Figure 15 and Figure 16 on page 60 illustrate how the base storage unit (9A2 and 9B2) has A and B physical locations for storage features. For each location (A or B), you must install the storage features from the top to the bottom.

In Figure 15, the images have the same storage capacity and have installed the same number of disk enclosures.
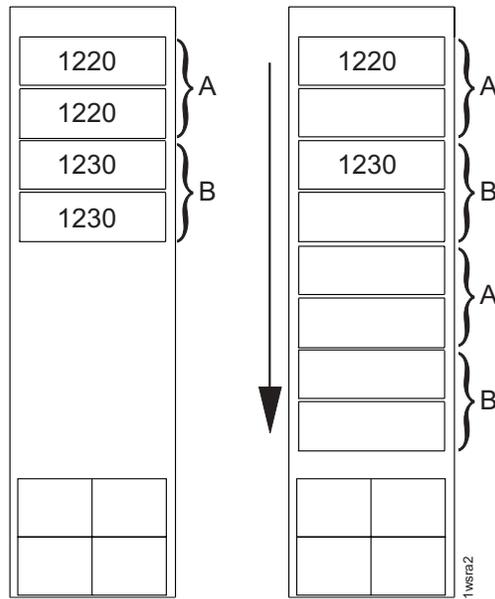
Figure 15. A base storage unit (Model 9A2 or 9B2) with equal storage capacity for both images. Physical locations A correspond to image 2. Physical locations B correspond to image 1.

In Figure 16 on page 60, the images have different amounts of storage capacity. Image 1 (B physical locations) has filled all the B locations on the base model and the first expansion model, and has started to fill in B locations in the second expansion model.

1220 1220 1220 } A

1220 1220 }

1230 1230 } B

1230

1220 } A

1220

} B

1wsrbm
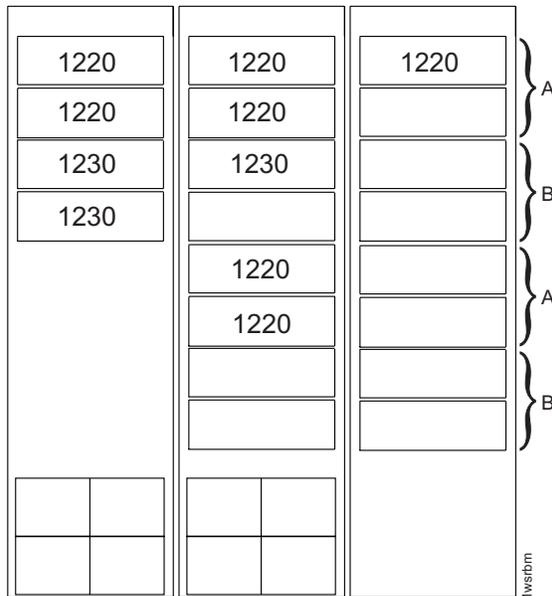
Figure 16. A base storage unit (Model 9A2 or 9B2) in which image 1 (physical locations B) has more storage capacity than image 2 (physical locations A).

Figure 17 shows how disk drive cable group 1 (1211) connects the disk drives to the device adapters within the same base model. Disk drive cable group 3 (1213) connects the disk drives from a Model 92E expansion unit to the device adapters in a Model 921 base unit to the device adapters in a Model 931 base unit.

1211 1213

1wsrcn
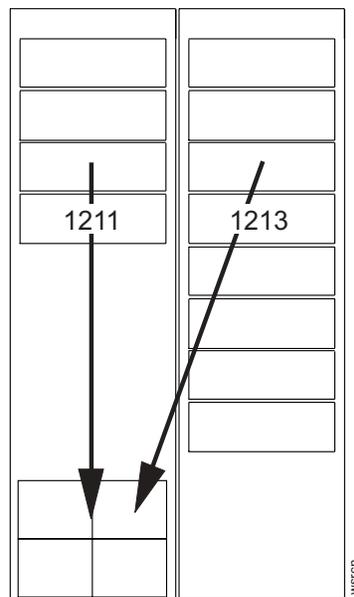
Figure 17. Disk drive cable group 1 (1211) and disk drive cable group 3 (2113) connections

Figure 18 on page 61 shows again how disk drive cable group 1 (1211) connects the disk drives to the device adapters within the same base model. Disk drive cable group 2 (1212) connects the disk drives from the first expansion unit to the device adapters within its own unit. Disk drive cable group 4 (1214) connects the disk drives from the second expansion unit to the device adapters in the base unit. (I/O adapter features are not allowed on the second expansion unit within a storage

unit, so the disk drives in the second expansion unit must connect back to the base
unit.)
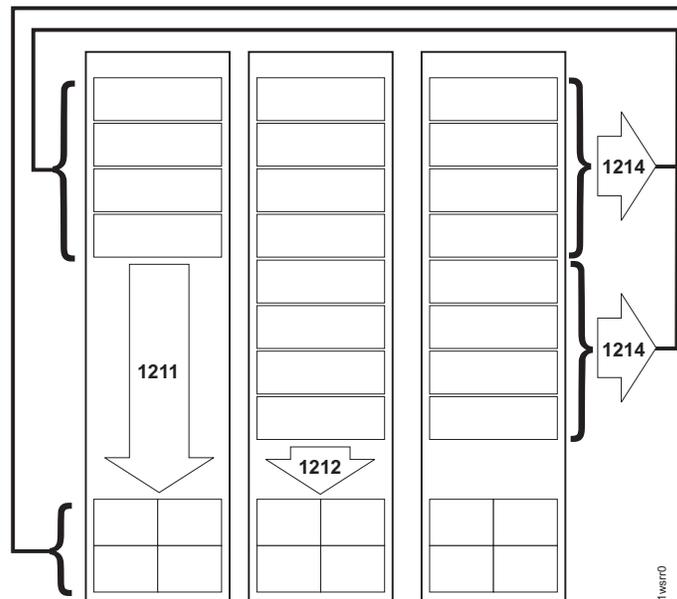
Figure 18. Disk drive cable group 1 (1211), disk drive cable group 2 (1212), and disk drive cable group 4 (1214) connections.

Configuration rules for Standby CoD disks

Use the following configuration rules and ordering information to help you order
and activate Standby Capacity On Demand (Standby CoD) disk drive sets.

The following requirements apply:
* The storage unit in which the Standby CoD disk drives reside must use the IBM
  call home feature.
* Each 921, 922, 931, and 932 storage unit can have a maximum of four Standby
  CoD disk drive features that are installed at any one time.
* Each 9A2 and 9B2 storage unit can have a maximum of four Standby CoD disk
  drive features that are installed on each image.
* You must have twice as many regular disk drive features that are installed in the
  storage unit as there are Standby CoD disk drive features. For example, if you
  order two Standby CoD disk drive features (32 drives) for a storage unit, you
  must have at least four regular disk drive features (64 drives) on the storage
  unit.
* If you have one type of Standby CoD disk drive feature installed, you cannot
  order regular disk drive features of the same type without first activating
  (purchasing) the Standby CoD disk drives.

Standby CoD capacity must be activated within one year of purchase. When you
activate Standby CoD capacity, you must order a feature conversion to convert the
Standby CoD disk drive set feature to the corresponding regular disk drive set
feature. You must activate all drives in the Standby CoD disk set at once. Once you
activate Standby CoD disk drive features, the activation is permanent (once
activated, disk capacity cannot be reduced).

Standby CoD disk drive sets are subject to the same intermix options and
limitations as regular disk drive sets.

Additional storage feature information

To help you determine the type and number of disk drives to add to your storage unit, this section includes additional information.

The following additional information is provided:
* Calculating physical and effective capacity of disk drives

Calculating physical and effective capacity

To calculate the total physical capacity of a DS8000 storage unit, multiply each disk drive set feature by its total physical capacity and sum the values.

The logical configuration of your DS8000 series storage affects the effective capacity of the disk drive set.

Specifically, effective capacities vary depending on the following:
* Data format

    Physical capacity can be logically configured as fixed block (FB) or count key data (CKD). Data accessed by open systems hosts or Linux on System z that support fibre channel protocol must be logically configured as FB. Data accessed by zSeries hosts with z/OS or z/VM must be configured as CKD.
* Array or rank configuration

    The disk drive arrays on the system can be combined in various ways into RAID ranks and RAID configurations. One or more arrays can be combined to create a single contiguous storage space called a RAID rank.

Each RAID rank is divided into equal-sized segments known as extents. All extents are approximately 1 GB. However, FB extents are slightly larger than CKD extents.

Table 17 describes the physical and effective capacity of a disk drive set (16 disk drives).

Table 17. Disk drive set capacity for open systems and zSeries environments

Disk size (GB)	Total physical capacity (GB) per disk drive set	Fixed block (FB) or count key data (CKD)	Effective capacity in GB (Number of Extents) (See Notes 1 and 2)			
			Ranks of RAID 10 arrays		Ranks of RAID 5 arrays (See Note 3)	
			3 x 3 (See Note 4)	4 x 4 (See Note 5)	6 + P (See Note 6)	7 + P (See Note 7)
73	1168	FB	207.23 (193)	277.03 (258)	416.61 (388)	485.33 (452)
		CKD	204.34 (216)	272.45 (288)	410.57 (434)	479.62 (507)
146	2336	FB	416.61 (388)	557.27 (519)	836.44 (779)	976.03 (909)
		CKD	411.51 (435)	549.63 (581)	825.86 (873)	963.03 (1018)

Table 17. Disk drive set capacity for open systems and zSeries environments (continued)

Disk size (GB)	Total physical capacity (GB) per disk drive set	Fixed block (FB) or count key data (CKD)	Effective capacity in GB (Number of Extents) (See Notes 1 and 2)			
			Ranks of RAID 10 arrays		Ranks of RAID 5 arrays (See Note 3)	
			3 x 3 (See Note 4)	4 x 4 (See Note 5)	6 + P (See Note 6)	7 + P (See Note 7)
300	4800	FB	848.26 (790)	1131.72 (1054)	1698.66 (1582)	1979.98 (1844)
		CKD	835.32 (883)	1114.39 (1178)	1675.38 (1771)	1954.45 (2066)
500	8000	FB	(1319)	(1760)	(2640)	(3078)
		CKD	(1477)	(1970)	(2957)	(3448)

Notes:

1. Physical capacities are in decimal gigabytes (GB). One decimal GB is 1 000 000 000 bytes.
2. Although disk drive sets contain 16 drives, arrays use only 8 drives. The effective capacity assumes that you have two arrays for each disk drive set.
3. In RAID 5 configurations, the parity information uses the capacity of one disk, but is actually distributed across all the disks within the array.
4. The array consists of 3 data drives that are mirrored to 3 copy drives. Two other drives in the disk drive set are used as spares.
5. The array consists of 4 data drives that are mirrored to 4 copy drives.
6. The array consists of 6 data drives and 1 parity drive. One other drive is used as a spare.
7. The array consists of 7 data drives and 1 parity drive.

I/O adapter features

You must select the I/O adapter features that you want on your DS8000 models.

The I/O adapter features are separated into the following categories:
- I/O enclosures
- Device adapters and cables
- Host adapters and cables

I/O enclosures and cables

I/O enclosures are required for your storage unit configuration.

The I/O enclosures hold the I/O adapters and provide connectivity between the I/O adapters and the storage unit processors. I/O enclosures are ordered and installed in pairs.

The I/O adapters contained in the I/O enclosures can be either device or host adapters. Each I/O enclosure pair can support up to four device adapters (two pairs) and eight host adapters.

The I/O cables are RIO-G cables (Remote I/O cables) that provide the connection between the I/O enclosures and the base model processors.

Feature code for I/O enclosures

Use the following I/O enclosure feature code to order a minimum of two I/O enclosure pairs for your storage unit.

1300   I/O enclosure pair

Feature codes for I/O cables

Use these feature codes to order I/O cables for your storage unit.

Table 18 provides the I/O cable groups that you can order, a description of the connection that is provided by the group, the supported models, and the feature codes to use.

Table 18. I/O (RIO-G) cable feature codes

Feature Code	Cable Group	Description	Models
1312	RIO-G cable group 2	Connects the device adapters in two I/O enclosure pairs on Model 921 or 931 to the processor.	921, 931
1313	RIO-G cable group 3	Connects the device adapters in both I/O enclosure pairs on a Model 922, 932, 9A2, or 9B2 to the processor.	922, 932, 9A2, 9B2
1314	RIO-G cable group 4	Connects device adapters in an I/O enclosure pair on a Model 92E to the processor on a Model 922 or connects the pair on a Model 93D to the processor on a Model 932.	92E
1315	RIO-G cable group 5	Connects device adapters in an I/O enclosure pair on a Model 9AE to the processor on a Model 9A2 or connects the pair on a Model 9BD to the processor on a Model 9B2.	9AE
1316	RIO-G cable group 6	Connects device adapters in I/O pairs. (See Note)	922, 932, 9A2, 9B2
Note: The RIO-G cable group 6 connects device adapters in both I/O enclosure pairs on a 922, 932, 9A2, or 9B2 to the processor. It also connects device adapters in both I/O enclosure pairs on a 92E or 9AE to the processor on a 922 or 9A2. When feature codes 0001, 0221, or 0231 are present, use feature code 1316 instead of feature code 1313. The first expansion unit is ordered as a factory merge as follows: • 92E expansion unit with 922 base unit • 9AE expansion unit with 9A2 base unit			

Fibre-channel (SCSI-FCP and FICON) host adapters and cables

You can order fibre-channel host adapters for your storage unit configuration.

The fibre-channel host adapters enable the storage unit to attach to fibre channel (SCSI-FCP) and FICON servers, and SAN fabric components. They are also used for remote mirror and copy control paths between DS8000 storage units or between a DS8000 storage unit and a DS6000 storage unit or a 2105 storage unit (Model 800 or 750). Fibre-channel host adapters are installed in an I/O enclosure.

The adapters have four ports and support 4Gb. 2Gb, or 1Gb per second full-duplex data transfer over longwave or shortwave fibre links.

Supported protocols include the following:
- SCSI-FCP ULP (Upper Layer Protocol) on point-to-point, fabric, and arbitrated loop (private loop) topologies.
- FICON ULP on point-to-point and fabric topologies.

Notes:

1. SCSI-FCP and FICON are supported simultaneously on the same adapter, but not on the same port.
2. For highest availability, it is recommended that adapters always be added in pairs.

A fibre-channel cable is required to attach each fibre-channel adapter port to a server or fabric component port. Each cable has an Lucent connector (LC) at one end to attach to the fibre-channel adapter port. The cables are available with either an LC or standard connector (SC) at the other end to attach to the server or fabric component port. You can also order a conversion cable that can be used to attach the fibre-channel adapter port to a cable with an SC connector.

Feature codes for fibre-channel host adapters

Use these feature codes when you order fibre-channel host adapters for your storage unit.

Table 19 provides a list of the types of fibre-channel adapters that you can order, their characteristics, and their feature codes.

Note: Fibre-channel adapters are optional features and are activated through the following feature codes. These features are chargeable and will carry a minimum monthly maintenance charge.

Table 19. fibre-channel host adapters feature codes

Feature Code	Description (See Note)	Model	Protocols	Link Speed	Receptacle Type
3111	Shortwave fibre-channel host adapter	921 922 92E 931 932	SCSI-FCP and FICON	2 Gb/second	LC
3113	Shortwave fibre-channel host adapter	921 922 92E 931 932	SCSI-FCP and FICON	4 Gb/second	LC
3121	Shortwave fibre-channel host adapter–A locations	9A2 9AE 9B2	SCSI-FCP and FICON	2 Gb/second	LC
3123	Shortwave fibre-channel host adapter–A locations	9A2 9AE 9B2	SCSI-FCP and FICON	4 Gb/second	LC
3131	Shortwave fibre-channel host adapter–B locations	9A2, 9AE 9B2	SCSI-FCP and FICON	2 Gb/second	LC
3133	Shortwave fibre-channel host adapter–B locations	9A2 9AE 9B2	SCSI-FCP and FICON	4 Gb/second	LC

Table 19. fibre-channel host adapters feature codes (continued)

Feature Code	Description (See Note)	Model	Protocols	Link Speed	Receptacle Type
3211	Longwave fibre-channel host adapter	921 922 92E 931 932	SCSI-FCP and FICON	2 Gb/second	LC
3213	Longwave fibre-channel host adapter	921 922 92E 931 932	SCSI-FCP and FICON	4 Gb/second	LC
3215	Longwave fibre-channel 10 km host adapter	921 922 92E 931 932	SCSI-FCP and FICON	4 Gb/second	LC
3221	Longwave fibre-channel host adapter–A locations	9A2 9AE 9B2	SCSI-FCP and FICON	2 Gb/second	LC
3223	Longwave fibre-channel host adapter–A locations	9A2 9AE 9B2	SCSI-FCP and FICON	4 Gb/second	LC
3225	Longwave fibre-channel 10 km host adapter–A location	9A2 9AE 9B2	SCSI-FCP and FICON	4 Gb/second	LC
3231	Longwave fibre-channel 10 km host adapter–B location	9A2 9AE 9B2	SCSI-FCP and FICON	2 Gb/second	LC
3233	Longwave fibre-channel host adapter–B locations	9A2 9AE 9B2	SCSI-FCP and FICON	4 Gb/second	LC
3235	Longwave fibre-channel 10 km host adapter–B locations	9A2 9AE 9B2	SCSI-FCP and FICON	4 Gb/second	LC
Note: Most feature codes that apply to Models 9A2, 9B2, 9AE. must be used for specific physical locations within the storage unit. The A locations support image 2, while the B locations support image 1.					

Feature codes for fibre channel cables

Use these feature codes when you order fibre channel cables to connect fibre channel host adapters to your storage unit.

Table 20. Fibre channel cable feature codes

Feature Code	Cable Type	Connector Types		Length	Compatible Fibre Channel Host Adapter Features
		First End	Second End		
1410	50 micron fibre channel cable, multimode	LC connector	LC connector	31 m (102 ft)	• Short wave fibre channel/ FICON host adapters (features 3111, 3113, 3121, 3123, 3131, and 3133) • Long wave fibre channel/ FICON adapters (features 3211, 3213, 3221, 3223, 3231, and 3233) only when the adapter is operating at a 1 Gb per second transfer rate
1411	50 micron fibre channel cable, multimode	LC connector	SC connector	31 m (102 ft)	
1412	50 micron fibre channel conversion cable, multimode	LC connector	SC receptacle	2 m (6.5 ft)	
1420	9 micron fibre channel cable, single mode	LC connector	LC connector	31 m (102 ft)	• Long wave fibre channel/ FICON adapters (features 3211, 3215, 3221, 3225, 3231, and 3235)
1421	9 micron fibre channel cable, single mode	LC connector	SC connector	31 m (102 ft)	
1422	9 micron fibre channel conversion cable, single mode	LC connector	SC receptacle	2 m (6.5 ft)	

Note: Table information is for all DS8000 series models.

ESCON host adapters and cables

You can order ESCON host adapters for your storage unit configuration.

The ESCON host adapters enable DS8000 storage units to attach to ESCON channels on zSeries and S/390 servers, or ESCON directors. ESCON host adapter are installed in an I/O enclosure.

Note: Remote Mirror and Copy functions are not supported by ESCON adapters. If you use these functions, use fibre channel host adapters instead.

Each 64-bit ESCON host adapter has two ports. Each port supports two ESCON links and up to 64 logical paths (a total of 128 logical paths per adapter). The ports use a light emitting diode (LED) as the optical transceiver.

Note: For highest availability, it is recommended that adapters always be added in pairs.

Each ESCON host adapter port requires a 62.5-micron multimode fiber-optic ESCON cable to connect the ports to a server or fabric port. These cables have a

small form factor, industry standard MT-RJ connector at one end for attachment to the ESCON adapter port. The other cable end, which connects to the server or fabric port, can be either an MT-RJ or ESCON Duplex connector. You also can order a conversion cable that can be used to attach the ESCON adapter port to a cable with an ESCON Duplex connector.

Feature codes for ESCON host adapters

Use these feature codes when you order ESCON host adapters for your storage unit.

Table 21 provides the host adapter feature codes to use, based on the model where the host adapter will be installed.

Table 21. ESCON host adapter feature codes

Feature Code	Description (See Note)	Model
3311	ESCON host adapter	921, 922, 92E, 931, 932
3321	ESCON host adapter–A locations	9A2, 9AE, 9B2
3331	ESCON host adapter–B locations	9A2, 9AE, 9B2
Note: The feature codes that apply to Models 9A2, 9AE, 9B2 must be used for specific physical locations within the storage unit. The A locations support image 2, while the B locations support image 1.		

Feature codes for ESCON cables

Use these feature codes when you order ESCON cables to attach your ESCON host adapters to your storage unit.

Table 22 provides the ESCON cable feature codes.

Table 22. ESCON cable feature codes

Feature Code	Cable Type	Connector Types		Length	DS8000 Models
		First End	Second End		
1430	62.5 micron ESCON cable	MT-RJ connector	MT-RJ connector	31 m (102 ft)	All models
1431	62.5 micron ESCON cable	MT-RJ connector	ESCON Duplex connector	31 m (102 ft)	All models
1432	62.5 micron ESCON conversion cable	MT-RJ connector	ESCON Duplex receptacle	2 m (6.5 ft)	All models
1440	62.5 micron ESCON cable, plenum-rated	MT-RJ connector	MT-RJ connector	31 m (102 ft)	All models
1441	62.5 micron ESCON cable, plenum-rated	MT-RJ connector	ESCON Duplex connector	31 m (102 ft)	All models

Configuration rules for I/O adapter features

To order I/O adapter features, you must follow specific configuration rules.

The following configuration rules affect I/O adapter features:
- Configuration rules for I/O enclosures, I/O cables, and device adapters

• Configuration rules for host adapters and host adapter cables

Configuration rules for I/O enclosures, I/O cables, and device adapters

Use these configuration rules and ordering information to help you order I/O enclosures, I/O cables, and device adapters.

You must consider your entire storage system (base model and any attached expansion units) when you order.

Use Table 23 to determine the number of I/O enclosures and device adapters features that you need in various storage unit configurations. To use this table, find the rows that contain the type of storage unit you are configuring. Then find the row that represents the number of disk enclosures that are installed on that storage unit. Look in the last two columns to find the number of I/O enclosures and device adapters that you need on the storage unit.

Table 23. Required I/O enclosures and device adapters (based on disk enclosures)

Storage Unit Type	Storage Unit Configuration	Disk Enclosure Features (12x0)	Required Device Adapter Features (30x1) (Note 1 and 2)	Required I/O Enclosure Features (1300)
921/931 storage unit	Base model (standalone)	1 - 2	1	2
		3 - 4	2	2
	Base model +1 expansion model	5 - 6	3	2
		7 - 12	4	2

Table 23. Required I/O enclosures and device adapters (based on disk enclosures) (continued)

Storage Unit Type	Storage Unit Configuration	Disk Enclosure Features (12x0)	Required Device Adapter Features (30x1) (Note 1 and 2)	Required I/O Enclosure Features (1300)
922/932 storage unit	Base model (standalone)	1 - 2	1	2
		3 - 4	2	2
	Base model +1 expansion model	5 - 6	3 (2 in base model; 1 in expansion model)	4 (2 in base model; 2 in expansion model)
		7 - 8	4 (2 in base model; 2 in expansion model)	4 (2 in base model; 2 in expansion model)
		9 - 10	5 (2 in base model; 3 in expansion model)	4 (2 in base model; 2 in expansion model)
		11 - 12	6 (2 in base model; 4 in expansion model)	4 (2 in base model; 2 in expansion model)
	Base model +2 expansion models	13 - 14	7 (3 in base model; 4 in first expansion model)	4 (2 in base model; 2 in first expansion model)
		15 - 20	8 (4 in base model; 4 in first expansion model)	4 (2 in base model; 2 in first expansion model)

Table 23. Required I/O enclosures and device adapters (based on disk enclosures) (continued)

Storage Unit Type	Storage Unit Configuration	Disk Enclosure Features (12x0)	Required Device Adapter Features (30x1) (Note 1 and 2)	Required I/O Enclosure Features (1300)
9A2/9B2 storage unit - A locations	Base model (standalone)	1 - 2	1	2
	Base model +1 expansion model	3 - 4	2 (1 in base model; 1 in expansion model)	2 (1 in base model; 1 in expansion model)
		5 - 6	3 (1 in base model; 2 in expansion model)	2 (1 in base model; 1 in expansion model)
	Base model +2 expansion models	7 - 10	4 (2 in base model; 2 in first expansion model)	2 (1 in base model; 1 in first expansion model)
9A2/9B2 storage unit - B locations	Base model (standalone)	1 - 2	1	2
	Base model +1 expansion model	3 - 4	2 (1 in base model; 1 in expansion model)	2 (1 in base model; 1 in expansion model)
		5 - 6	3 (1 in base model; 2 in expansion model)	2 (1 in base model; 1 in expansion model)
	Base model +2 expansion models	7 - 10	4 (2 in base model; 2 in first expansion model)	2 (1 in base model; 1 in first expansion model)

Notes:

1. Each device adapter feature code represents one device adapter pair.
2. The maximum quantity is two device adapter features for each I/O enclosure feature in the storage unit.
3. Each I/O enclosure feature represents one I/O enclosure pair.

You must order I/O cables when you order one of the base models (921, 922, 931, 932, 9A2, and 9B2).

I/O cables have the following configuration guidelines:

- You must order an I/O cable feature for every model that contains I/O enclosures.

- The I/O cable feature groups must be ordered as follows:
  - For each Model 921 or 931, order RIO-G cable group 2.
  - For each Model 922, 932, 9A2, or 9B2, order RIO-G cable group 3.
  - For each Model 92E that contains I/O enclosures, order RIO-G cable group 4.
  - For each Model 9AE that contains I/O enclosures, order RIO-G cable group 5.

Configuration rules for host adapters and cables

Use the following configuration rules and ordering information to help you order host adapters and cables.

When you configure your DS8000 storage unit, consider the following issues when ordering the host adapters for the storage unit:
- What are the minimum and maximum numbers of host adapters that I can install?
- How should I balance the host adapters across the storage unit to help ensure optimum storage unit performance?
- What host adapter configurations help ensure high availability of my data?
- How many and what type of cables do I need to order to support the host adapters?

Maximum and minimum configurations

Table 24 provides the minimum and maximum numbers of host adapter features that each type of storage unit configuration can contain.

Table 24. Minimum and maximum host adapter features

Storage Unit Type	Storage Unit Configuration	Minimum Number of Host Adapter Features for the Base Model (See Note 1)	Maximum Number of Host Adapter Features for the Storage Unit (See Note 1 and 2)
921/931	Base model (stand-alone)	2	16
	Base model + 1 expansion model	2	16
922/932	Base model (stand-alone)	2	16
	Base model + 1 expansion model	2	32
	Base model + 2 expansion models	2	32
9A2/9B2	Base model (stand-alone)	4	16
	Base model + 1 expansion model	4	32
	Base model + 2 expansion models	4	32

Table 24. Minimum and maximum host adapter features (continued)

Storage Unit Type	Storage Unit Configuration	Minimum Number of Host Adapter Features for the Base Model (See Note 1)	Maximum Number of Host Adapter Features for the Storage Unit (See Note 1 and 2)
Notes:			
1. The minimum number of host adapters applies only to the base model within the storage unit. Expansion models have no minimum requirement. The maximum number applies to the entire storage system.			
2. The maximum number of host adapters for any one model cannot exceed 16. Note that you can add host adapters only to the base model in a 921 or 931 storage unit.			

Configuring for highest availability

After you have met the initial minimum order requirement, you can order one host adapter at a time. However, to ensure the highest availability of your data, always add host adapters (of the same type) in pairs.

Note: Although one multiport adapter can provide redundant pathing, keep in mind that if you install only one adapter and if there is a failure or service action affecting that adapter, you will lose access to all data through that adapter.

Balancing host adapters across the storage unit

For optimum storage unit performance, it is important that you order host adapters to balance them within your storage unit. Depending on the base model within your storage unit, you balance the host adapters in the following ways:

- If you only have a base model or if you have a Model 921 or 931 and an expansion model, the host adapters in your storage unit are already balanced.
- For a 922 or 932 storage unit with one or two expansion models, you must order host adapters specifically for the base model and specifically for the first expansion model so that the host adapters are balanced. Host adapters are not supported in the second expansion model.
- For a 9A2 or 9B2 storage unit with one or two expansion models, you must order host adapters specifically for the base model and specifically for the expansion models so that they are balanced across all the I/O enclosures that are associated with the same image. Host adapters are not supported in the second expansion model.

For example, when you order a 9A2 or 9B2 storage unit, the first four host adapters are installed so that they are balanced across the images. You could have one image (that is, LPAR) with 2 shortwave adapters and an open host with fixed-block data, and the second LPAR could have 2 longwave adapters with 390 or CKD data.

When you want to add an expansion model to an existing 922, 932, 9A2, or 9B2 storage unit that contains only a base model with several host adapter pairs installed, order host adapter pairs for your expansion model to balance those installed on your base model.

The following three ordering scenarios help illustrate how you can order host adapters for a balanced configuration in each type of storage unit. The examples assume the following:

- You always order host adapters in feature code pairs (for example, a pair of 3211 longwave fibre-channel host adapters) and that each pair is installed in one I/O enclosure feature. Ordering in host adapters in pairs ensures the highest availability of your data.

Note: When you order host adapters for Model 922, 932, 9A2, or 9B2, ensure that you order the host adapters against the specific model in which you want to install the host adapters.

Scenario 1: Ordering an additional host adapter pair for a 921 or 931 storage unit with two adapters

Your existing 921 or 931 storage unit has a pair of 3211 longwave fibre-channel host adapters installed in the bottom I/O enclosure pair (one host adapter in each enclosure). Later, you order a pair of 3311 ESCON host adapters. The IBM service representative installs the second pair of host adapters (3311) in the top I/O enclosure pair to balance the host adapters across the I/O enclosures of the 921 or 931 storage unit. Figure 19 provides an illustration of this scenario.

Figure 19. 921 or 931 storage unit with four host adapters balanced across I/O enclosures

Scenario 2: Ordering host adapters for a 922 or 932 storage unit with a 92E expansion model

You initially order a 922 or 932 storage unit and order two pairs of 3211 longwave fibre-channel host adapters on that initial order (one pair is for the base model and one pair is for the expansion model). Later, you order a pair of 3311 ESCON host adapters. This third pair is installed in the top I/O enclosure pair of the base model. Later still, you order a pair of 3111 shortwave fibre-channel host adapters. This fourth pair is installed in the top I/O enclosure of the expansion unit. Figure 20 provides an illustration of this scenario.

| Second order | one 3311 host adapter | one 3311 host adapter | one 3111 host adapter | one 3111 host adapter | Third order |
| | one 3211 host adapter | one 3211 host adapter | one 3211 host adapter | one 3211 host adapter | |

Initial order

Base Model   Expansion Model

f2c00502
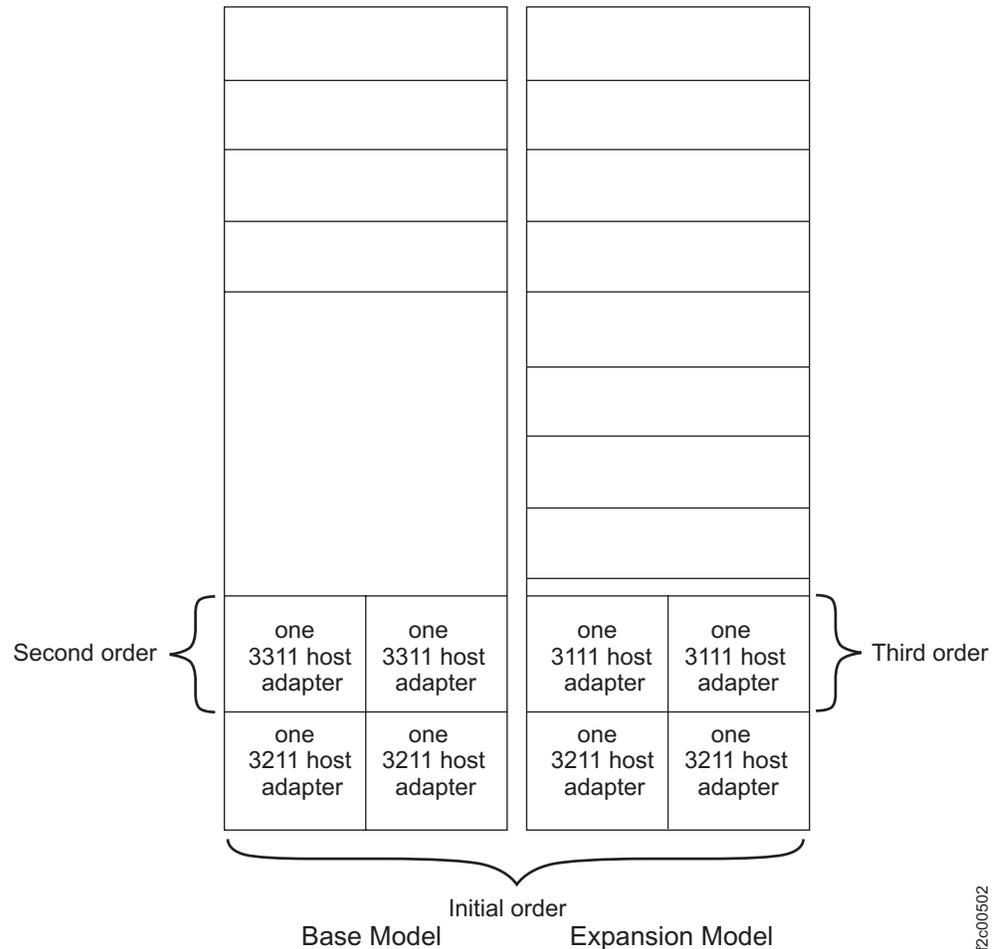
Figure 20. 922 or 932 storage unit with four pairs of host adapters balanced across the entire storage unit

Scenario 3: Ordering host adapters for a 9A2 or 9B2 storage unit with a 9AE expansion model

You initially order one pair of 3211 longwave fibre-channel host adapters for image 1 (B locations within the storage unit) and another 3211 pair for image 2 (A locations). Although you are ordering two pairs of host adapters, each image is configured independently. Therefore, when you receive your storage unit, both of these pairs are installed on the base model—one pair in the top B location I/O enclosure, and one in the bottom location A I/O enclosure. Later you order two more pairs of host adapters for image 1. You first order a pair of 3311 ESCON host adapters, and then you order a pair of 3111 shortwave fibre-channel host adapters. The 3311 pair is the second pair that is installed for image 1 and, to balance the image 1 installation, this pair is installed in the top (B location) I/O enclosure pair in the expansion model. The 3111 pair, which is the third pair that is installed for

image 1, can be installed in the B location of either the base model or the expansion model. If you later order a fourth pair for image 1, that pair is installed in the other model to keep the image 1 locations balanced. Figure 21 provides an illustration of this scenario.

Third order	3111 host adapter	3111 host adapter	3311 host adapter	3311 host adapter	Second order
Initial order	3211 host adapter	3211 host adapter	Future host adapter	Future host adapter	Possible fourth order
	3211 host adapter	3211 host adapter			
	Base Model		Expansion Model		

Image 1, B locations | Image 2, A locations

f2c00500
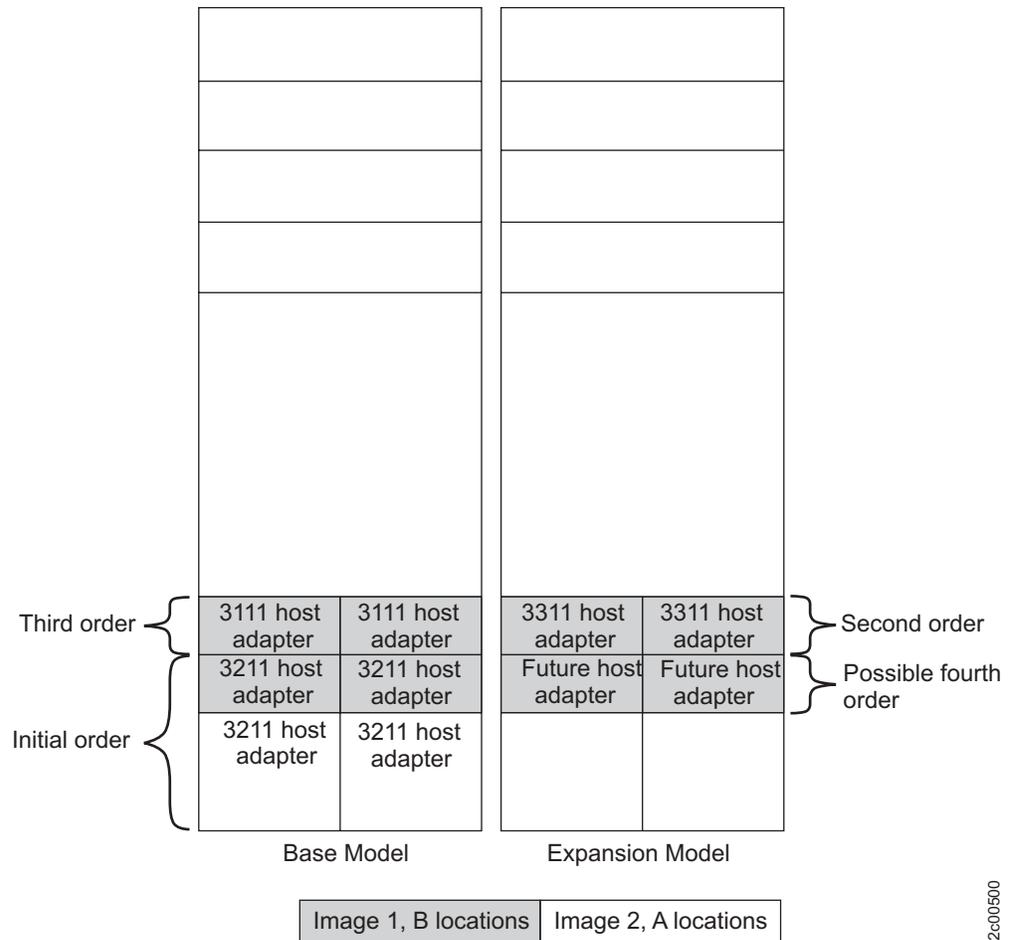
Figure 21. 9A2 or 9B2 storage unit with host adapter pairs balanced across the locations for each image

Note: If you have an IBM service representative move existing host adapters from one slot to another, you may need to reconfigure the host ports on your storage unit using the IBM System Storage DS Storage Manager or the IBM System Storage DS CLI. See the "DS Storage Manager configuration for I/O Attachment" section in the *IBM System Storage DS8000 Host Systems Attachment Guide* for information on configuring storage unit host I/O ports.

Other host adapter configuration guidelines

In addition to the above guidelines, note the following host adapter considerations:
- You can include a combination of fibre channel and ESCON host adapters in one I/O enclosure.
- Feature conversions are available to exchange installed adapters when purchasing new adapters of a different type.

Ordering host adapter cables

For each host adapter, you must also order the appropriate host adapter cables. Typically, to connect fibre channel host adapters to a server or fabric port, you order the following cables:

- For shortwave fibre-channel host adapters, order one of the 50 micron multimode fiber-optic cables terminated with an LC connector.
- For longwave fibre-channel host adapters, you can order either the 9 micron single mode that ends in an LC connector or one of the 50 micron multimode fiber-optic cables that ends in an LC connector. Only the 9 micron cable is supported when the adapter feature is operating at a 2 Gb or 4 Gb per second transfer rate.

IBM Global Services Networking Services can provide assistance for any unique cabling and installation requirements.

Processor memory features

These features specify the amount of memory you want for the processors on your model.

Feature codes for processor memory

Use these feature codes when you order processor memory (cache) for your storage unit configuration.

Table 25 provides the processor memory feature codes for the DS8000 models.

Table 25. Processor memory feature codes

Feature Code	Description	Models
4001	16 GB processor memory	921
4002	32 GB processor memory	921
4003	64 GB processor memory	921
4004	128 GB processor memory	921
4011	16 GB processor memory	921, 931
4012	32 GB processor memory	921, 931
4013	64 GB processor memory	921, 931
4014	128 GB processor memory	921, 931
4102	32 GB processor memory	922, 9A2
4103	64 GB processor memory	922, 9A2
4104	128 GB processor memory	922, 9A2
4105	256 GB processor memory	922, 9A2
4112	32 GB processor memory	922, 932, 9A2, 9B2
4113	64 GB processor memory	922, 932, 9A2, 9B2
4114	128 GB processor memory	922, 932, 9A2, 9B2
4115	256 GB processor memory	922, 932, 9A2, 9B2

Configuration rules for processor memory

Use the following configuration rules and ordering information to help you order processor memory.

You must order one processor memory feature for the configuration of each base model (Models 921, 922, 931, 932, 9A2, and 9B2).

You can select from 16 to 128 GB in processor memory for Models 921 and 931, and from 32 to 256 GB processor memory for Models 922, 932, 9A2, and 9B2.

Power features

You must specify the power features to include on your DS8000 models.

The power features are separated into the following categories:
- Power line cords
- Input voltage
- Battery assemblies

The "Planning for power requirements" on page 114 topics provide more details about specific power requirements for your DS8000 storage unit.

Power line cords

A pair of power line cords is required for each base or expansion model. (Power line cords are also known as power cables.)

Each power line cord feature provides two 3-phase line cords to supply external power to the machine. These features can be used to order replacement line cords.

Feature codes for power line cords

Use these feature codes when you order power line cords for your base or expansion model. Each feature code represents two line cords.

Table 26 provides the power line cord feature codes and associated wire gauges for the DS8000 models. The "Power connector requirements" on page 116 topic provides requirements for each power line cord.

Table 26. Power line cord feature codes

Feature Code	Power Line Cord Type	Wire Gauge
1090	Line cord pair for U.S., Canada, Latin America, and Asia Pacific	10 mm²
1091	Line cord pair for Europe, the Middle East, and Africa (EMEA)	6 mm²
1092	Line cord pair for Japan, U.S., and Canada	10 mm²
1093	Line cord pair for Chicago (U.S.)	10 mm²

Note: All cords are three-phase power cords.

Input voltage

Due to different power requirements across the world, you must specify the nominal AC voltage (phase to phase) that is supported by the power supply that is installed on the model.

This feature can be changed on an installed machine by submitting a Request for Price Quotation (RPQ).

Feature codes for input voltage

Use these feature codes when you specify the input voltage for your base or expansion model.

9090   ac input voltage: 200 V to 240 V

9091   ac input voltage: 380 V to 480 V

Battery assemblies

For any model that includes an I/O enclosure feature or an extended power line disturbance feature, you must order battery assembly features for it.

This feature provides a battery assembly to power the machine when the external power source is lost.

Feature codes for battery assemblies

Use this feature code to order battery assemblies for your base or expansion model.

The following feature codes applies to all models.

1050   Battery assembly

Configuration rules for power features

Use the following configuration rules and ordering information to help you order power features.

When you order power line cord features, the following rules apply:
- You must order a minimum of one line cord feature for each model. Each feature code represents a pair of power line cords (2 cords).
- You must select the power line cord that is appropriate to the geographic region where the storage unit is located.
- You must also specify the appropriate input voltage feature.

You must specify an input voltage feature each time you order a power line cord. Table 27 shows the input voltage feature code to select for each power line cord feature code.

Table 27. Corequisite power line cord and input voltage feature codes

Power Line Cord Feature Code		Corequisite Input Voltage Feature Code	
Feature code	**Geographic region supported**	**Feature code**	**AC input voltage**
1090	U.S., Canada, Latin America, and Asia Pacific	9090 (or 9091)	200 V to 240 V (or 380 V to 480 V)
1091	Europe, the Middle East, and Africa (EMEA)	9091	380 V to 480 V
1092	Japan, U.S., and Canada	9090	200 V to 240 V
1093	Chicago (U.S.)	9090	200 V to 240 V

For battery assemblies, the following rules apply:

- You must order battery assembly features for each model that contains an I/O enclosure feature (feature 1300) or an extended PLD feature (feature 1055).
- On 921 and 931 base models, you must order two battery assembly features. (This is both the minimum and the maximum.)
- On 922, 932, 9A2, and 9B2 base models, you must order three battery assembly features. (This is both the minimum and the maximum.)
- There is no minimum order that is required for 92E, 9AE expansion models, unless the expansion model contains an I/O enclosure feature or an extended PLD feature. If either of these features is installed, you must order battery assembly features for the expansion model. Table 28 provides the required quantity of battery assemblies that you must order.

Table 28. Required quantity of battery assemblies for expansion models. The I/O enclosure feature is 1300 and the extended PLD feature is 1055.

Quantity of disk drive features (1210/1220/ 1230) in expansion model	Required battery assemblies in expansion model • without 1300 • without 1055	Required quantity of battery assemblies in expansion model • without 1300 • with 1055	Required battery assemblies in expansion model • with 1300 • without 1055	Required battery assemblies in expansion model • with 1300 • with 1055
2 to 8	0	2	2	2
10 to 16	0	2	3	3

Other configuration features

Optional feature codes

This section includes information about the following optional feature codes that you can specify to customize or to receive your DS8000 storage unit:
- Extended power line disturbance (PLD) option
- Remote zSeries power control option
- Earthquake Resistance Kit option
- Shipping weight reduction option

Extended power line disturbance

The extended power line disturbance (PLD) feature allows your storage unit to be protected for several seconds, rather than only milliseconds, from a power line disturbance. This feature is optional for your storage unit configuration.

Without the extended PLD feature, a standard DS8000 storage unit offers you about 30 milliseconds of protection from power line disturbances. Adding this feature increases your protection to between 17 and 50 seconds.

If you order the extended PLD feature for an expansion model, the expansion model must contain two or three battery assemblies. "Configuration rules for power features" on page 79 provides more information about the configuration rules for battery assemblies.

Extended power line disturbance feature code

Use this feature code when you order the extended power line disturbance feature for your storage unit.

You can order this feature with the following feature code:

1055   Extended power line disturbance (all models)

Remote zSeries power control

The optional remote zSeries power control feature adds a logic card that allows one or more attached S/390 units to control the power on and power off sequences for your storage unit.

When you use this feature, you must specify the **zSeries power control** setting in the DS Storage Manager that is running on the management console.

This feature includes the cables necessary to connect the logic card.

Feature code for remote zSeries power control

Use this feature code when you order the remote zSeries power control feature for your storage unit.

1000   Remote zSeries power control

Performance accelerator

The performance accelerator feature allows you to install only two disk drive features (32 disk drives) per device adapter pair instead of four disk drive features (64 disk drives), which is the minimum standard configuration.

When this feature is installed, disk drive slots are filled, skipping every other pair slot (skipping the even slots).

The following ordering rules apply to this feature:
- This feature is available only on a 932 base model and for the first expansion unit (Model 92E) on that model. If you want the feature activated on both the base model and the expansion unit, you must order the feature for both models.
- This feature can be ordered only at the initial ordering of these models because it must be installed at the factory.
- If you order a second expansion model for the storage unit (so that the storage unit consists of a Model 932 and two expansion models), the performance accelerator feature must be removed and the first 92E expansion unit be filled with disk drives before the second expansion model can be added.

Feature code for performance accelerator

Use this feature code when you order the performance accelerator feature for a Model 932 or the first expansion model for a Model 932.

1980   This feature allows you to install only two disk drive features (32 disk drives) per device adapter pair instead of four disk drive features (64 disk drives).

Earthquake Resistance Kit

The Earthquake Resistance Kit is an optional seismic kit for stabilizing the storage unit rack, so that the rack complies with IBM earthquake resistance standards.

It is important for computer systems to be adequately restrained during earthquakes. This helps to prevent human injury. It also ensures that the system will be available following an earthquake by limiting potential damage to critical system components such as hard drives. This optional Earthquake Resistance Kit feature includes cross-braces on the front and rear of the rack, which prevent the rack from twisting. Hardware at the bottom of the rack secures it to the floor. The Earthquake Resistance Kit ensures that your storage unit complies with the earthquake resistance objectives that are documented in Earthquake Resistance for IBM Hardware Products (IBM Corporate Bulletin C-B 1-9711-009 9202).

You are responsible for obtaining specific fastening hardware and preparing the floor before the IBM service representative can install the Earthquake Resistance Kit. Installation of the required floor hardware and the Earthquake Resistance Kit is disruptive. If the Earthquake Resistance Kit feature is installed on an existing storage unit, the storage unit must be turned off and temporarily moved while the floor preparations are made and the kit is installed.

Note: If you order the optional Earthquake Resistance Kit, you must order one for each storage unit rack.

If the location of your storage unit is susceptible to earthquakes, order the Earthquake Resistance Kit. The Earthquake Resistance Kit option is available on the 2107/242x models 921, 931, 922, 932, 9A2, 9B2, 92E, 9AE. It can be installed either during product configuration or by your IBM service representative during the storage unit installation.

A minimum monthly maintenance charge applies when this feature is installed.

Note: If you want IBM to remove a previously installed Earthquake Resistance Kit, you must contact IBM Global Services to remove the kit.

Earthquake Resistance Kit feature code
Use this feature code when you order the Earthquake Resistance Kit option for models 921, 931, 922, 932, 9A2, 9B2, 92E, 9AE.

1906   Earthquake Resistance Kit (all models)

Shipping weight reduction

The shipping weight reduction option allows you to receive delivery of a DS8000 model in multiple shipments.

If your site has delivery weight constraints, IBM offers a shipping weight reduction option that ensures the maximum shipping weight of the initial model shipment does not exceed 909 kg (2000 lb). The model weight is reduced by removing selected components, which will be shipped separately.

The IBM service representative installs the components that were shipped separately during the storage unit installation. This feature increases storage unit installation time, so order it only if it is required.

Feature code for shipping weight reduction
Use this feature code when you order the shipping weight reduction option for a DS8000 model.

0200   This feature ensures that the maximum shipping weight of any DS8000 base model or expansion model does not exceed 909 kilograms (2000 lb) each. Packaging adds 120 kilograms (265 lb).

Chapter 3. Planning use of licensed functions

Licensed functions are the storage unit system operating system and functions. These include both required features and optional features.

IBM authorization for licensed functions is purchased as 2244 or 239x machine function authorizations. However, the license functions are actually machine models. For example, the operating environment license (OEL) is listed as a 2244 Model OEL or the 239x Model LFA, OEL license. The 2244 or 239x machine function authorization features are for billing purposes only.

Machine type 2244 and 239x function authorization models

To establish the extent of IBM authorization for a licensed function, you purchase a *function authorization model* by ordering a specific feature code that indicates the size, in terabytes (TB), of the extent of IBM authorization.

The function authorization model size (or level) represents physical capacity, where one TB equals one trillion bytes. The total authorization level for a given licensed function is the sum of the TBs associated with all the purchased feature numbers.

Function authorizations are purchased for the DS8000 base model and they establish the authorization level for the entire storage unit (base model plus any expansion models). The operating environment license authorizations (2244 Model OEL or the 239x Model LFA, OEL license) must be authorized for the full physical capacity of the storage unit. If the 2244 Model OEL or the 239x Model LFA, OEL license is for a 9A2 or 9B2 storage unit, the function authorization must cover both images. When you order optional licensed functions, you purchase a license for a specific authorization level (a specific number of TBs) for the storage unit.

Note: If you are activating features for any of the licensed functions, such as Copy Services, all the features must have the same capacity, including the operating environment license feature.

After you purchase the function authorizations, you manage and activate the functions through the following IBM Disk Storage Feature Activation (DSFA) Web site:

http://www.ibm.com/storage/dsfa

Licensed function indicators

Each licensed function indicator feature that you order on a DS8000 (2107/242x) base unit enables that function at the system level.

After you receive and apply the IBM feature activation keys for the licensed function indicators, your functions are enabled for you to use. The license function indicators are also used for maintenance billing purposes.

DS8000 Series Function Authorization (machine type 2244 or machine type 239x) feature numbers must be purchased to establish the extent of IBM authorization for the licensed function before the feature activation code is provided by IBM.

Note: You do not select these features for any attached 2107/242x expansion units in the storage unit.

Table 29 provides the appropriate licensed function indicators for each licensed function for Models 92x and 9Ax. You can order licensed functions for these models only if you have a 2107 hardware machine type.

Table 29. Licensed function indicators for Models 92x and 9Ax for a 2107 hardware machine type

Licensed Function	Hardware machine type 2107 indicator feature number	Function authorization machine type 2244 models and features
Operating environment	0700	Model OEL features 70xx
Point in time copy	0720	Model PTC features 72xx
Remote mirror and copy	0740	Model RMC features 74xx
Metro/Global Mirror	0742	Model MGM features 74xx
Remote mirror for z/OS	0760	Model RMZ features 76xx
Parallel access volumes	0780	Model PAV features 78xx
IBM HyperPAV	0782	Model PAV feature 7899

Table 30 and Table 31 on page 85 provide the appropriate licensed function indicators for each licensed function for Models 93x and 9Bx.

Table 30. Licensed function indicators for Models 93x and 9Bx for a 2107 hardware machine type

Licensed Function	Hardware machine type 2107 indicator feature number	Function authorization machine type 2244 models and features
Operating environment	0700	Model OEL features 70xx
FICON/ESCON Attachment	0702	Model OEL FICON/ESCON Attachment feature 7090
Point in time copy	0720	Model PTC features 72xx
Metro/Global Mirror	0742	Model RMC MGM features 74xx
Metro Mirror	0744	Model RMC MM features 74xx
Global Mirror	0746	Model RMC GM features 74xx
Metro Mirror Add-on	0754	Model RMC MM Add features 75xx
Global Mirror Add-on	0756	Model RMC GM Add features 75xx
Remote mirror for z/OS	0760	Model RMZ features 76xx
Parallel access volumes	0780	Model PAV features 78xx
IBM HyperPAV	0782	Model PAV HyperPAV feature 7899

Table 31. Licensed function indicators for Models 93x and 9Bx for a 242x hardware machine type

Licensed Function	Hardware machine type 242x indicator feature numbers	Function authorization machine type 239x models and features
Operating environment	0700 and 70xx	Model LFA OEL features 70*xx*
FICON/ESCON Attachment	0702 and 7090	Model LFA FICON/ESCON Attachment feature 7090
Point in time copy	0720 and 72xx	Model LFA PTC features 72*xx*
Metro/Global Mirror	0742 and 74xx	Model LFA MGM features 74*xx*
Metro Mirror	0744 and 74xx	Model LFA MM features 74*xx*
Global Mirror	0746 and 74xx	Model LFA GM features 74*xx*
Metro Mirror Add-on	0754 and 75xx	Model LFA MM Add features 75*xx*
Global Mirror Add-on	0756 and 75xx	Model LFA GM Add features 75*xx*
Remote mirror for z/OS	0760 and 76xx	Model LFA RMZ features 76*xx*
Parallel access volumes	0780 and 78xx	Model LFA PAV features 78*xx*
IBM HyperPAV	0782 and 7899	Model LFA HyperPAV feature 7899

License scope

Licensed functions are activated and enforced within a defined license scope.

License scope refers to the following types of storage and types of servers with which the function can be used:

Fixed block (FB)
> The function can be used only with data from fibre channel-attached servers.

Count key data (CKD)
> The function can be used only with data from FICON-attached servers.

Both FB and CKD (ALL)
> The function can be used with data from all attached servers.

Some licensed functions have multiple license scope options, while other functions have only a single license scope. Table 32 provides the license scope options for each licensed function.

Table 32. License scope for each DS8000 licensed function

Licensed Function	License Scope Options
Operating environment	ALL
Point-in-time copy	FB, CKD, or ALL

Table 32. License scope for each DS8000 licensed function (continued)

Licensed Function	License Scope Options
Remote mirror and copy	FB, CKD, or ALL
Remote mirror for z/OS	CKD
Parallel access volumes	CKD

You do not specify the license scope when you order function authorization feature numbers. Feature numbers establish only the extent of the IBM authorization (in terms of physical capacity), regardless of the storage type. However, if a licensed function has multiple license scope options, you must select a license scope when you initially retrieve the feature activation codes for your storage unit. This activity is performed using the Disk Storage Feature Activation (DSFA) Web site:

http://www.ibm.com/storage/dsfa

Note: Retrieving feature activation codes is part of managing and activating your licenses. Before you can logically configure your storage unit, you must first manage and activate your licenses.

At the DSFA Web site, you manage and activate the function authorizations on a per-image basis. Because Model 921, 922, 931, and 932 storage units contain only one image, your management and activation tasks actually apply to the entire storage unit. However, when you are managing or activating your function authorization for Model 9A2 or 9B2, the license scope can be different for each image. For example, if you purchase a 30 TB point-in-time function authorization (2244 Model PTC or a Model LFA, PTC license), you can choose to apply the entire 30 TB to one image or you can split the 30 TB as you want between the images. You can also select different license scope options for each image. You could select a license scope of FB for image 1 and a license scope of ALL for image 2. If your needs change later, you can go to the DSFA Web site and allocate your license scope differently between your images.

When you use the DSFA Web site to change the license scope after a licensed function has been activated, a new feature activation code is generated. When you install the new feature activation code into the machine, the function is activated and enforced using the newly selected license scope. Only an increase in the license scope (changing FB or CKD to ALL) is a nondisruptive activity. A lateral change (changing FB to CKD or changing CKD to FB) or a reduction of the license scope (changing ALL to FB or CKD) is a disruptive activity and requires a machine IML. On a Model 9A2 or 9B2, if the license scope change is disruptive but it affects only one image, you need to reboot only the affected image.

Ordering licensed functions

After you decide which licensed functions to use with your storage unit, you are ready to order the functions.

Licensed functions are purchased as DS8000 function authorization (machine type 2244 or machine type 239x) features.

Note: If you are activating features for any of the licensed functions, such as Copy Services, all the features must have the same capacity, including the operating environment license feature.

To order licensed functions, use the following general steps:

1. Order the operating environment license (OEL) features that support the total physical capacity of your storage unit.
2. Order optional licensed functions for your storage unit.

Operating environment license (2244 Model OEL and 239x Model LFA, OEL license)

The operating environment model and features establish the extent of IBM authorization for the use of the IBM System Storage DS operating environment.

For every storage unit, you must order an operating environment license (OEL). This operating environment license support function is called the 2244 Model OEL on the 2107 hardware machine type, and 239x Model LFA, OEL license on the 242x hardware machine type. The OEL licenses the operating environment and is based on the total physical capacity of the storage unit (base model plus any expansion models). It authorizes you to use the model configuration at a given capacity level. Once the OEL has been activated for the storage unit, you can configure the storage unit. Activating the OEL means that you have obtained the feature activation key from the DSFA Web site and entered it into the DS Storage Manager.

Feature codes for the operating environment license

You must order an operating environment license (OEL) feature for every storage unit.

Table 33 provides the feature codes for the operating environment license.

Table 33. Operating environment license feature codes

Feature code	Description	Hardware models
7000	OEL—Inactive	921, 922, 9A2, 931, 932, 9B2
7001	OEL—1 TB unit	921, 922, 9A2, 931, 932, 9B2
7002	OEL—5 TB unit	921, 922, 9A2, 931, 932, 9B2
7003	OEL—10 TB unit	921, 922, 9A2, 931, 932, 9B2
7004	OEL—25 TB unit	921, 922, 9A2, 931, 932, 9B2
7005	OEL—50 TB unit	921, 922, 9A2, 931, 932, 9B2
7010	OEL—100 TB unit	921, 922, 9A2, 931, 932, 9B2
7015	OEL—200 TB unit	921, 922, 9A2, 931, 932, 9B2
7090	FICON/ESCON attachment	931, 932, 9B2

Point-in-time copy function (2244 Model PTC and 239x Model LFA, PTC license)

The point-in-time copy licensed function model and features establish the extent of IBM authorization for the use of the point-in-time copy licensed function on your storage unit.

The IBM System Storage FlashCopy function is a point-in-time licensed function.

Feature codes for point-in-time copy

When you order point-in-time copy functions, you specify the feature code that represents the physical capacity you want to authorize for the function.

The point-in-time copy license feature codes enable the use of the point-in-time copy licensed function.

Note: If you are activating features for any of the licensed functions, such as Copy Services, all the features must have the same capacity, including the operating environment license feature.

You can combine feature codes to order the exact capacity that you need. For example, if you determine that you need 23 TB of point-in-time capacity, you can order two 7203 features and three 7201 features.

Note: If you have a 9A2 or 9B2 storage unit, you can later activate and manage the function authorization on a per-image basis. For example, if you ordered 23 TB, you could activate 10 TB on one image and 13 TB on the other image. You can activate your licenses on the IBM Disk Storage Feature Activation (DSFA) Web site after you receive the serial number for your ordered function authorization.

Table 34 provides the feature codes for the point-in-time copy function.

Note: If you have an active point-in-time feature and replace it with an inactive feature, you must later repurchase the feature if you decide to use it again. However, you can use the IBM Disk Storage Feature Activation (DSFA) Web site to change the assigned value from the current number of terabytes (TB) to 0 TB. The latter method allows you to use the function again by simply changing the value back to the level that you have authorized for the function.

Table 34. Point-in-time copy (PTC) feature codes

Feature code	Description	Hardware models
7200	PTC—Inactive	921, 922, 931, 932, 9A2, 9B2
7201	PTC—1 TB unit	921, 922, 931, 932, 9A2, 9B2
7202	PTC—5 TB unit	921, 922, 931, 932, 9A2, 9B2
7203	PTC—10 TB unit	921, 922, 931, 932, 9A2, 9B2
7204	PTC—25 TB unit	921, 922, 931, 932, 9A2, 9B2
7205	PTC—50 TB unit	921, 922, 931, 932, 9A2, 9B2
7210	PTC—100 TB unit	921, 922, 931, 932, 9A2, 9B2
7215	PTC—200 TB unit	921, 922, 931, 932, 9A2, 9B2

Remote mirror and copy functions (2244 Model RMC and 239x Model LFA)

The remote mirror and copy licensed function model and features establish the extent of IBM authorization for the use of the remote mirror and copy licensed functions on your storage unit.

The following functions are remote mirror and copy licensed functions:

- Metro Mirror (formerly Synchronous PPRC)
- Global Mirror (formerly Asynchronous PPRC)
- Global Copy (formerly PPRC Extended Distance)
- Metro/Global Mirror

Feature codes for remote mirror and copy

When you order remote mirror and copy functions, you specify the feature code that represents the physical capacity to authorize for the function.

Note: If you are activating features for any of the licensed functions, such as Copy Services, all the features must have the same capacity, including the operating environment license feature.

The remote mirror and copy license feature codes enable the use of the following remote mirror and copy (RMC) licensed functions:
- IBM System Storage Metro Mirror (MM)
- IBM System Storage Global Mirror (GM)
- IBM System Storage Metro Global Mirror (MGM)

You can combine feature codes to order the exact capacity that you need. For example, if you determine that you need a function authorization for 28 TB of remote mirror and copy capacity, you would order one 7404 feature and three 7401 features.

Note: If you have a 9A2 or 9B2 storage unit, you can later activate and manage the function authorization on a per-image basis. For example, if you ordered 28 TB, you could activate 10 TB on one image and 18 TB on the other image. You will activate your licenses on the IBM Disk Storage Feature Activation (DSFA) Web site after you receive the serial number for your ordered function authorization.

Table 35 provides the feature codes for the remote mirror and copy functions.

Note: If you have an active remote mirror and copy feature and replace it with an inactive feature, you must later repurchase the feature if you decide to use it again. However, you can use the IBM Disk Storage Feature Activation (DSFA) Web site to change the assigned value from the current number of terabytes (TB) to 0 TB. The latter method allows you to use the function again by simply changing the value back to the level that you have authorized for the function.

Table 35 provides the feature codes for the remote mirror and copy functions.

Table 35. Remote mirror and copy (RMC) feature codes

Feature code	Description	Hardware models
7400	RMC—Inactive	921, 922, 9A2
7401	RMC—1 TB unit	921, 922, 9A2
7402	RMC—5 TB unit	921, 922, 9A2
7403	RMC—10 TB unit	921, 922, 9A2
7404	RMC—25 TB unit	921, 922, 9A2
7405	RMC—50 TB unit	921, 922, 9A2

Table 35. Remote mirror and copy (RMC) feature codes (continued)

Feature code	Description	Hardware models
7410	RMC—100 TB unit	921, 922, 9A2
7415	RMC—200 TB unit	921, 922, 9A2
7420	MGM—inactive	921, 922, 9A2, 931, 932, 9B2
7421	MGM—1 TB unit	921, 922, 9A2, 931, 932, 9B2
7422	MGM—5 TB unit	921, 922, 9A2, 931, 932, 9B2
7423	MGM—10 TB unit	921, 922, 9A2, 931, 932, 9B2
7424	MGM—25 TB unit	921, 922, 9A2, 931, 932, 9B2
7425	MGM—50 TB unit	921, 922, 9A2, 931, 932, 9B2
7430	MGM—100 TB unit	921, 922, 9A2, 931, 932, 9B2
7435	MGM—200 TB unit	921, 922, 9A2, 931, 932, 9B2
7440	MM—Inactive	931, 932, 9B2
7441	MM—1 TB unit	931, 932, 9B2
7442	MM—5 TB unit	931, 932, 9B2
7443	MM—10 TB unit	931, 932, 9B2
7444	MM—25 TB unit	931, 932, 9B2
7445	MM—50 TB unit	931, 932, 9B2
7450	MM—100 TB unit	931, 932, 9B2
7455	MM—200 TB unit	931, 932, 9B2
7460	GM—Inactive	931, 932, 9B2
7461	GM—1 TB unit	931, 932, 9B2
7462	GM—5 TB unit	931, 932, 9B2
7463	GM—10 TB unit	931, 932, 9B2
7464	GM—25 TB unit	931, 932, 9B2
7465	GM—50 TB unit	931, 932, 9B2
7470	GM—100 TB unit	931, 932, 9B2
7475	GM—200 TB unit	931, 932, 9B2
7540	MM Add—Inactive	931, 932, 9B2
7541	MM Add—1 TB unit	931, 932, 9B2
7542	MM Add—5 TB unit	931, 932, 9B2
7543	MM Add—10 TB unit	931, 932, 9B2
7544	MM Add—25 TB unit	931, 932, 9B2
7545	MM Add—50 TB unit	931, 932, 9B2
7550	MM Add—100 TB unit	931, 932, 9B2
7555	MM Add—200 TB unit	931, 932, 9B2
7560	GM Add—Inactive	931, 932, 9B2
7561	GM Add—1 TB unit	931, 932, 9B2
7562	GM Add—5 TB unit	931, 932, 9B2
7563	GM Add—10 TB unit	931, 932, 9B2
7564	GM Add—25 TB unit	931, 932, 9B2
7565	GM Add—50 TB unit	931, 932, 9B2

Table 35. Remote mirror and copy (RMC) feature codes (continued)

Feature code	Description	Hardware models
7570	GM Add—100 TB unit	931, 932, 9B2
7575	GM Add—200 TB unit	931, 932, 9B2

IBM TotalStorage Productivity Center for Replication function

TotalStorage Productivity Center for Replication is an option of the TotalStorage Productivity Center for Replication software program.

If you are licensed for Copy Services functions and have the required Ethernet adapter pair (feature code 180x) that supports the communication between the storage units and Replication Manager, you can use TotalStorage Productivity Center for Replication to manage your data copy environment.

Feature codes for IBM TotalStorage Productivity Center for Replication

The Ethernet adapter pair supports the communication between the storage units and TotalStorage Productivity Center for Replication.

This is an optional feature for Models 921, 922, 9A2, 931, 932, and 9B2.

If you order remote mirror and copy functions, you will also be able to access the TotalStorage Productivity Center for Replication provided that you have ordered the Ethernet adapters. Table 36 provides the feature codes for the Ethernet adapters.

Table 36. Ethernet adapter pair feature codes

Feature code	Description	Hardware models
1801	RM Ethernet adapter pair	921, 931, 922, 932
1802	RM Ethernet adapter pair A	9A2, 9B2
1803	RM Ethernet adapter pair B	9A2, 9B2

Remote mirror for z/OS (2244 Model RMZ and 239x Model LFA, RMZ license)

The remote mirror for z/OS licensed function model and features establish the extent of IBM authorization for the use of the z/OS remote mirroring licensed function on your storage unit.

The IBM System Storage z/OS Global Mirror function is a z/OS remote mirroring licensed function:

Feature codes for z/OS Global Mirror

When you order the z/OS Global Mirror function, you specify the feature code that represents the physical capacity to authorize for the function.

Note: If you are activating features for any of the licensed functions, such as Copy Services, all the features must have the same capacity, including the operating environment license feature.

You can combine feature codes to order the exact capacity that you need. For example, if you determine that you need 30 TB of capacity, you would order one 7604 feature and one 7602 feature.

Notes:

1. If you have a 9A2 or 9B2 storage unit, you can later activate and manage the function authorization on a per-image basis. For example, if you ordered 30 TB, you could activate 20 TB on one image and 10 TB on the other image. You will activate your licenses on the IBM Disk Storage Feature Activation (DSFA) Web site after you receive the serial number for your ordered function authorization.

2. If you have an active z/OS Global Mirror feature and replace it with an inactive feature, you must later repurchase the feature if you decide to use it again. However, you can use the IBM Disk Storage Feature Activation (DSFA) Web site to change the assigned value from the current number of terabytes (TB) to 0 TB. The latter method allows you to use the function again by simply changing the value back to the level that you have authorized for the function.

Table 37 provides the feature codes for remote mirror for zSeries functions.

Table 37. Remote mirror for zSeries (RMZ) feature codes

Feature code	Description	Hardware models
7600	RMZ—Inactive	921, 922, 9A2, 931, 932, 9B2
7601	RMZ—1 TB unit	921, 922, 9A2, 931, 932, 9B2
7602	RMZ—5 TB unit	921, 922, 9A2, 931, 932, 9B2
7603	RMZ—10 TB unit	921, 922, 9A2, 931, 932, 9B2
7604	RMZ—25 TB unit	921, 922, 9A2, 931, 932, 9B2
7605	RMZ—50 TB unit	921, 922, 9A2, 931, 932, 9B2
7610	RMZ—100 TB unit	921, 922, 9A2, 931, 932, 9B2
7615	RMZ—200 TB unit	921, 922, 9A2, 931, 932, 9B2
Note: Models 931, 932, and 9B2 require a FICON/ESCON attachment license for this feature.		

Parallel access volumes (2244 Model PAV and 239x Model LFA, PAV license)

The parallel access volumes (PAV) features establish the extent of IBM authorization for the use of the parallel access volumes licensed function.

Feature codes for parallel access volume

When you order the parallel access volume (PAV) function, you specify the feature code that represents the physical capacity allowed for the function.

A license is required for the total physical capacity in the storage unit that is configured as count key data (CKD). The total authorization level must be greater than or equal to the total physical capacity of the unit.

Table 38 on page 93 provides the feature codes for the PAV function.

Note: If you currently have an active PAV feature and replace it with an inactive feature, you must later repurchase the feature if you decide to use it again. However, you can use the IBM Disk Storage Feature Activation (DSFA) Web site to change the assigned value from the current number of terabytes (TB) to 0 TB. The latter method allows you to use the function again by simply changing the value back to the level that you have authorized for the function.

Table 38. Parallel access volume (PAV) feature codes

Feature code	Description	Hardware models
7800	PAV—Disable	921, 922, 9A2, 931, 932, 9B2
7801	PAV—1 TB unit	921, 922, 9A2, 931, 932, 9B2
7802	PAV—5 TB unit	921, 922, 9A2, 931, 932, 9B2
7803	PAV—10 TB unit	921, 922, 9A2, 931, 932, 9B2
7804	PAV—25 TB unit	921, 922, 9A2, 931, 932, 9B2
7805	PAV—50 TB unit	921, 922, 9A2, 931, 932, 9B2
7810	PAV—100 TB unit	921, 922, 9A2, 931, 932, 9B2
7815	PAV—200 TB unit	921, 922, 9A2, 931, 932, 9B2
Note: Models 931, 932, and 9B2 require a FICON/ESCON attachment license for this feature.		

IBM HyperPAV (2244 Model PAV and 239x Model LFA, PAV license)

You can add the optional IBM HyperPAV feature to any licensed parallel access volume (PAV) feature.

IBM HyperPAV can be enabled only if PAV is enabled on the storage image. The IBM HyperPAV feature is available for a single charge (flat fee) regardless of the extent of IBM authorization that you have for the corresponding PAV feature. "Ordering rules for licensed functions" describes any further ordering requirements for this feature.

Feature code for IBM HyperPAV

Use this feature code when you add the IBM HyperPAV function to an existing or new parallel access volumes (PAV) function on a storage unit.

7899   IBM HyperPAV (all hardware models)

Ordering rules for licensed functions

An operating environment license (OEL) is required for every DS8000 base model (hardware models 921, 922, 931, 932, 9A2, and 9B2). All other licensed functions are optional.

For all licensed functions, you can combine feature codes to order the exact capacity that you need. For example, if you determine that you need 23 TB of point-in-time capacity, you can order two 7203 features (10 TB each) and three 7200 features (1 TB each).

Note: If you are activating features for any of the licensed functions, such as Copy Services, all the features must have the same capacity, including the operating environment license feature.

When you calculate physical capacity, consider the capacity across the entire storage unit, including the base model and any expansion models. To calculate the physical capacity, use Table 39 to determine the total size of each regular disk drive feature on your storage unit, and then add all the values.

Note: Standby CoD disk drive features do not count toward the physical capacity.

Table 39. Total physical capacity of each type of disk drive feature

Size of Disk Drives	Total Size of One Disk Drive Feature (16 Drives)
73 GB	1168 GB
146 GB	2336 GB
300 GB	4800 GB
500 GB	8000 GB

Rules specific to 2244 Model OEL and 239x Model LFA, OEL license

The operating environment license (OEL) must cover the full physical capacity of your storage unit, which includes the physical capacity of any Model 92E, 9AE expansion frames within the storage unit. The license must cover both open systems data (fixed block data) and zSeries data (count key data). Standby CoD drives are not included in this calculation.

Note: Your storage unit cannot be logically configured until you have activated the OEL for it. Upon activation, disk drives can be logically configured up to the extent of the IBM OEL authorization level.

You can combine feature codes to order the exact capacity that you need. For example, if you determine that you need 23 TB of point-in-time capacity, you can order two 7203 features (10 TB each) and three 7200 features (1 TB each).

As you add additional disk drives to your storage unit, you must increase the OEL authorization level for the storage unit by purchasing additional 2244 Model OEL or 239x Model LFA, OEL license features. (Otherwise, you cannot logically configure the additional disk drives for use.)

When you activate Standby CoD disk drives, you must also increase the OEL authorization to cover the activated Standby CoD capacity.

Rules specific to optional licensed functions

The following ordering rules apply when you order point-in-time licenses for FlashCopy or remote mirror and copy licenses:
- If the function is used with only open systems data, a license is required for only the total physical capacity that is logically configured as fixed block (FB).
- If the function is used with only zSeries data, a license is required for only the total physical capacity that is logically configured as count key data (CKD).
- If the function is used for both open systems and zSeries data, a license is required for the total configured capacity.

The following ordering rules apply when you order remote mirror and copy licenses:

- If the function is used with only open systems data, a license is required for only the total physical capacity that is logically configured as fixed block (FB).
- If the function is used with only zSeries data, a license is required for only the total physical capacity that is logically configured as count key data (CKD).
- If the function is used for both open systems and zSeries data, a license is required for the total configured capacity.
- You must use fibre-channel host adapters with remote mirror and copy functions. ESCON adapters do not support these functions. To see a current list of environments, configurations, networks, and products that support remote mirror and copy functions, click **Interoperability Matrix** at the following DS8000 web site:

  http://www.ibm.com/servers/storage/disk/ds8000/
- You must purchase features for both the source (primary) and target (secondary) DS8000 storage units.
- If you use the Metro/Global Mirror solution in your environment, the following rules apply:

  DS8000 Turbo Models 931, 932, and 9B2
    – Site A - You must have a Metro/Global Mirror license, and a Metro Mirror license.

      Note: A Global Mirror Add-on license is required if you remove Site B and you want to resync between Site A and Site C.
    – Site B - You must have a Metro/Global Mirror license, a Metro Mirror license, and a Global Mirror Add-on license.
    – Site C - You must have a Metro/Global Mirror license, a Global Mirror license, and a point-in-time copy license.

  DS8000 Models 921, 922, and 9A2
    – Site A - You must have a Metro/Global Mirror license, and a remote mirror and copy license.
    – Site B - You must have a Metro/Global Mirror license, and a remote mirror and copy license.
    – Site C - You must have a Metro/Global Mirror license, a remote mirror and copy license, and a point-in-time copy license.
- If you use Global Mirror, you must use the following additional rules:
  – A point-in-time copy function authorization (2244 Model PTC or 239x Model LFA, PTC license) must be purchased for the secondary storage unit.
  – If Global Mirror will be used during failback on the secondary storage unit, a point-in-time copy function authorization must also be purchased on the primary system.

The following ordering rule applies to remote mirror for z/OS licenses:
- A license is required for only the total physical capacity that is logically configured as count key data (CKD) volumes for use with zSeries servers.
- When failback from the secondary storage unit to the primary storage unit is required, the remote mirror for z/OS function authorization (2244 Model RMZ or 239x Model LFA, RMZ license) must be purchased for both systems.
- For 93x and 9Bx hardware models, you also need the FICON/ESCON Attachment licensed feature.

The following ordering rule applies to parallel access volumes (PAV):

- A license is required for only the total physical capacity that is logically configured as count key data (CKD) volumes for use with zSeries servers.
- For 93x and 9Bx hardware models, you also need the FICON/ESCON Attachment licensed feature.

The following ordering rule applies to IBM HyperPAV:
- A license for IBM HyperPAV requires the purchase of PAV licensed features.
- For 93x and 9Bx hardware models, you also need the FICON/ESCON Attachment licensed feature.

The initial enablement of any optional DS8000 licensed function is a concurrent activity (assuming that the appropriate level of microcode is installed on the machine for the given function). The removal of a DS8000 licensed function to deactivate the function is a disruptive activity and requires a machine IML.

If you have an active optional function and no longer want to use it, you can deactivate the function in one of the following ways:
- Order an inactive or disabled license and replace the active license activation key with the new inactive license activation key at the IBM Disk Storage Feature Activation (DSFA) Web site.
- Go to the DSFA Web site and change the assigned value from the current number of terabytes (TB) to 0 TB. This, in effect, makes the feature inactive. If you do this, you can later go back to DSFA and reactivate the feature, up to the previously purchased level, without having to repurchase the feature.

Regardless of which method is used, the deactivation of a licensed function is a disruptive activity and requires a machine IML (Models 921, 922, 931, and 932) or a reboot of the affected image (Models 9A2 and 9B2).

On a Model 9A2 or 9B2 storage unit, plan for each image separately when you order optional function licenses. For example, suppose that you order a remote mirror and copy license, and you want one image to be used only for zSeries data and the other image to be used for both open systems and zSeries data. In this case, you must order a license that covers the following:
- The total physical capacity on image 1, which is logically configured as CKD
- The total physical capacity on image 2

Note: Although you do not need to specify how licenses will be applied when you order them, you must allocate the licenses to each image when you obtain your license keys on the IBM Disk Storage Feature Activation (DSFA) Web site.

Chapter 4. Meeting DS8000 delivery and installation requirements

Delivery and installation planning is your responsibility.

This chapter provides the following planning information for the delivery and installation of your DS8000 storage unit:
- Planning for delivery of your storage unit
- Planning the physical installation site
- Planning for power requirements
- Planning for network and communication requirements
- Energy savings

For a discussion of equipment and documents that IBM ships with your DS8000, see Appendix A, "IBM-provided DS8000 equipment and documents," on page 141

Delivery requirements

Before you receive your DS8000 shipment, ensure that you meet all delivery requirements.

The topics in this section will help you ensure that you select a site that meets all requirements.

Attention: Customers can prepare their environments to accept the new product based on the installation planning information with assistance from an IBM Installation Planning Representative (IPR) or an IBM authorized service provider. In anticipation of the equipment delivery, the final installation site must be prepared in advance so that professional movers can transport the equipment to the final installation site within the computer room. If this is not possible at the time of delivery, customers must make arrangements to have the professional movers return to finish the transportation at a later date. Only professional movers should transport the equipment. The IBM authorized service provider only performs minimal frame repositioning within the computer room, as needed, to perform required service actions. Customers are also responsible for using professional movers in the case of equipment relocation or disposal.

Receiving delivery

The shipping carrier is responsible for delivering and unloading the DS8000 as close to its final destination as possible. You must ensure that your loading ramp and your receiving area can accommodate your DS8000 shipment.

Use the following steps to ensure that your receiving area and loading ramp can safely accommodate the delivery of your storage unit:

1. Find out the packaged weight and dimensions of the DS8000 container and other containers that you will receive.
2. Ensure that your loading dock, receiving area, and elevators can safely support the packaged weight and dimensions of the shipping containers.

Note: You can order a weight-reduced shipment of a DS8000 model when a configured model exceeds the weight capability of the receiving area at your site.

3. To compensate for the weight of the DS8000 shipment, ensure that the loading ramp at your site does not exceed an angle of 10°. (See Figure 22.)
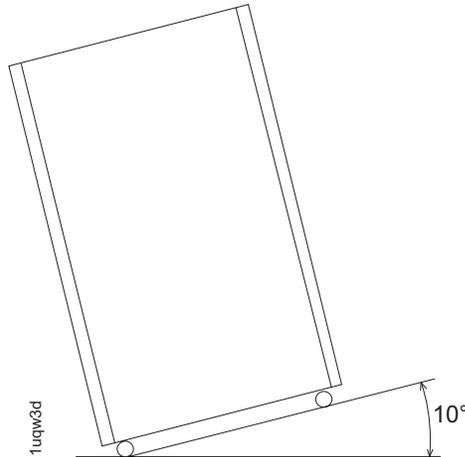

Figure 22. Maximum tilt for a packed unit is 10°

Shipment weights and dimensions

To help you plan for the delivery of your storage unit, you must ensure that your loading dock and receiving area can support the weight and dimensions of the packaged DS8000 shipments.

You receive at least two, and up to three, shipping containers for each DS8000 model that you order. You always receive the following items:

- A container with the DS8000 model. In the People's Republic of China (including Hong Kong S.A.R. of China), India, and Brazil, this container is a wooden crate. In all other countries, this container is a pallet covered by a corrugated fiberboard (cardboard) cover.
- A container with the remaining ship group items, such as power cords, CDs, and other ordered features or peripherals for your model.

If ordered, you also receive the following container:

- A container with the external management consoles (MCs).

Table 40 on page 99 shows the final packaged dimensions and maximum packaged weight of the storage unit shipments.

To calculate the weight of your total shipment, add the weight of each model container that you will receive and the weight of one ship group container for each model. If you ordered any external management consoles, add the weight of those containers, as well.

Table 40. Packaged dimensions and weight for DS8000 models (all countries)

Shipping container	Packaged dimensions (in centimeters and inches)		Maximum packaged weight (in kilograms and pounds)
Model 921/931 pallet or crate	Height	207.5 cm (81.7 in.)	1309 kg (2886 lb)
	Width	101.5 cm (40 in.)	
	Depth	137.5 cm (54.2 in.)	
Model 922/932 pallet or crate	Height	207.5 cm (81.7 in.)	1368 kg (3016 lb)
	Width	101.5 cm (40 in.)	
	Depth	137.5 cm (54.2 in.)	
Model 9A2/9B2 pallet or crate	Height	207.5 cm (81.7 in.)	1368 kg (3016 lb)
	Width	101.5 cm (40 in.)	
	Depth	137.5 cm (54.2 in.)	
Model 92E (expansion unit) pallet or crate	Height	207.5 cm (81.7 in.)	1209 kg (2665 lb)
	Width	101.5 cm (40 in.)	
	Depth	137.5 cm (54.2 in.)	
Model 9AE (expansion unit) pallet or crate	Height	207.5 cm (81.7 in.)	1209 kg (2665 lb)
	Width	101.5 cm (40 in.)	
	Depth	137.5 cm (54.2 in.)	

Table 40. Packaged dimensions and weight for DS8000 models (all countries) (continued)

Shipping container	Packaged dimensions (in centimeters and inches)		Maximum packaged weight (in kilograms and pounds)
External MC container (If ordered)	**Height**	69.0 cm (27.2 in.)	75 kg (165 lb)
	Width	80.0 cm (31.5 in.)	
	Depth	120.0 cm (47.3 in.)	

Note: MC represents management console in this table.

CAUTION:
A fully configured model in the packaging can weigh over 1406 kg (3100 lb). Use of less than three persons to move it can result in injury.

Installation site requirements

You must ensure that the location where you plan to install your DS8000 storage units meets all requirements.

The topics in this section will help you ensure that you select a site that meets all requirements.

Planning for floor and space requirements

You must ensure that the location of your DS8000 storage units meets space and floor requirements.

When you are planning the location of your storage units, you must answer the following questions that relate to floor types, floor loads, and space:

- Will you install on a raised or non-raised floor?
- If the planned location has a raised floor, does the floor require preparation (such as cutting out tiles) to accommodate cable entry into the units?
- Does the floor of the location meet floor load requirements?
- Can the location accommodate the amount of space that is required by the storage units, and does the space size meet the following criteria?
  - Weight distribution area that is needed to meet floor load requirements
  - Service clearance requirements

Use the following steps to ensure that your planned installation location meets space and floor load requirements:

1. Identify the base models and expansion models that are included in your storage units. If your storage units use external management consoles, include the racks containing the external management consoles.
2. Decide whether the storage units will be installed on a raised or non-raised floor.
   a. If the location has a raised floor, plan where the floor tiles must be cut to accommodate the cables.

b. If the location has a non-raised floor, resolve any safety problems caused by the location of cable exits and routing.

3. Determine whether the floor of the location meets the floor load requirements for the storage units.

4. Calculate the amount of space that the storage units will use.

   a. Identify the total amount of space that is needed for the storage units using the dimensions of models and the weight distribution areas calculated in step 3.

   b. Ensure that the area around each standalone model and each storage unit meets the service clearance requirements.

   Note: Any expansion units within the storage unit must be attached to the base model on the right side (as you face the front of the units).

Installing on raised or nonraised floors

You can install your DS8000 storage units on a raised or nonraised floor.

However, installing the models on a raised floor provides the following benefits:
- Improves operational efficiency and allows greater flexibility in the arrangement of equipment.
- Increases air circulation for better cooling.
- Protects the interconnecting cables and power receptacles.
- Prevents tripping hazards because cables can be routed underneath the raised floor.

When you install a raised floor, consider the following factors:
- The raised floor should be constructed of fire-resistant or noncombustible material.
- No metal or highly-conductive material that might be at ground potential should be exposed to the walking surface when a metallic raised floor structure is used. Such exposure is considered an electrical safety hazard.
- The raised floor height should be between 30.5 cm (12 in.) and 75.0 cm (30 in.). For processors with multiple channels, a minimum raised floor height of 45.7 cm (18 in.) is recommended. Clearance must be adequate to accommodate interconnecting cables, fibre-channel cable raceways, power distribution, and any piping that is present under the floor. Floors with greater raised floor heights allow for better equipment cooling.
- When a raised floor panel is cut for cable entry or air supply, an additional panel support (pedestal) might be required to restore the structural integrity of the panel to the above requirement.
- Protective covering (such as plywood, tempered masonite, or plyron panels) should be used to prevent damage to floor tiles, carpeting, and panels while equipment is being moved into or is relocated within the installation. When the equipment is moved, the dynamic load on the casters is significantly greater than when the equipment is stationary.
- Concrete subfloors require treatment to prevent the release of dust.
- Use noncombustible protective molding to eliminate sharp edges on all floor cutouts, to prevent damage to cables and hoses, and to prevent casters from rolling into the floor cutout.
- Seal raised floor cable openings to prevent chilled air that is not used to directly cool the equipment from escaping.

- Pedestals must be firmly attached to the structural (concrete) floor using an adhesive.

Accommodating cables

You must ensure that the location and dimensions of the cable cutouts for the models can be accommodated by the installation location.

Use the following steps to ensure that you prepare for cabling for each unit:

1. Based on your planned storage unit layout, ensure that you can accommodate the locations of the cables exiting each unit. See Figure 23 for the location of the cable cutouts.
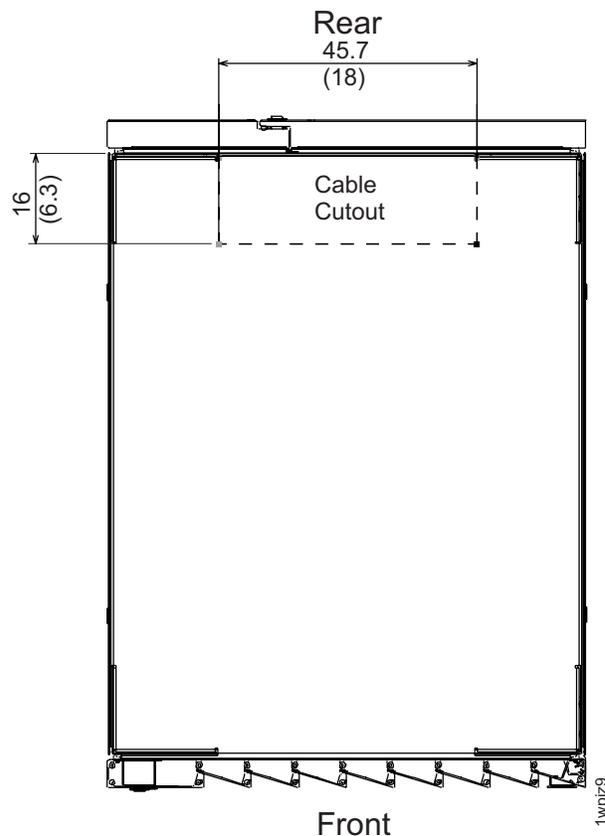

Figure 23. Cable cutouts for a DS8000 unit.

2. If you install the storage units on a raised floor, use the following measurements when you cut the floor tile for the cabling:
   - Width: 45.7 cm (18.0 in.)
   - Depth: 16 cm (6.3 in.)

   Note: Raised floors are recommended. You can better support the cabling needed by the storage units, and you ensure more efficient cooling for your units.

Meeting floor load requirements

It is very important that your location meet floor load requirements.

Use the following steps to ensure that your location meets the floor load requirements and to determine the weight distribution area required for the floor load:

1. Find out the floor load rating of the location where you plan to install the storage units.

   Important: If you do not know or are not certain about the floor load rating of the installation site, be sure to check with the building engineer or another appropriate person.

2. Determine whether the floor load rating of the location meets the following requirements:
   - The minimum floor load rating used by IBM is 342 kg per m² (70 lb. per ft²).
   - When you install a storage unit, which includes both base models and expansion models, the minimum floor load rating is 361 kg per m² (74 lb. per ft²). At 342 kg per m² (70 lb per ft²), the side dimension for the weight distribution area exceeds the 76.2 cm (30 in.) allowed maximum.
   - The per caster transferred weight to a raised floor panel is 450 kg (1000 lb.).

3. Using Table 41, perform the following steps for each storage unit:
   a. Find the rows that are associated with the storage unit.
   b. Locate the configuration row that corresponds with the floor load rating of the site.
   c. Identify the weight distribution area needed for that storage unit and floor load rating.

Table 41. Floor load ratings and required weight distribution areas

Configuration of storage unit (Note 1)	Total weight of configuration (Note 2)	Floor Load Rating, kg per m² (lb per ft²)	Weight Distribution Areas (Notes 3, 4, and 5)		
			Sides cm (in.)	Front cm (in.)	Rear cm (in.)
Model 921/931 (base model only)	1189 kg (2620 lb)	610 (125)	2.5 (1)	76.2 (30)	76.2 (30)
		488 (100)	17.8 (7)	76.2 (30)	76.2 (30)
		439 (90)	28 (11)	76.2 (30)	76.2 (30)
		342 (70)	55.9 (22)	76.2 (30)	76.2 (30)
Model 921/931 and one 92E expansion model	2055 kg (4530 lb)	610 (125)	0 (0)	61.0 (24)	61.0 (24)
		488 (100)	15.3 (6)	76.2 (30)	76.2 (30)
		439 (90)	30.5 (12)	76.2 (30)	76.2 (30)
		342 (70)	Not recommended		
Model 922/932 (base model only)	1248 kg (2750 lb)	610 (125)	5.1 (2)	76.2 (30)	76.2 (30)
		488 (100)	20.3 (8)	76.2 (30)	76.2 (30)
		439 (90)	30.48 (12)	76.2 (30)	76.2 (30)
		342 (70)	61.0 (24)	76.2 (30)	76.2 (30)
Model 922/932 and one 92E expansion model	2336 kg (5150 lb)	610 (125)	2.6 (2)	76.2 (30)	76.2 (30)
		488 (100)	30.5 (12)	76.2 (30)	76.2 (30)
		439 (90)	48.3 (19)	76.2 (30)	76.2 (30)
		342 (70)	Not recommended		

Table 41. Floor load ratings and required weight distribution areas (continued)

Configuration of storage unit (Note 1)	Total weight of configuration (Note 2)	Floor Load Rating, kg per m² (lb per ft²)	Weight Distribution Areas (Notes 3, 4, and 5)		
			Sides cm (in.)	Front cm (in.)	Rear cm (in.)
Model 922/932 and two 92E expansion models	3,203 kg (7060 lb)	610 (125)	0 (0)	66.1 (26)	66.1 (26)
		488 (100)	30.5 (12)	76.2 (30)	76.2 (30)
		439 (90)	50.8 (20)	76.2 (30)	76.2 (30)
		342 (70)	Not recommended		
Model 9A2/9B2 (base model only)	1248 kg (2750 lb)	610 (125)	5.1 (2)	76.2 (30)	76.2 (30)
		488 (100)	20.3 (8)	76.2 (30)	76.2 (30)
		439 (90)	30.48 (12)	76.2 (30)	76.2 (30)
		342 (70)	61.0 (24)	76.2 (30)	76.2 (30)
Model 9A2/9B2 and one 9AE expansion model	2336 kg (5150 lb)	610 (125)	2.6 (2)	76.2 (30)	76.2 (30)
		488 (100)	30.5 (12)	76.2 (30)	76.2 (30)
		439 (90)	48.3 (19)	76.2 (30)	76.2 (30)
		342 (70)	Not recommended		
Model 9A2/9B2 and two 9AE expansion models	3,203 kg (7060 lb)	610 (125)	0 (0)	66.1 (26)	66.1 (26)
		488 (100)	30.5 (12)	76.2 (30)	76.2 (30)
		439 (90)	50.8 (20)	76.2 (30)	76.2 (30)
		342 (70)	Not recommended		

Notes:

1. A storage unit contains a base model and any expansion models associated with it.

2. The first expansion units for Models 922, 932, 9A2, and 9B2 can be fully-configured expansion units (they contain I/O enclosures). These expansion units are heavier and weigh 1089 kg (2400 lb). The expansion unit that attaches to a Model 921 or 931 does not contain I/O enclosures. The expansion unit that attaches to the second expansion unit for Models 922, 932, 9A2, and 9B2 does not contain I/O enclosures. These lighter expansion units (units without I/O enclosures) weigh 867 kg (1910 lb).

3. Weight distribution areas cannot overlap.

4. Weight distribution areas are calculated for maximum weight of the models.

5. The base and expansion models of each storage unit are bolted to each other with 5-cm (2-in.) spacers. Move one side cover and mounting brackets from the base model to the side of the expansion model. Side clearance for racks that are bolted together applies to both sides of the assembled racks.

> **Note:** Consult a structural engineer if you are unsure about the correct placement and weight distribution areas for your units.

Calculating space requirements

When you planning the installation location, you must first calculate the total amount of space that is needed for the storage units. Use these steps to calculate enough space for your storage units.

1. Determine the dimensions of each model configuration in your storage units.

2. Calculate the total area that is needed for model configuration by adding the weight distribution area to the dimensions determined from Table 41 on page 103.

3. Determine the total space that is needed for the storage units by planning where you will place each model configuration in the storage units and how much area each configuration will need based on step 2 on page 104.

   Note: You must provide two Ethernet cables that are straight 4 pair UTP CAT5e Ethernet cable with RJ-45 jacks. They must be a minimum of 100 meters (330 feet) long. One Ethernet cable must be labeled "Black" on both ends. The other cable must be labeled "Gray" on both ends. All private network cables are marked as "Black" or "Gray" to visually distinguish the redundant network cabling.

4. Verify that the planned space and layout also meets the service clearance requirements for each unit and system.

Dimensions and weight of individual models

When you are planning the floor and space requirements for your storage units, consider the dimensions and weights of the models that compose your storage units.

Table 42 provides the dimensions and weights of the DS8000 models.

Table 42. DS8000 dimensions and weights

Model	Dimensions (See Note 1)		Maximum weight of fully-configured base models and expansion models (See Notes 2 and 3)	Maximum weight of second expansion units (See Notes 2 and 4)
Model 921/931	**Height**	193 cm (76 in.)	1189 kg (2620 lb)	(Not applicable)
	Width	84.7 cm (33.35 in.)		
	Depth	118.3 (46.6 in.)		
Model 922/932	**Height**	193 cm (76 in.)	1248 kg (2750 lb)	(Not applicable)
	Width	84.7 cm (33.35 in.)		
	Depth	118.3 (46.6 in.)		
Model 9A2/9B2	**Height**	193 cm (76 in.)	1248 kg (2750 lb)	(Not applicable)
	Width	84.7 cm (33.35 in.)		
	Depth	118.3 (46.6 in.)		
Model 92E (expansion unit)	**Height**	193 cm (76 in.)	1089 kg (2400 lb)	867 kg (1910 lb)
	Width	84.7 cm (33.35 in.)		
	Depth	118.3 (46.6 in.)		
Model 9AE (expansion unit)	**Height**	193 cm (76 in.)	1089 kg (2400 lb)	867 kg (1910 lb)
	Width	84.7 cm (33.35 in.)		
	Depth	118.3 (46.6 in.)		

Table 42. DS8000 dimensions and weights (continued)

Model	Dimensions (See Note 1)	Maximum weight of fully-configured base models and expansion models (See Notes 2 and 3)	Maximum weight of second expansion units (See Notes 2 and 4)

Notes:

1. These dimensions include casters and covers. (The casters are recessed and do not require extra clearance.)
2. Weight is in kilograms (kg) and pounds (lb).
3. Use this column for all base models and for any expansions models that can be fully configured with I/O enclosures and adapters. Expansion models can be fully configured only if they are attached to a 922, 932, 9A2, or 9B2 base model, and if they are the first expansion model that is attached. Any expansion model that is attached to a 921 or 931 base model and any second expansion model that is attached to a 922, 932, 9A2, or 9B2 base model cannot include I/O enclosures and adapters.
4. Use this column for the second expansion model that is attached to a 922, 932, 9A2, or 9B2 base model.

Service clearance requirements

The service clearance area is the area around the storage unit that IBM service representatives need to service the unit.

For DS8000 models, IBM services representatives must open the front and rear covers to service the unit. Use the following minimum service clearances. (These dimensions are also shown on Figure 24 on page 107.)

- For the front of the unit, allow a minimum of 121.9 cm (48 in.) for the service clearance.
- For the rear of the unit, allow a minimum of 76.2 cm (30 in.) for the service clearance.
- For the sides of the unit, allow a minimum of 5.1 cm (2 in.) for the service clearance.
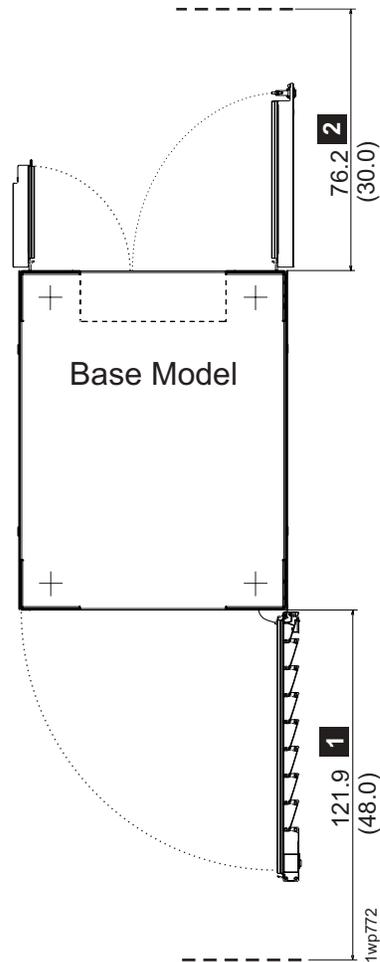
Figure 24. Service clearance requirements

Unlike weight distribution areas that are required to handle floor loading, keep in mind that service clearances of adjacent unrelated storage units can overlap.

Note: The terms *service clearance* and *weight distribution area* are often confused with each other. The service clearance is the area that is required to open the service covers and to pull out components for servicing. The weight distribution area is the area that is required to distribute the weight of the storage unit.

Earthquake Resistance Kit installation preparation

Before an IBM service representative can install the Earthquake Resistance Kit on any of your storage units racks, you must purchase fastening hardware and prepare the location where the kit is to be installed.

The required tasks that you must complete prior to the Earthquake Resistance Kit installation depends on whether your storage unit sits on a raised or a nonraised floor. For either type of installation, work with a consultant or structural engineer to ensure that your site preparations meet the requirements.

The following list provides an overview of the preparations necessary for each type of floor:

Raised floor

- Cut the necessary holes and cable cutouts in the raised floor.
- Purchase and install eyebolt fasteners in the concrete floor.

Nonraised floor

Purchase and install fasteners in the concrete floor.

Further instructions for the preparation of your site for the Earthquake Resistance Kit are provided in "Preparing a raised floor for the Earthquake Resistance Kit installation" and "Preparing a nonraised floor for the Earthquake Resistance Kit" on page 111.

Preparing a raised floor for the Earthquake Resistance Kit installation:

You must prepare a raised floor as well as the concrete floor underneath before an Earthquake Resistance Kit can be installed on any of your storage units racks.

To ensure that you meet all site requirements, obtain the service of a qualified consultant or structural engineer to help you prepare the floor.

Figure 25 on page 109 provides an illustration of the Earthquake Resistance Kit after the IBM service representative installs it for a raised floor. Before the IBM service representative installs the kit, you must prepare the area shown as **2** in the figure.
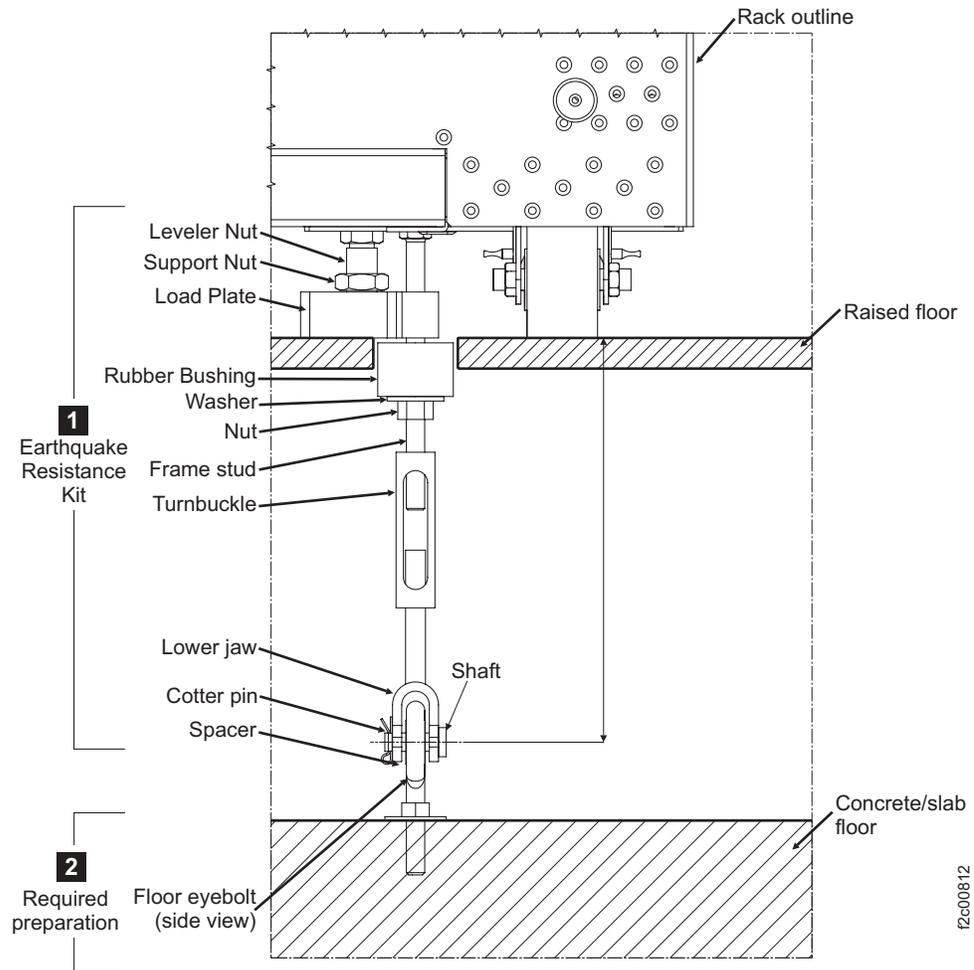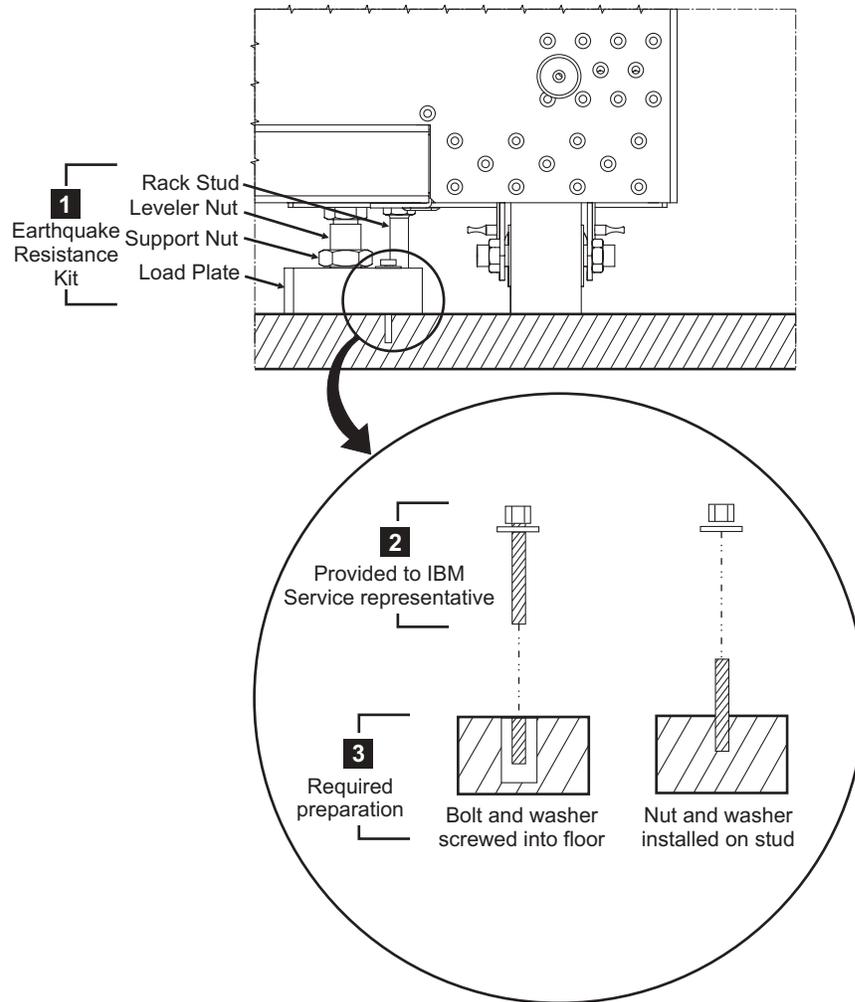
Figure 25. Earthquake Resistance Kit, as installed on a raised floor

Use the following steps to prepare your raised floor:

1. Cut the following openings in the raised floor for each rack that uses an Earthquake Resistance Kit:

   - Four holes for the kit's rubber bushings to fit through the floor
   - One cable cutout for power and other cables that connect to the rack

   Use Figure 26 on page 110 as a guide for the location and dimensions of these openings.

Figure 26. Locations for the cable cutouts and rubber bushing holes in the raised floor as well as the eyebolt installation on the concrete floor. Dimensions are in millimeters (inches).

2. Obtain four fasteners that are heavy duty concrete or slab floor eyebolts. These eyebolts are used to secure the Earthquake Resistance Kit. Work with your consultant or structural engineer to determine the correct eyebolts to use, but each eyebolt must meet the following specifications:

   • Each eyebolt must withstand 3600 lb pull force.
   • The dimensions of the eyebolt must allow the kit's turnbuckle lower jaw to fit over the eyebolt (**1** on Figure 27 on page 111) and allow the Earthquake Resistance Kit's spacer to fit inside the eye (**2** on Figure 27 on page 111)

Figure 27. Eyebolt required dimensions. Dimensions are in millimeters (inches).

3. Install the eyebolt fasteners in the concrete floor using the following guidelines:

   - Use Figure 26 on page 110 to determine the placement of the eyebolts. Note that the eyebolts must be installed so that they are directly below the holes that you cut in the raised floor for the rubber bushings.
   - Ensure that the installed eyebolts do not exceed a height of 101 mm (4 in.) from the floor to the center of the eye. This maximum height helps to reduce any bending of the eye bolt shaft.
   - Ensure that the installation allows the eyebolts to meet the required pull force after they are installed (3600 lb pull force for raised floor eyebolts).
   - If you use a threaded eye bolt that secures into a threaded insert in the floor, consider using a jam nut and washer on the shaft of the eyebolt. Talk to your consultant or structural engineer to determine if this is necessary.

Preparing a nonraised floor for the Earthquake Resistance Kit:

You must prepare a nonraised floor before an Earthquake Resistance Kit can be installed on any of your storage units racks.

To ensure that you meet all site requirements, obtain the service of a qualified consultant or structural engineer to help you prepare the floor.

Figure 28 provides an illustration of the Earthquake Resistance Kit (**1** in the figure) after the IBM service representative installs it on the nonraised floor. Before the IBM service representative installs the kit, you must prepare the area shown as **3** in the figure.

Figure 28. Earthquake Resistance Kit, as installed on a nonraised floor. The detail shows two of the most common fasteners that you could use.

Use the following steps to prepare your nonraised floor:

1. Obtain six fastener sets for each rack that uses the Earthquake Resistance Kit. These fastener sets are used to secure the Earthquake Resistance Kit load plate. The type of fastener set that you use can be determined by your consultant or structural engineer. However, each bolt or stud must meet the following specifications:

   - Each fastener set must withstand 2400 lb pull force.
   - The fasteners must have a dimension that fits into the load plate holes, which are each 27 mm (1.0 in.) in diameter.
   - The fasteners must be long enough to extend through and securely fasten a load plate that is 30 mm (1.2 in.) thick. The fasteners must also be short enough so that the height of the installed fastener does not exceed 65 mm (2.5 in.). This maximum height ensures that the fastener can fit under the rack.

The following examples provide descriptions of nonraised floor fastener sets:

- Threaded hole insert that is secured into the concrete floor and a bolt (with a washer) that screws into the insert
- Threaded stud that is secured into the concrete floor with a nut (with a washer) that screws over it

Figure 28 on page 112 shows illustrations of the example fastener sets.

2. Work with your consultant or structural engineer and use the following guidelines to install the fasteners in the concrete floor:

- Use Figure 29 to determine the placement of the fasteners.
- Ensure that the installed fasteners do not exceed a height of 65 mm (2.5 in.) from the floor. This maximum height ensures that the fastener can fit under the rack.
- Ensure that the installation allows the fasteners to meet the required pull force after they are installed (2400 lb pull force).
- If you use a threaded bolt that secures into a threaded insert in the floor and the bolt extends longer than 30 mm (1.2 in.), which is the thickness of the load plate, consider using a jam nut and a washer on the shaft of the bolt so that the load plate can be secured snugly to the floor. Talk to your consultant or structural engineer to determine if this is necessary.
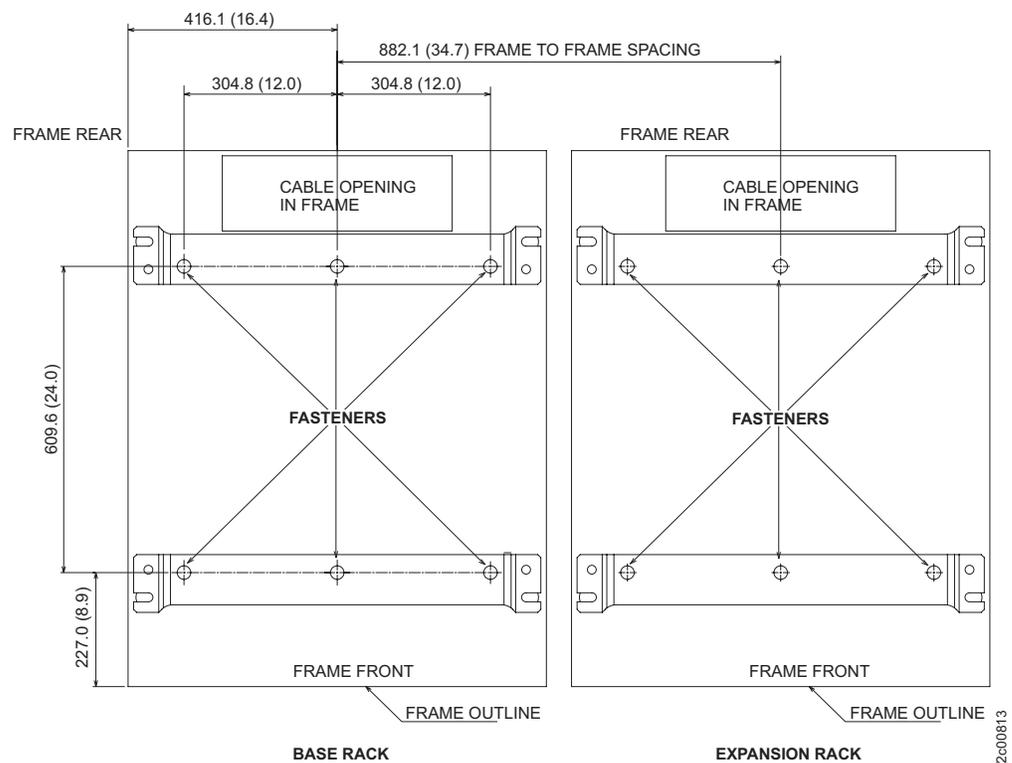
Figure 29. Locations for fastener installation (nonraised floor). Dimensions are in millimeters (inches).

3. When the IBM service representative arrives to install the Earthquake Resistance Kit, provide the other fastener parts (**2** in Figure 28 on page 112) so that the representative can use these parts secure the load plates onto the floor.

Planning for power requirements

You must select a DS8000 storage complex location that meets specific power requirements.

When you consider the DS8000 storage complex location, consider the following issues:

- Power control selections
- Power outlet requirements
- Input voltage requirements
- Power connector requirements
- Remote force power off switch requirements
- Power consumption and environment

IBM cannot install the DS8000 if your site does not meet these power requirements.

Overview of DS8000 power controls

The DS8000 provides power controls on the model racks. Power controls can be configured by an IBM service support representative. Power controls can also be accessed through the Management Console.

The DS8000 models have these following manual power controls in the form of physical switches on the racks:

- **Remote force power off (Remote FPO) switch**

  (Available on base models) The remote FPO switch causes the base model in the storage unit (which includes the base model plus any connected expansion models) to initiate a power off sequence that completes within five minutes. Use this switch only in the case where an emergency power off is required. During the power off sequence, the processors attempt to save any data held in memory so that it is not lost. However, once the unit completes the power off sequence, the storage unit powers off in less than five minutes, whether the data in the memory is completely saved or not. After the remote FPO switch is activated, you must deactivate this switch to restore power to the storage unit. This switch operates independently from the local/remote switch setting. When activated, this switch overrides all other power controls except the UEPO switch. **Planning requirements:** To use this feature, you must supply a remote force power off circuit.

- **Local/remote switch**

  (Available on base models) The local/remote switch setting determines whether you will use local or remote power controls. When you set the switch to local, the local power on/local force power off switch controls power in the storage unit. You can access this switch by opening the rear cover of the unit. When the local/remote switch is set to remote, the power for the storage unit is controlled by remote power control settings that are entered in the DS Storage Manager. **Planning requirements:** None.

- **Local power on/local force power off switch**

  (Available on base models) The local power on/local force power off switch initiates a storage unit power on sequence or a storage unit force power off sequence. This switch is applicable only when the local/remote switch is set to local. You can access this switch by opening the rear cover of the unit. **Planning requirements:** None.

- **Unit emergency power off switch**

(Available on all models) *Use this switch only in extreme emergencies. Using this switch often results in data loss.* If activated, the unit emergency power off (UEPO) switch causes the individual model rack to immediately drop all power, including any power that is provided by the battery system. When active, this switch overrides all other power controls for the specific rack. This switch is located on the front of each model rack. **Planning requirements:** None.

The following power controls can be configured by an IBM service support representative. You can also use the following power controls through the DS Storage Manager (running on the Management Console):

- **Local power control mode**

  (Visible in the DS Storage Manager) You cannot change this setting in the DS Storage Manager. This mode is enabled when the local/remote switch on the storage unit is in the local position. When this setting is used, the local power on/local force power off switch on the storage unit controls the power. **Planning requirements:** None.

- **Remote power control mode**

  (Visible in the DS Storage Manager)If you select the **Remote** power control mode, you choose one of the following remote mode options. **Planning requirements:** If you choose the **Remote zSeries Power Control** options, you must have the remote zSeries power control feature. There are no requirements for the other options.

  – **Remote Management Console, Manual**: Your use of the DS Storage Manager power on/off page controls when the unit powers on and off.

  – **Remote Management Console, Scheduled**: A schedule, which you set up, controls when the unit powers on and off.

  – **Remote Management Console, Auto**: This setting applies only in situations in which input power is lost. In those situations, the unit powers on as soon as external power becomes available again.

  – **Remote Auto/Scheduled**: A schedule, which you set up, controls when the unit powers on and off. A power on sequence is also initiated if the unit was powered off due to an external power loss during the time that the units are scheduled to be on and external power becomes available again.

  – **Remote zSeries Power Control**: One or more attached zSeries units control the power on and power off sequences.

Power outlet requirements

Plan for the required power outlets when planning for the installation of your storage units.

The following power outlets are required:

- Two independent power outlets for the two DS8000 power line cords needed by each base model and expansion model.

  Important: To eliminate a single point of failure, the outlets must be independent. This means that each outlet must use a separate power source and each power source must have its own wall circuit breaker.

- Two outlets that are within 3.1 m (10 ft.) of the external management console. Typically, these outlets will be in a rack that you provide.

Input voltage requirements

When you plan for the power requirements of the DS8000, consider the input voltage requirements.

Table 43 provides the input voltages and frequencies that the DS8000 storage units support. Inputs are balanced three phase.

Note: The DS8000 storage unit can support voltages that range from 200 V ac to 480 V ac nominal (180 V ac to 508 V ac).

Table 43. DS8000 input voltages and frequencies

Characteristic	Low Voltage (Feature 9090)	High voltage feature (Feature 9091)
Nominal input voltages	200, 208, 220, or 240 RMS V ac	380, 400, 415, or 480 RMS V ac
Minimum input voltage	180 RMS V ac	333 RMS V ac
Maximum input voltage	264 RMS V ac	508 RMS V ac
Nominal input current (3-ph)	30 Amps	15 Amps
Customer wall breaker rating (3-ph)	50 - 60 Amps	30 Amps
Steady-state input frequencies	50 ± 3 or 60 ± 3.0 Hz	50 ± 3 or 60 ± 3.0 Hz
PLD input frequencies (<10 seconds)	50 ± 3 or 60 ± 3.0 Hz	50 ± 3 or 60 ± 3.0 Hz

Power connector requirements

Ensure that the site where you plan to install the DS8000 storage units meets the power connector requirements.

Table 44 on page 117 provides the power line cords and the inline connectors and receptacles types that they support. Find the power line cord row that is appropriate for your site and ensure that the site where you plan to install the DS8000 storage units meets the power connector requirements that are shown in that row.

Phase rotation on 3-phase power-cable connectors is counterclockwise as you look at the power line cord plug. Phase rotation is clockwise as you look at the face of the power receptacle at your installation site.

Attention:

- Low-voltage, three-phase installations (200 - 240 V) require wall circuit breakers that have a rating of 50 to 60 A.
- High-voltage, three-phase installations (380 - 480 V) require wall circuit breakers that have a rating of 30 to 35 A.

> **Note:** Special applications that use 30 A line cords must rely on 30 A wall circuit breakers for line cord protection.

Do not exceed the wire rating of the facility.

Table 44. DS8000 power line cords

Power Line Cord Feature Code	Power Line Cord Description	Inline Connector	Receptacle
1090 (See Notes 1, 2, 3, and 5.)	Line cord for U.S., Canada, LA, and AP: Three phase 50 or 60 Hz 60 amperes	7428-78	7324-78
1091 (See Note 1, 2, and 5.)	Line cord for EMEA: Three phase 50 Hz 35 amperes	Not applicable	Hard-wired
1092 (See Notes 1, 2, 4, 5, and 7.)	Line cord for Japan, U.S., and Canada: Three phase 50 or 60 Hz 60 amperes	HBL460C9W	HBL460R9W
1093 (See Notes 1, 2, 3, and 6.)	Line cords for Chicago: Three phase 50 or 60 Hz 60 amperes	7428-78	7324-78

Notes:

1. All power line cords are rated at 600 V ac, except line cords for Japan, which are 250 V ac. Each cord has 3 poles and 4 wires.
2. The conductor size for non-EMEA and Japan line cords is 6 awg. The conductor size for EMEA cords is 6 mm².
3. Connectors and receptacles are supplied by Russellstoll.
4. Preferred connectors and receptacles are supplied by Hubbell.
5. With the exception of the Chicago line cord, all line cords extend 4.2 m (14 ft.) from lowest point where they exit the frame to the mating face of the plug or bare leads.
6. Chicago line cords extend 1.8 m (6 ft.) from lowest point where they exit the frame to the mating face of the plug connector or bare leads.
7. The IEC309 receptacle must be installed in a metal-backed box with the green wire ground-connected to the grounding lug within the box. Ensure continuity between the box and the metallic shielding of the liquid-tight conduit.

Amperage ratings of the power connector for the expansion unit must match the ratings that are used in the base model. For example, because a Model 922 or 932 uses a 60 A connector, any Model 92E expansion model that is attached to that base model must use a 60 A connector.

Connecting to a remote FPO room switch

You can connect your DS8000 storage unit (base model plus any expansion models) to a room remote force power off (remote FPO) switch, which is used when a complete loss of external power is likely.

Note: Use the remote FPO switch or remove power from the storage units only when an emergency power off is required. DS8000 storage units are designed to save data when the remote FPO switch is used or an external loss of power is detected.

If you set up a remote FPO switch at your installation location, the storage unit immediately initiates an emergency power off sequence that completes within five minutes when the remote FPO switch is activated. During the power off sequence, the processors attempt to save any data held in memory. The storage unit does not use its batteries to complete the power off sequence (as long as there is still power available). Instead the storage unit uses the available power to complete the sequence. After the sequence completes, the storage unit enters a standby mode. The storage unit is not completely powered off in standby mode, but is ready for any full loss of power.

The remote FPO power off sequence is the same sequence used by DS8000 storage units whenever the rack power control (RPC) cards on the storage unit detect a full loss of power in the room. However, when you use a remote FPO switch, the storage unit can power back up almost as soon as the remote FPO switch is deactivated. This is because the batteries were never used for the emergency power off and they continue to be charged. Without the remote FPO, the storage unit must rely on its batteries to complete the power off sequence. This means that when power is available again, the storage unit must first recharge the batteries before it can fully power on.

Note: The DS8000 storage units maintain protection for any sudden data loss by requiring that the backup batteries are fully charged before you can use the storage unit again.

When you activate a remote FPO switch, this switch overrides all other power controls except the UEPO switch located on the storage unit rack.

When you set up a remote FPO switch, the switch and its cables must meet the following requirements:
- The remote FPO switch must consist of a parallel set of simple normally open contacts or switches (for example, a DPST switch) with a separate contact for each of the two RPC cards that are on the DS8000 base model within the storage unit.
- Two cables, which you supply, must connect the remote FPO switch to the RPC cards on the DS8000 base model. One cable attaches to the J216 receptacle on one RPC card and the other cable attaches to the J216 receptacle on the other RPC card. The cables must meet the following requirements:
  - The cables must have an RJ-45 plug at the end.
  - The cables must contain four conductors.
  - The cable must be shielded with the shield tied to the facility ground at the your connection.
  - The maximum resistance of the cable, connections, and contacts is 5 Ohms Maximum (~200' of #24 AWG).
  - It must have the pins shown on Table 45.

Table 45. Required pins for the remote force power off circuit

Pin number	Description	Type	Level
1	+5 V remote FPO send	Output	0 V to +5 V

Table 45. Required pins for the remote force power off circuit (continued)

Pin number	Description	Type	Level
2	+5 V remote FPO return	Input	0 V to +5 V
3	No connection	Ground	(not applicable)
4	No connection	Ground	(not applicable)
5	Frame ground	Frame ground	(not applicable)
6	Frame ground	Frame ground	(not applicable)
7	No connect	Reserved	(not applicable)
8	No connect	Reserved	(not applicable)

When you connect the cable to the remote force power off circuit, you connect the pins as follows:

- Connect pin 1 to one side of the contact or switch.
- Connect pin 2 to the other side of the contact or switch.
- Leave pins 3 or 4 unconnected.
- Connect the cable shield to pins 5 or 6, or to both.

Power consumption and environmental information

When you are planning to meet the power requirements for the DS8000, consider the power consumption and other environmental points of the storage unit.

Table 46 provides this power consumption and environmental information for the various DS8000 models.

Table 46. Power consumption and environmental information for the DS8000

Measurement	Units	Base model 921/931	Base model 922/932	Base model 9A2/9B2	Expansion model	
					92E	9AE
Peak electric power (See Note 1)	kilovolt amperes (kVA)	5.8	7.0	7.0	6.5	6.5
Thermal load	British thermal units (BTU) per hour	19 800	24 000	24 000	22 200	22 200
Capacity of exhaust	cubic meters per minute (cubic feet per minute or CFM)	32.5 (1150)	32.5 (1150)	32.5 (1150)	35.4 (1250)	35.4 (1250)
Ground leakage current	milliamperes (mA)	60	60	60	60	60
Startup current	amperes (A or amp)	<= 100	<= 100	<= 100	<= 100	<= 100
Startup current duration	microseconds (µs or µsec)	< 200	< 200	< 200	< 200	< 200

Table 46. Power consumption and environmental information for the DS8000 (continued)

Idle and operating sound power level, LWAd (See Note 2)	A-weighted bels (B)	7.5	7.5	7.5	7.5	7.5

Notes:

1. These power values represent data obtained during preliminary testing. These measurement represent the peak power usage by the models when they are configured as follows:
   - Base models (921, 922, 931, 932, 9A2, and 9B2) that contain eight 146 GB disk drive sets (128 disk drives) and fibre-channel adapters.
   - Expansion models (92E and 9AE) that contain sixteen 146 GB disk drive sets (256 disk drives).
2. LWAd is the statistical upper-limit A-weighted sound power level, expressed in bels, declared in conformance with ISO 9296. The values correspond to DS8000 models that contain 128 disk drives. The values represent data obtained during preliminary testing. Bels relate to decibels (dB) as follows: *1 B = 10 dB*. The ratings are rounded to the nearest 0.1 B. Measurements are in conformance with ISO 7779.

Acoustic declaration for the DS8000 series

Table 47 describes the acoustic declaration information for the DS8000 series.

Table 47. Acoustic declaration for the DS8000 series

Product Description	Declared A-Weighted Sound Power Level, LWAd (B)		Declared A-Weighted Sound Pressure Level, LpAm (dB)	
	Operating	Idling	Operating	Idling
DS8000 with 128 hard disk drives	7.5	7.5	56	56

Notes:

- LWAd is the statistical upper-limit A-weighted sound power level (rounded to the nearest 0.1 B).
- LpAm is the mean A-weighted emission sound pressure level measured at the 1-meter bystander positions (rounded to the nearest dB).
- 10 dB (decibel) = 1 B (bel).
- Preliminary data subject to change.
- All measurements made in conformance with ISO 7779 and declared in conformance with ISO 9296.

Planning for environmental requirements

You must install your storage unit in a location that meets the operating environment requirements to properly maintain your DS8000 storage unit.

Take the following steps to ensure that you meet these requirements:

1. Note where air intake locations are on the models that compose your storage unit.
2. Verify that you can meet the environmental operating requirements at the air intake locations.

3. Consider optimizing the air circulation and cooling for the storage unit by using a raised floor, adjusting the floor layout, and adding perforated tiles around the air intake areas.

Fans and air intake areas

The DS8000 models provide air circulation through various fans throughout the frame. You must maintain the correct operating environment requirements for your models at each air intake location.

Table 48 summarizes fan, intake, and exhaust locations.

Table 48. Machine fan location

DS8000 Fan Location	Machine Location	Intake Location	Exhaust Location
Lower part of machine	Lower	Front covers	Rear covers
Power complex	Left-side	Front covers	Rear covers
Disk drive section	Upper part of machine for base models; Upper 3/4 of the machine for expansion models	Front and rear covers	Top of machine

Operating environment requirements

You must meet specific operating environment requirements at all the air intake locations of your models.

The operating points vary depending on the state of the model. The models can be in the following states:

- Powered on
- Powered off
- In storage

Powered on:

Plan for the DS8000 operating ranges and recommended operating points when the storage unit is on.

Table 49 provides the operating ranges for your storage unit when the power is on.

Table 49. Operating extremes with the power on

Altitude	0 - 2133 m (0 - 7000 ft)
Dry bulb temperature	16 - 32°C (60 - 90°F)
Relative humidity	20 - 80%
Wet bulb temperature (maximum)	23°C (73°F)

Table 50 provides the operating points that IBM recommends for your storage unit with the power on.

Table 50. Recommended operating points with the power on

Temperature	22°C (72°F)
Relative humidity	45%

Table 51 provides the operating ranges that IBM recommends for a storage unit with the power on.

Table 51. Recommended operating ranges with the power on

Temperature	20 - 25°C (68 - 77°F)
Relative humidity	40 - 50%

Powered off:

Plan for the required DS8000 temperature and humidity ranges when the storage unit is off.

Table 52 provides the temperatures and humidity requirements for your storage unit when the power is off.

Table 52. Temperatures and humidity with the power off

Temperature	10 - 43°C (50 - 110°F)
Relative humidity	8 - 80%
Wet bulb temperature (maximum)	27°C (80°F)

In storage:

Plan for the required DS8000 temperature and humidity ranges when the storage unit is in storage.

Table 53 provides the temperatures and humidity requirements for storing your storage unit.

Table 53. Temperatures and humidity while in storage

Temperature	1 - 60°C (34 - 140°F)
Relative humidity	5 - 80%
Wet bulb temperature (maximum)	29°C (84°F)

Cooling the storage complex

You can take steps to optimize the air circulation and cooling for your storage units.

To optimize the cooling around your storage images , prepare the location of your storage images as recommended in the following steps.

1. Install the storage image on a raised floor. Although you can install the storage image on a non-raised floor, installing the storage image on a raised floor provides increased air circulation for better cooling.

2. Install perforated tiles in the front and back of each base model and expansion model as follows:

   a. For a standalone base model, install two fully perforated tiles in front of each base model and one partially perforated tile at the back of each base model, as shown in Figure 30 on page 123 in the single-machine examples (1 and 2 in the figure).

   b. For a row of machines, install a row of perforated tiles in front of the machines and one or two fully perforated tiles at the back of each two machines, as shown in Figure 30 on page 123 (3 and 4 in the figure).

c. For groupings of machines, where a hot aisle/cold aisle layout is used, use a cold aisle row of perforated tiles in front of all machines. For hot aisles, install a perforated tile per pair of machines. A possible minimal configuration is shown in Figure 30 (5 in the figure).

Note: Keep in mind that the dimensions represented in Figure 30 might not be adequate for floor-load requirements.

f = front   Base = Base model   2 ft tile   2 ft perforated tile
r = rear   Exp = Expansion model

Single Machine - 2 examples   **Row of Machines - 2 examples**
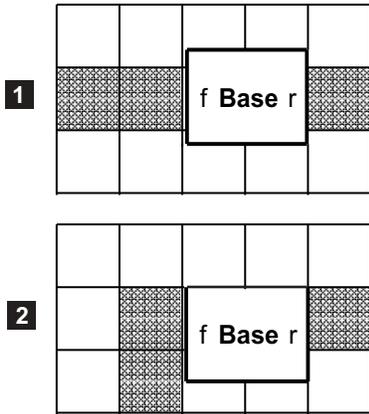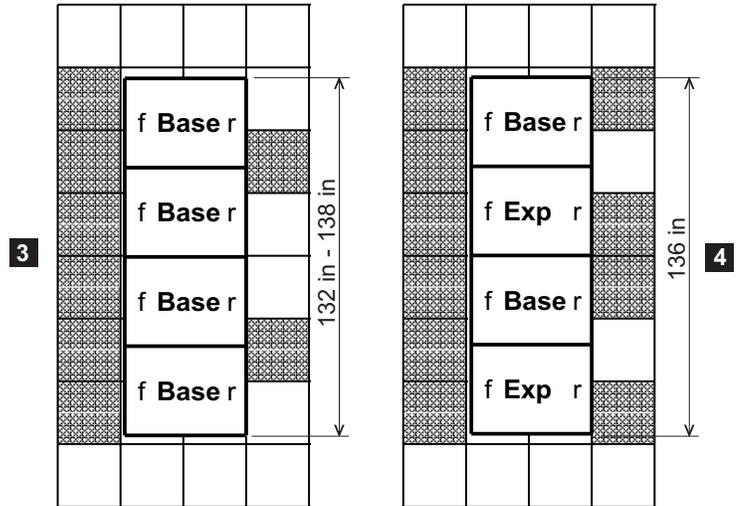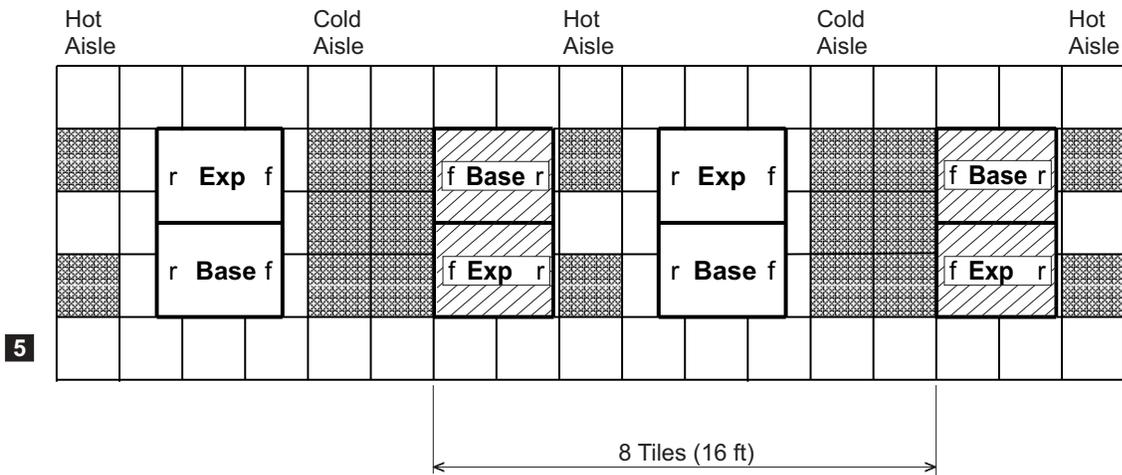
Figure 30. DS8000 layouts and tile setups for cooling

Providing a fire-suppression system

You are responsible for providing a fire suppression system for your DS8000 series.

IBM designs and manufactures equipment to internal and external standards that require certain environments for reliable operation. Because IBM does not test any

equipment for compatibility with fire-suppression systems, IBM does not make compatibility claims of any kind. IBM does not provide recommendations on fire-suppression systems.

1. Consult your insurance underwriter, local fire marshal, or local building inspector about selecting a fire-suppression system that provides the proper level of coverage and protection.

2. See "Planning for environmental requirements" on page 120 for the temperature and cooling requirements for your DS8000 storage unit.

Considering safety issues

You must consider various safety issues when you plan your DS8000 series location.

The following list identifies some of the safety issues you must consider:
- Fire suppression
- Earthquake safety

Planning for external management console installation

If you use an external management console (feature code 1110), you must plan for its installation.

IBM provides power cables and two 31 m (101 ft) private network Ethernet cables for the external management console.

You must provide the following for the installation of the external management console:

- A location for the external management console that allows the IBM-supplied Ethernet cable, which is 31 m (101 ft), to reach the management console on one end and the storage unit on the other end. You can locate your management console farther away, if necessary; however, this makes servicing your storage unit more difficult, and you must provide two of your own Ethernet cables. Any Ethernet cables that you supply must meet the following requirements:
  - The cables must be straight 4-pair UTP CAT 5E (or better) cables with RJ-45 jacks.
  - The length of each cable cannot exceed 100 m (328 ft).
  - The two private network cables are labeled or marked on both ends to make it obvious which one belongs to the gray network and which one belongs to the black network.
- A rack in which to mount the management console. This rack can be an IBM rack or a non-IBM rack, but it must meet specifications.
- Two outlets that are within 3.1 m (10 ft) of the external management console. Typically, these outlets will be in the rack that you provide. The outlets are used by the country-specific line cords that you select when you order the external management console.

Both the internal and external management console's are xSeries servers that have a monitor and a keyboard.

Rack specifications for the external management consoles

The external management console is an xSeries 336 1U model that is designed to be installed in a 19 in. rack that can accommodate devices that are 711.1 mm (28 in.) deep.

IBM racks that support the management console are racks such as the NetBAY42U ER and NetBAY42U SR. Installation into some of the older Netfinity racks (9306900, 9306910, 9306200) require a rack extension kit for proper cable bend radius and cooling.

If you install your external management console in a non-IBM rack, be sure the rack satisfies the required specifications. The following specifications are required for a non-IBM rack:

- The rack must meet EIA-310-D standards for mounting flanges and hole locations.
- The front-to-rear distance of the mounting flanges must be 720 mm (28.3 in.).
- The thickness of the mounting flanges must be between 1.9 and 3.3 mm (0.08 and 1.3 in.).
- The mounting flanges must have either 7.1 mm (0.28 in.) diameter holes or 9.6 mm (0.38 in.) square holes on the standard EIA hole spacing.
- The rack must have a minimum depth of 70 mm (2.76 in.) between the front mounting flange and inside of the front door for appropriate cooling.
- The rack must have a minimum depth of 157 mm (6.2 in.) between the rear mounting flange and inside of the rear door to install the external management console and provide cable management space.
- The minimum side-to-side clearance in the rack between the front and rear mounting flanges must be of 467 mm (18.2 in.) to accommodate the width of the server and the slide mounting brackets.
- The front edge of the keyboard/display tray is 19 in. wide including the tabs for the front thumbscrews. To use the tray, it must be extended out fully on its rails. If the rack is equipped with front covers, ensure they are hinged in such a way that in their fully open position they allow the keyboard/display tray to be fully extended.
- The rack must include perforated front and rear doors and must not prevent the flow of cool air into or out of the rack.
- The weight-handling capacity of the rack must be able to support the maximum rack configuration, including all servers, external cables, PDUs, and so on.
- The rack must provide proper stabilization so that the rack does not become unstable when the external management console or other equipment are pulled out for use or for service.

Planning for network and communications requirements

You must locate your DS8000 storage units in a location that meets the network and communications requirements.

Keep in mind the following network and communications issues when you plan the location and interoperability of your storage units:

- Management console network requirements
- Remote support connection requirements
- Remote power control requirements
- Host attachment requirements
- SAN considerations

Management console network requirements

You must plan for the network requirements of the management console.

Each management console requires a dedicated connection to the network.

Note: If you will be accessing CLI or the Storage Manager and have a firewall between the management console and your network, you need to open the following TCP/IP ports prior to installation: 1718, 1720, 1722, 1750, 1755 and 8451-8455.

Remote support connection requirements

You must meet the requirements for the modem and for an outside connection if you will use remote support.

Your DS8000 management console contains a modem to take advantage of remote support, which can include outbound support (call home) or inbound support (remote service performed by an IBM next level support representative). For each management console, you must provide the following equipment close enough to the management console to support the modem connection:

- One analog telephone line for initial setup
- A telephone cable to connect the modem to a telephone jack

In order to enable remote support you must allow an external connection, such as one of the following:

- A telephone line
- An outbound Internet connection through your firewall that allows IBM to use a VPN connection to your management console

The DS8000 modems support worldwide use, and they meet all required standards.

Remote power control requirements

Remote power control allows you to control the power of your storage complex. It can be controlled through the DS Storage Manager (running on the management console).

There are several settings for remote power control. Only the remote zSeries power control setting requires planning on your part.

The remote zSeries power control setting allows you to power on and off a room from one zSeries interface. If you use the remote zSeries power control setting, you must meet the following requirements:

- You must order the remote zSeries power control feature.
- You can allow up to four zSeries remote power-control interfaces.

See the *IBM System Storage DS8000 User's Guide* for additional information about DS8000 remote power control settings.

SAN requirements and considerations

These requirements and considerations can help you plan for a DS8000 series that attaches to a SAN.

A fibre-channel storage area network (SAN) is a specialized, high-speed network that attaches servers and storage devices. With a SAN, you can perform an any-to-any connection across the network using interconnect elements such as routers, gateways, hubs, and switches.

For a DS8000 series configuration, you can use SANs to attach storage unit disks and to attach hosts to the storage unit.

When you connect your DS8000 storage units to a SAN, you must meet the following requirements:

- When a SAN is used to attach both disks and hosts to the storage unit, any storage device that is managed by the storage unit must be visible to the host systems.
- When concurrent device adapters and I/O adapter operations are supported through the same I/O port, the SAN attached to the port must provide both host and device access.
- Fibre-channel I/O adapters must be configured to operate in a point-to-point mode fabric topology. See the *IBM System Storage DS8000 Host Systems Attachment Guide*, for more information.

Also keep the following considerations in mind:

- Fibre-channel SANs can provide the capability to interconnect open systems and storage in the same network as S/390 and zSeries host systems and storage.
- A single fibre-channel I/O adapter can have physical access to multiple fibre-channel ports on the storage unit.

Host attachment communication requirements

This list describes requirements and other considerations for connecting host attachments in your network.

- You must use worldwide port names to uniquely identify fibre-channel adapter cards that are installed in your host system.
- For open-system hosts with fibre-channel adapters, keep in mind that fibre channel architecture provides a variety of communication protocols. Each interconnected storage unit within the architecture is referred to as a *node*, and each host is also a node. Each node corresponds to one or more ports. (In the case of fibre-channel I/O adapters, these ports are fibre-channel ports.) Each port attaches to a serial-transmission medium that provides duplex communication with the node at the other end of the medium. You can configure your network structure based on one of three basic interconnection topologies (network structures):
  - Point-to-point
  - Switched fabric
  - Arbitrated loop

  See the *IBM System Storage DS8000 Host Systems Attachment Guide* for more information about these supported topologies.

- The maximum distance between a host fibre-channel port and the following network components is 300 meters (984 ft) with a shortwave adapter and 10 km (6.2 miles) with a longwave adapter.
  - Fabric switches
  - Fabric hubs
  - Link extenders
  - Storage unit fibre-channel port

  The maximum distance might be greater than 10 km (6.2 miles) when a link extender provides target initiator functions or controller emulation functions.

  Note: Do not use link extenders with emulation functions on links over which Remote Mirror and Copy operations are performed. This is because of the additional path delay that is introduced by these units.

- Because the fibre channel architecture allows any channel initiator to access any fibre-channel device, without access restrictions, this can represent a security exposure. Have your IBM service representative set the fibre-channel access modes to the proper setting. See the *IBM System Storage DS8000 Host Systems Attachment Guide* for more information about fibre-channel access modes.
- DS8000 storage units can connect to IBM SAN Volume Controller host systems. See the *IBM System Storage DS8000 Host Systems Attachment Guide* for more information.

Chapter 5. Planning your DS8000 storage complex setup

During installation, IBM customizes the setup of your storage complex based on information that you provide in the customization work sheets.

Each time you install a new storage unit or management console, you must complete the customization work sheets before the IBM service representatives can perform the installation.

The customization work sheets allow you to specify the initial setup for the following:
- Company information
- Management console network settings
- Remote support (includes call home and remote service settings)
- Notifications (includes SNMP trap and e-mail notification settings)
- Power control
- Control Switch settings

Important: IBM service representatives cannot install a storage unit or management console until you provide them with the completed customization work sheets.

Company information

The company information work sheet allows you to specify any company information that enables IBM service personnel (or your service provider) to contact you as quickly as possible and to access your storage complex.

This information includes the following:
- General company information, such as company name and telephone number
- Administrator contact information
- Storage complex location and modem numbers

You must complete this work sheet for all installations that include a management console. See Appendix B, "Company information work sheet," on page 145.

Management console network settings

The management console network setting work sheet enables you to specify the IP address and LAN settings for your management console.

The management console network settings include the following:
- Management console network identification
- Ethernet settings, if you want the management console to connect to your LAN
- DNS settings, if you plan to use a domain name server to resolve network names
- Routings, if you want to specify a default gateway for routing

Note: IBM will attach your LAN after the storage complex is installed and in operation.

You must complete the work sheet for all installations that include an management console. Before completing it, review the exceptions listed in the notes at the bottom of the work sheet. See Appendix C, "Management console network settings work sheet," on page 149.

Remote support settings

The remote support work sheets enable you to specify whether you want outbound (call home) or inbound (remote services) remote support.

IBM recommends that you enable both outbound and inbound support to help you maintain the highest availability of your data.

When you enable outbound (call home) support, your management console sends an electronic call home record to IBM support when there is a problem within the storage complex. In the header of each call-home record, a callback password appears. If inbound remote services is also enabled, this password enables IBM service representatives to remotely sign on to the management console in response to the service call. If outbound support is enabled, but inbound remote services is not enabled, the IBM service representative must physically come out to your location to troubleshoot and service the storage complex.

When inbound remote services are enabled, service representatives can perform service tasks remotely. They can view error logs and problem logs, and initiate trace or dump retrievals.

For faster service and maintenance, virtual private network (VPN) connectivity is preferred over modem connectivity. For information about VPN, access the following Web site:

http://www-1.ibm.com/support/docview.wss?rs=1114&uid=ssg1S1002693

You must complete the work sheet for all installations that include a management console. See Appendix D, "Remote support work sheets," on page 155, "Outbound (call home) work sheet" on page 155, and "Inbound (remote services) work sheet" on page 159.

Notification settings

The notification work sheets allow you specify the types of notifications that you want you and others to receive.

Notifications contain information about your storage complex, such as serviceable events.

You can receive notifications through the following methods:
- Simple Network Management Protocol (SNMP) traps
- E-mail

You can choose one or both notification methods.

When you choose to have your storage complex generate SNMP traps, you can monitor the storage complex over your network. You can control whether

management information base (MIB) information is accessible and what type of SNMP traps to send. You can also specify the maximum number of traps sent for each event and where to send the traps.

Note: If you have open-systems hosts and remote mirror and copy functions, you must enable SNMP notifications for status reporting.

When you choose to enable e-mail notifications, e-mail messages are sent to all the e-mail addresses that you specify on the work sheet when the storage complex encounters a serviceable event or must alert you to other information.

You must complete the work sheet for all installations that include a management console. See Appendix E, "Notification work sheets," on page 161, "SNMP trap notification work sheet" on page 161, and "E-mail notification work sheet" on page 162.

Power control settings

The power control work sheet enables you to select and control the various power modes for the storage complex.

If you use the remote zSeries power control feature, you must specify that on the power control work sheet, so the power mode can be set up to support that feature.

You can also specify whether power turns on and off automatically or uses a schedule. If you want to use a scheduled power mode, you must enter the schedule on the work sheet.

You must complete this work sheet for *all installations*. See Appendix F, "Power control work sheet," on page 165.

Control switch settings

Control switch settings allow you to specify certain DS8000 settings that affect host connectivity. You are asked to enter these choices on the control switch settings work sheet so that the service representative can set them during the installation of your DS8000.

AS/400 LUN or iSeries serial number setting

Use this control switch setting when you attach more than one DS8000 to an AS/400 or iSeries host *and* the last 3 digits of the DS8000 serial number happen to be the same in each case. Setting this serial number is optional.

For example, the serial number for the first DS8000 is 2107-13-**14321** and the serial number for the second DS8000 is 2107-13-**15321**. Because the original LUN serial number is used for identification, the AS/400 does not use the second LUN. Specifying a new serial number base for the second DS8000 prevents this problem. IBM service personnel enters the control-switch setting for the new serial number base that you specify for this field.

Note: The probability of receiving two DS8000 with the same last three serial numbers is unlikely, but possible.

Fibre LUN access number settings

This control switch setting on the DS8000 determines whether hosts have access to all LUNs over fibre channels or whether access is restricted. Restricted access is based on the worldwide ID (WWID) of the adapter port in the host system. Access also depends on the logical configuration that is defined for that host port WWID.

Control-unit initiated reconfiguration (CUIR) settings

Control-unit initiated reconfiguration (CUIR) allows automation of channel path quiesce and resume actions during certain service actions. This eliminates the requirement for manual actions from the host. CUIR relies on a combination of host software and DS8000 firmware.

The CUIR setting on the control switch setting work sheet enables you to indicate whether this option can be enabled. The CUIR setting applies to IBM zSeries and S/390 environments only.

See Appendix G, "Control switch settings work sheet," on page 167.

Chapter 6. Planning data migration

Use these data migration considerations to formulate your data migration plan.

There are three levels of considerations to keep in mind when selecting the best method for your environment. At the first level, you consider broad questions about your environment to create a generic profile of your needs. At the second level you compare which migration methods fit into your generic profile. The level is to review a set of hints and other guidelines that apply to specific environments or that may help you take advantage of a migration to optimize your environment.

The following are some key questions to use to define your generic migration environment

- Why is the data migrating?
- How much data is migrating?
- How quickly must the migration be performed?
- What duration of service outage can be tolerated?
- Is the data migration to/from the same type storage?
- What resources are available for the migration?

If you will be performing any of the following, you might need to allow for more time or resources:

- Creating new logical volumes or file systems
- Modifying configuration files
- Receiving integrity checks

After determining general answers to the considerations listed above, a better understanding of some of the migration options along with their advantages and disadvantages will help frame your generic profile into a subset of acceptable migration options. Table 54 compares the data migration options.

Table 54. Comparison of data migration options

Type	Example	Advantages	Disadvantages
OS / LVM Mirroring	Logical Volume Managers, (LVM) Veritas Volume Manager (VxVM), Windows Disk Administrator	Little or no application service disruption	Potential application delays
UNIX or Windows Commands	cpio, cplv, dd, tar, backup restore; copy, scopy, xcopy, drag and drop	Common, easy to use, tested	Length of service interruption varies; scripting prone to errors and additional testing
Remote Copy	Synchronous Mirror (Metro Mirror); Asynchronous Mirroring (Global Mirror and Global Copy)	Operating system independent	Like storage device types needed

Table 54. Comparison of data migration options (continued)

Type	Example	Advantages	Disadvantages
Third party software packages	Data Migration (Softek, XoSoft); Backup /Restore (Tivoli, Legato, Veritas)	Some have little application service interruption, standard utilities	Cost of software; some have high application service interruption
Third party migration appliances	IGS Piper Service Offerings, IBM San Volume Controller, DataCore SANsymphony	Multiple heterogeneous storage venders supported; migration cycles offloaded to appliance	Cost of migration appliance / service, application disruption to install / remove appliance

Besides these two sets of general considerations, there are a few more specific considerations and hints to review before finalizing your data migration method. Some will apply to your environment and some will not. **As well, you should review each of the methods in more detail, as described in the** *IBM System Storage DS8000 User's Guide*. Also keep in mind that data migration is a service offered through IBM Global Services. Contact your IBM Representative for more information.

Select a migration method by your operating system:
- Is it UNIX based? You will probably use some variation of a logical volume manger.
- Is it a zSeries or S/390? You will probably use IBM TotalStorage Global Mirror, Remote Mirror and Copy (when available).
- Is it z/OS? You will probably use DFDSS, though there are many choices.
- Is it VM? You might use DASD Dump Restore or PTAPE.
- Is it VSE? You might use the VSE fastcopy or ditto commands.

Notes:
- AIX and HP-UX 10.xx ship with logical volume management (LVM) software as part of the base operating system. LVM provides complete control over all disks and file systems that exist on an AIX system. HP-UX has similar volume management software.
- Sun Microsystems has a basic volume management product called Solstice, which is available for the Solaris systems. You can also purchase the Veritas Volume Manager (VxVM) and Veritas File System (VxFS) as optional products for Solaris.
- Linux systems also use the LVM

When replacing existing storage, you should partition the storage so that its virtual disks are similar in configuration to the disk drives that they are replacing. New configurations must be large enough to accommodate the existing data.

You might want to take advantage of this opportunity to do some remapping. The allocation and distribution of data does not have to be a straight one-to-one relationship, although that is possible. For instance, you can take advantage of using a maximum of 255 logical subsystems whereas the prior limitation was 32 logical subsystems.

Chapter 7. Managing and activating licenses

Managing and activating licensed functions is your responsibility.

Management refers to the use of the IBM Disk Storage Feature Activation (DSFA) Web site to select a license scope and to assign a license value. You will perform these activities and then activate the function.

Note: If you are activating features for any of the licensed functions, such as Copy Services, all the features must have the same capacity, including the operating environment license feature.

Activation refers to the retrieval and installation of the feature activation code into the DS8000 system. The feature activation code is obtained using the DSFA Web site and is based on the license scope and license value.

You perform these activities at the following times:
- After the IBM service representative has installed your storage unit and before you configure it
- When you increase the extent of the function authorization for a licensed function (that is, you add additional capacity to your license)
- When you reallocate function authorizations between images on Model 9A2 or 9B2

To perform these activities, you must access the DSFA Web site at

http://www.ibm.com/storage/dsfa

When you access DSFA, you must enter information about your DS8000 storage unit so the Web application can access the correct function authorization records. You can find the information you must enter into DSFA on the Storage Unit General Properties page in the IBM System Storage DS Storage Manager application.

Activating licensed functions

After the IBM service representatives have completed your DS8000 storage complex installation, your first step is to activate your licensed functions.

To activate your licensed functions, you must perform the following actions:
- Obtain your feature activation codes.
- Apply the activation codes to your storage unit. You can apply the activation codes by importing a file that you download from the IBM Disk Storage Feature Activation (DSFA) Web site.

The initial enablement of any optional DS8000 licensed function is a concurrent activity (assuming the appropriate level of microcode is installed on the machine for the given function).

Note: The following activating activities are disruptive and require a machine IML (Models 921, 922, 931, and 932) or reboot of the affected image (Models 9A2 and 9B2):

- Removal of a DS8000 licensed function to deactivate the function.
- A lateral change or reduction in the license scope. A lateral change is defined as changing the license scope from fixed block (FB) to count key data (CKD) or from CKD to FB. A reduction is defined as changing the license scope from all physical capacity (ALL) to only FB or only CKD capacity.

Obtaining activation codes

Complete this task to obtain your feature activation codes for the licensed features for each storage unit. To obtain your activation codes, you must connect to the IBM Disk Storage Feature Activation (DSFA) Web site.

Before you can connect to the site, ensure that you have the following items:

- The IBM License Function Authorization documents. If you are activating codes for a new storage unit, these documents are included in the shipment of the storage unit. If you are activating codes for an existing storage unit, IBM sends these documents to you in an envelope.
- A diskette for downloading your activation codes into a file. Use the diskette if you cannot access the IBM System Storage DS Storage Manager from the system that you are using to access the DSFA Web site. Instead of using a diskette, you can also write down the activation codes and then manually enter them into the system that runs the DS Storage Manager.
- The machine serial number, model, and signature.

To obtain your activation codes, perform the following steps:

1. At a computer with an Internet connection and a browser, connect to the IBM Disk Storage Feature Activation (DSFA) Web site at http://www.ibm.com/storage/dsfa.
2. The DSFA application displays in the browser. Use the application to obtain the activation codes and follow the instructions on the screen.

   Note: In most situations, the DSFA application can locate your 2244 or 239x license authorization record when you enter the DS8000 (2107 or 242x) serial number and signature. However, if the 2244/239x license authorization record is not attached to the 2107/242x record, you must assign it to the 2107/242x record in the DSFA application. In this situation, you will need the 2244/239x serial number (which you can find on the License Function Authorization document).

Importing activation codes

Complete this task to import the activation codes that must be applied before you can begin configuring storage on a storage image.

Notes:

1. Before you begin this task, you must resolve any current DS8000 problems. Contact IBM Support for assistance in resolving these problems.
2. Before you configure, disable or provide paths through any firewalls, because they might interfere with DS8000 communication.

Perform the following steps to import your activation codes:

1. In the navigation, select **Real-time manager** → **Manage Hardware** → **Storage images**. On the Storage images main page, select the storage image that you want to import the activation code for.

2. From the **Select Action** menu, select **Apply activation codes**. The Apply Activation codes: Real-time page is displayed.

3. Click **Import key file**. The Import page is displayed.

4. In the **Select file to import** field, specify the target file. Use the **Browse** button to navigate to the appropriate directory.

5. After you have specified the code file, click **OK** to complete the process.

Applying activation codes

Complete this task to apply the activation codes that enable you to begin configuring storage on a storage image.

Notes:

1. The initial enablement of any optional DS8000 licensed function is a concurrent activity (assuming that the appropriate level of microcode is installed on the machine for the given function). The following activating activities are disruptive and require a machine IML (Models 921, 922, 931, and 932) or reboot of the affected image (Models 9A2 and 9B2):

   - Removal of a DS8000 licensed function to deactivate the function. Contact your IBM service representative to perform this operation.

   - A lateral change or reduction in the license scope. A lateral change is defined as changing the license scope from fixed block (FB) to count key data (CKD) or from CKD to FB. A reduction is defined as changing the license scope from all physical capacity (ALL) to only FB or only CKD capacity.

2. Before you begin this task, you must check the error log and resolve any current DS8000 problems. Contact IBM Support for assistance in resolving these problems.

3. Before you configure, disable or provide paths through any firewalls, because they might interfere with DS8000 communication.

The easiest way to apply the feature activation codes is to download the activation codes from the IBM Disk Storage Feature Activation (DSFA) Web site to your local computer and then to import the file into the DS Storage Manager. If you cannot access the DS Storage Manager from the same computer that you used to access the DSFA Web site, you can download the file to a diskette or write down the information. If you are using either of these latter methods, ensure that you have your diskette containing the downloaded activation codes file or your paper that contains the written activation codes before you begin the following steps.

1. Ensure that the Import activation codes page is not open. You cannot have both the Apply activation codes page and the Import activation codes page open at the same time. You must close one in order to access the other.

2. In the navigation, select **Real-time manager** → **Manage Hardware** → **Storage images**. On the Storage images main page, select the storage image that you want to import the activation code for.

3. From the **Select Action** menu, select **Apply activation codes**. The Apply Activation codes: Real-time page is displayed.

a. If you already imported your activation codes from a file or retrieved existing codes from the storage unit, the values are displayed in the fields and you can modify or overwrite them, as appropriate.

b. If you are importing your activation codes from a file that you downloaded from the DSFA Web site, click **Import key file**. Once you complete the import process, the data from the file is displayed.

c. If you did not download your activation codes into a file, enter the codes into the appropriate fields.

Notes:

a. For Models 9A2 and 9B2, you need to perform this process for both images, one image at a time.

b. The **Authorization level** and **Scope** fields are populated based on the information that is contained within the activation codes.

4. Click **OK** to complete the process.

Scenarios for managing licensing

These topics provide scenarios for managing your DS8000 licenses after you have initially activated them.

The following scenarios are provided:
- Adding storage capacity to an existing machine
- Reallocating a license between storage images

Note: Additional scenarios may be on the IBM System Storage DS8000 Information Center.

Adding storage to your machine

This scenario describes how to add storage (in terabytes) to an existing licensed feature such as the point-in-time copy.

For this scenario, assume you initially purchased a 2244 point-in-time feature (2244–PTC) for 25 terabytes (TB). After several months, you need an additional 20 TB for your point-in-time copy operations. To increase storage, you must purchase and activate a larger license. This is a nondisruptive activity and does not require that you reboot your machine.

1. You order two of feature 7203 (10 TB each of 2244–PTC) against the serial number of the 2244 Model PTC license currently on your machine. These features will be the additional 2244 features that will increase your point-in-time copy authorization level.

2. After you have ordered the features, you receive confirmation from IBM that these new features have been processed.

3. Connect to the IBM-supported Disk Storage Feature Activation (DSFA) Web site at http://www.ibm.com/storage/dsfa to retrieve an activation code for the licensed feature. This new code represents the total capacity that you now have licensed (or 45 TB). It licenses the original 25 TB plus the additional 20 TB that you just ordered.

4. After you obtain the activation codes for the licensed feature, enter it into the Web-based DS Storage Manager. You replace the existing activation code with the new activation code.

5. After the activation code is installed successfully, you now have 45 TB of 2244–PTC capacity.

Reallocating a license between storage images

This scenario describes how to reallocate a license between storage images when you have a Model 9A2 or 9B2 storage unit.

For this scenario, assume that you have a Model 9A2 or 9B2 storage unit and a 5 TB point-in-time copy feature that is allocated to storage image 1. Later, you decide you want to start using the point-in-time copy feature on storage image 2 instead. (Keep in mind that deactivating a function and then reactivating it can be disruptive to your system and might require that you reboot your machine.)

Use the following steps for this scenario:

1. Connect to the DSFA Web site at http://www.ibm.com/storage/dsfa to initiate a request to reallocate a license between storage images.

2. Reduce the allocation value of the point-in-time copy feature for storage image 1 from 5 TB to 0 TB. Increase the point-in-time copy allocation value for storage image 2 from 0 TB to 5 TB. Click **Submit** to apply changes. After submitting allocation changes, retrieve the activation codes by selecting **View Activation Codes** in the upper left panel. The new point-in-time feature activation codes for the storage images are generated and displayed on the screen.

3. In the DS Storage Manager, apply the new activation codes to storage images 1 and 2.

4. Reboot storage image 1. When you reduce a license to 0 TB, you must reboot the image.

Appendix A. IBM-provided DS8000 equipment and documents

These topics list the main equipment and documents that IBM ships with your DS8000 models.

The equipment that you receive can be grouped as follows:
- Components that must stay with the shipment because they are needed for installation
- Components that are for customer use
- Components that must stay with the storage unit after installation because they are needed by service representatives

Note: These lists are not intended to be a comprehensive lists. They describe only the main shipped components.

Installation components

Your shipment includes all the equipment that is needed for the installation of your storage units.

The following installation components are included with your shipment:
- **Storage unit**

  You will receive one or more of the following models that you ordered:
  - Model 921 (base unit)
  - Model 922 (base unit)
  - Model 931 (base unit)
  - Model 932 (base unit)
  - Model 9A2 (base unit)
  - Model 9B2 (base unit)
  - Model 92E (expansion unit)
  - Model 9AE (expansion unit)

  When your models arrive, they contain any ordered I/O enclosures, device adapters, disk enclosures, disk drives, and the appropriate cables to support those components. IBM installs these components at the factory.

  A shipment of a base unit (Model 921, 922, 931, 932, 9A2, or 9B2) will include two 31-meter Ethernet cables.
- **IBM System Storage Management Console**

  For each base unit (Model 921, 922, 931, 932, 9A2, or 9B2) that you order you will receive at least one management console.

  If you order an external management console, you receive this separate workstation, the necessary Ethernet cables, and any required installation hardware to install the external management console to the rack that you provide. The IBM service representatives install the external management console into an IBM or a non-IBM rack when they install your storage unit.
- **ESCON and fibre channel I/O adapters and cables**

  Your shipment includes all ordered ESCON and fibre channel I/O adapters and the ordered cable for each I/O adapter.

- **Power line cords**

  You will receive the country or region-specific power line cord that you ordered. See "Power line cords" on page 78 for information about the power line cords that are available.
- **Various media**

  IBM ships the following media (typically CDs), which are used during the installation of your storage units:
  - I/O adapter media
  - Installation media, which includes installation scripts for the I/O attachment for AIX® and HP-UX, IBM System Storage DS CLI (command-line interface) software, and IBM Multipath Subsystem Device Driver installation instructions and software
  - Licensed machine code (LMC) media for the MC
  - Operating system media
  - LMC media for the 2107/242x
- **Hardcopy installation instructions**

  Your shipment includes hardcopy installation instructions for the IBM service representatives who install your storage unit.
- **Engineering changes (if applicable)**

  IBM occasionally releases engineering changes (ECs) to correct problems or provide additional support. If released, these ECs are included in your shipment for the IBM service representative to install.

Customer components

IBM ships DS8000 media and documents that are intended for you to keep.

You can keep the following items at your desk or any other convenient location. They do not need to be located near the storage unit.
- **IBM Agreement for Licensed Machine Code (LMC)**

  Read this LMC agreement to understand IBM DS8000 licensing policies.
- **Warranty forms**

  IBM ships the following warranty forms. Keep these warranties in a safe place.
  - Statement of Limited Warranty
  - Machine Specific Warranty Information
  - Other important warranty information
- **DS8000 customer publications CD**

  This CD includes a softcopy of the DS8000 customer publications.

Service components

IBM ships service-related media and documents with your DS8000 shipment.

Keep the following components with your storage unit so that IBM service representatives can use them when they service your storage unit.
-
- **Service media**

  Your delivery includes the following media for IBM service representatives to use:
  - **Operating system media**

- **Management console media:**
  - Management console critical backup CDs
  - Dump, trace, statesave CDs, which IBM service representatives use for extracting statesave information during service
- DS8000 customer publications CD
- A program temporary fix (PTF) CD for the operating system
- Service documents CD, which includes the following documentation: DS8000 service guides, DS8000 parts catalog, and the DS8000 customer publications

Appendix B. Company information work sheet

This work sheet allows you to provide basic information about your company and administrator as well as general system information.

Purpose

IBM service representatives use the information that is provided on the company information work sheet to customize your IBM storage complex. When you use any of the remote support features, the management console sends this information to IBM so an IBM service representative can contact you.

You must complete the Table 55 work sheet for all installations that include a management console.

Note: Management console is abbreviated as MC in the work sheet.

Table 55. Company information work sheet

Item or setting	Instructions	Your information
Company name	Provide the name of your company. IBM service representatives use this information to identify your company when they receive call home reports from your IBM storage system. Ensure that the company name that is provided here is consistent with all other machines that correspond to your IBM customer account.	
Customer number	Provide the customer number that is assigned by IBM to your company.	
Administrator information Provide information about your storage system administrator in the following section.		
Administrator name	Provide the name of the individual at your site who service representatives can contact about IBM storage system service matters.	
Administrator e-mail address	Provide the e-mail address that can be used to contact the administrator.	
Administrator telephone number	Provide the primary telephone number for service personnel to use to contact the storage system administrator. Include the area code and the country code, if appropriate.	

Table 55. Company information work sheet (continued)

Item or setting	Instructions	Your information
Alternate telephone number	Provide an alternate or off-shift telephone number that IBM service representatives can use to contact the storage system administrator. Include the area code and the country code, if appropriate.	
Fax number	Provide the primary fax number that IBM service representatives can use when they must fax documents to the storage system administrator. Include the area code and the country code, if appropriate.	
Alternate fax number	Provide an alternate fax number that service personnel can use when they must fax documents to the storage system administrator. Include the area code and the country code, if appropriate.	
Administrator's mailing address	Provide the mailing address for the administrator. Specify the complete address, including the street address, building (if appropriate), city or locality, state or province, and postal or zip code.	
Storage system information Provide basic information about your storage system and the management console in the following section.		
System location	If different than the administrator's address, provide the full address where the storage unit is located. Include the street address, building (if appropriate), city or locality, state or province, and postal or zip code.	
Modem number (MC1)	For the first MC to take advantage of inbound remote services, Provide the telephone number to the modem of the first MC in the storage complex. Include the area code and the country code, if appropriate.	

Table 55. Company information work sheet (continued)

Item or setting	Instructions	Your information
Modem number (MC2, if installed)	For a second MC to take advantage of inbound remote services, provide the telephone number to the modem of the second MC. Include the area code and the country code, if appropriate.	

Appendix C. Management console network settings work sheet

Specify basic network information on this work sheet such as the management console identification, Ethernet settings, and DNS settings.

When your storage unit sends IBM any call home information through VPN or sends you notices about serviceable events (using SNMP trap or e-mail), these settings will be included in the information to identify and provide important information about the management console that has sent a service request.

Work sheet purpose

IBM service representatives use the information you provide on the management console network settings work sheet to set up the network settings that support your management console.

You must complete this work sheet for all installations that include a management console.

Work sheet and instructions

The IP addresses and name server information shown on this work sheet are examples only. They do not function. Contact your IBM service representative for the correct IP addresses and name servers that function with your DS8000 system. Complete the Table 56 work sheet to provide the IBM service representatives information about how to set up your network settings.

Note: Management console is abbreviated as MC in the work sheet.

Table 56. Management console network settings work sheet

Item or Setting	Instructions	MC1	MC2 (if applicable)
MC name (host name)	Record the console or host name that you want to assign to the management console workstation (for example, **dsmc1**). The console name and the domain are used to identify the MC to the network.		
Domain name	Provide the domain name that you are assigning to the MC workstation (for example, **medina.xyz.it**).		

Table 56. Management console network settings work sheet (continued)

Item or Setting	Instructions	MC1	MC2 (if applicable)
MC time and time zone	Check **Use local time and time zone** to set the MC to the local time and time zone (local to where the MC physically resides). If you want to use a different time zone, check **Use the following time zone** and specify the time zone to use (for example, **Central European Time** or **US Pacific Time**).	_ Use local time and time zone _ Use the following time zone: _____	_ Use local time and time zone _ Use the following time zone: _____
Ethernet settings Complete the LAN Adapter Details section when the MC connects to your LAN.			
Media speed (Ethernet)	Check **Autodetection** or the media speed of the Ethernet adapter. Tip: If you check **Autodetection**, the MC can automatically select the media speed appropriate for your configuration.	_ **Autodetection** _ 10Mpbs Half Duplex _ 10Mpbs Full Duplex _ 100Mpbs Half Duplex _ 100Mpbs Full Duplex _ 1000Mpbs Half Duplex _ 1000Mpbs Full Duplex	_ **Autodetection** _ 10Mpbs Half Duplex _ 10Mpbs Full Duplex _ 100Mpbs Half Duplex _ 100Mpbs Full Duplex _ 1000Mpbs Half Duplex _ 1000Mpbs Full Duplex

Table 56. Management console network settings work sheet (continued)

Item or Setting	Instructions	MC1	MC2 (if applicable)
TCP/IP interface address	- Ensure that the TCP/IP address that you select is not in a range that is reserved for the 2107/242x private network. For more information, see "TCP/IP address ranges" on page 152. If you plan to use the IBM Internet VPN connectivity with the Network Address Translation (NAT), the IP address for the MC must be a routable private address (RFC1981) that is not already available on the Internet. - Record the dotted decimal address that you are assigning to the MC (for example, **7.127.152.14**).		
2107/242x private network address ranges	Can the default 2107/242x private network address ranges be used? For more information, see "TCP/IP address ranges" on page 152.	[ ] Yes: Use default ranges. [ ] No: Check off the address range option to use. Table 58 on page 153 provides the addresses associated with each option. [ ] Option 1 [ ] Option 2 [ ] Option 3	[ ] Yes: Use default ranges. [ ] No: Check off the address range option to use. Table 58 on page 153 provides the addresses associated with each option. [ ] Option 1 [ ] Option 2 [ ] Option 3
TCP/IP interface network mask	Record the dotted decimal network mask that you want to apply to the TCP/IP address (for example, **127.123.546.0**).		
DNS settings Complete this section if you plan to use a domain name server (DNS) to resolve network names.			

Table 56. Management console network settings work sheet (continued)

Item or Setting	Instructions	MC1	MC2 (if applicable)
Name server (DNS) internet address 1	Provide the dotted decimal address of the name server that the MC workstation will access (for example, **5.127.42.250**).		
Name server domain name 1	Provide the domain name of the name server (for example, **medina.xyz.it**).		
Name server (DNS) internet address 2 (Optional)	Provide the dotted decimal address of the second name server that this workstation can access (for example, **5.127.42.252**). **Tip:** You can specify a second name server when you configure a backup or secondary server for Copy Services.		
Name server domain name 2	If you have a second name server, provide the domain name of the second name server (for example, **medina2.xyz.it**).		
Routing settings Complete the following section if you want to specify a default gateway for routing. (See Note following this table)			
Gateway address	Confirm and record the dotted decimal or symbolic name address of the gateway (for example, **8.127.155.254** or **londongate**).		
Note: Bolded options in the MC1 and MC2 columns indicate default settings.			

TCP/IP address ranges

When you select a management console TCP/IP address, ensure that you do not create a TCP/IP address conflict between your network and the 2107/242x private network.

Use the following guidelines to prevent an address conflict:

- The management console TCP/IP address that you select must not be in the same address range as the address used by the 2107/242x private networks.
- The TCP/IP addresses used by the 2107/242x private networks must be outside the address ranges used by any network that the management console can reach.
- The 2107/242x private network has one default address range. If the default address range cannot be used because it conflicts with another network, you can instead specify one of three optional addresses ranges.
- The IBM service documentation can refer to the two private networks as "black" and "gray" regardless of which address range has been assigned.
- Table 57 and Table 58 can help you determine the 2107/242x private network address range that the IBM service representative sets during the install.

Use Table 57 to determine if the default address range can be used.

Table 57. Default TCP/IP address range determination

Question:	If the answer is no...	If the answer is yes...
Do any of your networks that will be reachable by the management console use either of these address ranges: • 172.16.0.0 to 172.16.255.255 (172.16.0.0/16) • 172.17.0.0 to 172.17.255.255 (172.17.0.0/16)	There is not a potential address conflict. The default 2107/242x private network address ranges can be used. In Table 56 on page 149, use the following instructions: 1. In the MC1 or MC2 column of the **TCP/IP interface address** row, as appropriate, enter the IP address for the management console. 2. In the MC1 or MC2 column of the **2107/242x private network address ranges** row, as appropriate, check Yes.	There might be an address conflict between your networks and the 2107/242x private networks. Your service representative must reconfigure the 2107/242x private networks to use one address range option from Table 58. 1. In Table 58, select only one address range option for the 2107/242x private network that will not create a potential address conflict. 2. In Table 56 on page 149, in the MC1 or MC2 column of the **2107/242x private networks address ranges** row, as appropriate, check the address range option that you selected from Table 58.

If the default address range cannot be used, use one of the optional TCP/IP address range options provided on Table 58.

Note: The options in the table are listed from most preferable (Option 1) to least preferable (Option 3).

Table 58. Optional 2107/242x private network address range options

Private network setting	2107/242x Private network (black)	2107/242x Private network (gray)
Option 1	10.235.158.0 to 10.235.159.255 (10.235.158.0/23)	10.236.158.0 to 10.236.159.255 (10.236.158.0/23)
Option 2	192.168.162.0 to 192.168.163.255 (192.168.162.0/23)	192.168.164.0 to 192.168.165.255 (192.168.164.0/23)
Option 3	9.15.132.0 to 9.15.133.255 (9.15.132.0/23)	9.16.132.0 to 9.16.133.255 (9.16.132.0/23)

Appendix D. Remote support work sheets

These work sheets allow you to specify the outbound (call home) and inbound (remote services) settings.

The remote support work sheets allow you to specify the settings to use for outbound and inbound remote support.

There are two remote support work sheets:
- Outbound (call home) work sheet
- Inbound (remote services) work sheet

Outbound (call home) work sheet

The outbound (call home) work sheet allows you to specify the settings for the IBM call home feature.

Setting up IBM call home allows the storage system to automatically request service from an IBM service representative when the system identifies a serviceable event.

The call home feature helps you quickly resolve serviceable events because it automatically reports hardware problems to IBM so that IBM service representatives can start looking into the problem without you having to alert them.

Tip: You must set up the call home feature if you participate in the Standby Capacity On Demand program.

Work sheet purpose

IBM service representatives use the information that is provided on the outbound (call home) work sheet to customize your storage system to use or disable the call home feature.

You must complete this work sheet for all installations that include a management console.

Work sheet and instructions

Notes:

1. Bold options in the MC1 and MC2 columns indicate default settings.
2. Management console is abbreviated as MC in the following table.

Table 59. Outbound (call home) work sheet

Item or Setting	Instructions	MC1	MC2 (if applicable)

Enable Call Home feature?	If you want IBM to enable the call home feature, check **Yes** and then check the modes to use for call home. (You can select both modes.) If you choose not to enable IBM call home, check **No**. If you select **No**, you have completed this work sheet.	[ ] **Yes**
		   Modes:
		   [ ] By modem
		   [ ] By VPN[1]
		[ ] No
			[ ] **Yes**
			   Modes:
			   [ ] By modem
			   [ ] By VPN[1]
			[ ] No

[1] Selecting **By VPN** means that you allow your MC to use VPN over an Internet connection when a connection is established to the IBM service center. The IBM VPN implementation is a client/server VPN. The two VPN endpoints are on the MC and on the IBM Boulder and Rochester VPN server. There is no need for additional VPN hardware in your network infrastructure.

If you use VPN, the MC must have access through your Internet firewall to the following servers:

- **IBM Boulder VPN server** (IP address 207.25.252.196)
- **IBM Rochester VPN server** (IP address 129.42.160.16)

If VPN connectivity is not an option, you can configure FTP to offload log and trace data faster.

You also must enable access to the following ports and protocols:

- Port 500 UDP
- Port 500 ESP
- Port 4500 UDP

For information about the IBM VPN implementation including technical details, access the following Web site:

http://www-1.ibm.com/support/docview.wss?rs=1114&uid=ssg1S1002693

Your IBM service representative can also provide you with additional information.

Modem settings

Complete the following section if you are enabling call home using a modem.

Even if your VPN is configured, a modem can serve as a backup. If the modem is configured, it allows IBM support personnel to remotely access the MC without having a person on-site to initiate a connection.

Item or Setting	Instructions	MC1	MC2 (if applicable)
Dialing mode used by modem	Check the box that indicates whether your local modem uses tone or pulse dialing.	[ ] **Tone** [ ] Pulse	[ ] **Tone** [ ] Pulse
Wait for dial tone?	If the MC modem waits for a dial tone before dialing a telephone number, check **Yes**. If the modem dials without checking for the dial tone, check **No**.	[ ] Yes [ ] No	[ ] Yes [ ] No

Table 59. Outbound (call home) work sheet (continued)

Item or Setting	Instructions	MC1	MC2 (if applicable)
Dial-out prefix	If the modem must dial a prefix to access an outside line, check **Prefixes** and provide the prefix numbers. If no prefix is necessary, check **N/A**.	[ ] Prefixes: _____ [ ] N/A	[ ] Prefixes: _____ [ ] N/A
Dumps and traces Complete the following section to specify how you want to send trace or dump files to the IBM service center.			
Delivery method for dumps and traces	Check **Use the call home setup** if you want the MC to use the call home settings for dump and trace call-home transmissions. Check **Use FTP** if you want to send dumps and traces directly to the IBM FTP data repository server. FTP is recommended if VPN connectivity is not provided. This offloads data faster if there is only a modem that is available for call home. (To use FTP, you must connect the MC to your LAN and provide a path to the Internet from the repository server.) If you check **Use the call home setup**, you have completed this work sheet.	[ ] **Use the call home setup** [ ] Use FTP	[ ] **Use the call home setup** [ ] Use FTP
Do you use an FTP firewall?	If you are using FTP to deliver dump and trace call-home transmissions, check **Yes** if your dump and trace files cross a firewall that filters FTP traffic. Check **No** if no FTP firewall filters the transmissions. If you check **Yes**, complete the remaining work sheet items. If you check **No**, you have completed this work sheet.	[ ] Yes [ ] No	[ ] Yes [ ] No

Table 59. Outbound (call home) work sheet (continued)

Item or Setting	Instructions	MC1	MC2 (if applicable)
FTP firewall settings Table 60 lists the types of FTP firewall that are supported by the management console. Review Table 60 to determine the type of FTP to use if you plan to send dumps and traces to the IBM service center and if the dumps and traces pass through an FTP firewall.			

Types of FTP firewalls

As an alternative to a VPN connection through the Internet, the management console (MC) can be set up to use the file transfer protocol (FTP) for sending error data to IBM. Table 60 lists the supported types of FTP firewalls.

Table 60. Types of FTP firewalls

Type	MC1	MC2 (if applicable)
1	Connect to the firewall host and log in with `USER user real host name`.	Connect to the firewall host and log in with `USER user real host name`.
2	Connect to the firewall host and log in with the following settings: • `USER fwuser` • `PASS fwpassword` • `USER user real host name`	Connect to the firewall host and log in with the following settings: • `USER fwuser` • `PASS fwpassword` • `USER user real host name`
3	Connect to and log in to the firewall hosts. Provide the following settings: SITE `real.host.name`, followed by the regular USER and PASS addresses.	Connect to and log in to the firewall host. Provide the following settings: SITE `real.host.name`, followed by the regular USER and PASS addresses.
4	Connect to and log in to the firewall host. Provide the following settings: OPEN `real.host.name`, followed by the regular USER and PASS addresses.	Connect to and log in to the firewall host. Provide the following settings: OPEN `real.host.name`, followed by the regular USER and PASS addresses.
5	Connect to the firewall host and log in with the following settings: • `USER user wuser@real.host.name` • `PASS pass fwpass`	Connect to the firewall host and log in with the following settings: • `USER user wuser@real.host.name` • `PASS pass fwpass`
6	Connect to the firewall host and log in with the following settings: • `USER fwuser real host name` • `PASS fwpass` • `USER user` • `PASS pass`	Connect to the firewall host and log in with the following settings: • `USER fwuser real host name` • `PASS fwpass` • `USER user` • `PASS pass`
7	Connect to the firewall host and log in with the following settings: • `USER user real host name fwuser` • `PASS pass` • `ACCT fwpass`	Connect to the firewall host and log in with the following settings: • `USER user real host name fwuser` • `PASS pass` • `ACCT fwpass`

Inbound (remote services) work sheet

The inbound (remote services) work sheet allows you to specify whether you want to allow unattended inbound remote services, and which settings to use if you allow unattended sessions.

If you choose not to allow unattended service sessions during the initial configuration and you later want to have your storage unit serviced remotely, you must make specific scheduling arrangements with IBM service representatives. You then can either configure the management console to allow unattended remote services temporarily (specifying a start and stop date) or appoint an on-site person to manually enable the inbound call from the service representative and to remain at the management console during the service session.

Work sheet purpose

IBM service representatives use the information on the inbound remote services work sheet to customize your storage system to allow or prohibit authorized IBM service representatives the ability to dial into your management console and launch unattended sessions to further analyze and resolve serviceable events.

Work sheet and instructions

You must complete Table 61 for all installations that include a management console.

Notes:

1. Bold options in the MC1 and MC2 columns indicate default settings.
2. Management console is abbreviated as MC in the following table.

Table 61. Inbound (remote services) work sheet

Item or Setting	Instructions	MC1	MC2 (if applicable)
Allow unattended remote sessions?	Check **Yes** if you want to allow authorized IBM service representatives to initiate unattended remote service sessions on your storage unit. Check **No** if you do not want to allow unattended remote services. If you check **No**, you have completed this work sheet.	[ ] **Yes** [ ] No	[ ] **Yes** [ ] No
Unattended remote session settings			
Complete the following section if you selected **Yes** above (to allow unattended remote sessions).			

Table 61. Inbound (remote services) work sheet (continued)

Item or Setting	Instructions	MC1	MC2 (if applicable)
Remote service mode	Check the mode that indicates when to allow unattended sessions. Select **Always on** to enable inbound remote service at any time. Select **Automatic** to allow inbound calls for a specified number of days following a failure on the storage complex.	[ ] **Always on** [ ] Automatic	[ ] **Always on** [ ] Automatic
Number of days for Automatic mode	If you selected the **Automatic** mode, specify the number of days to allow an unattended service session after any failure on the storage complex.		

Appendix E. Notification work sheets

These work sheets allow you to specify how you will be notified about serviceable events.

The notification work sheets allow you to specify the settings to use when you want the storage system to notify you or other people in our organization when you have serviceable events.

There are two notification work sheets:
- SNMP trap notification work sheet
- E-mail notification work sheet

SNMP trap notification work sheet

This work sheet allows you to specify the setting for SNMP trap notifications.

The SNMP trap notification work sheet allows you to indicate whether you want to receive Simple Network Management Protocol (SNMP) trap notifications when a management console encounters serviceable events.

Note: Remote copy status reporting for Copy Services requires SNMP for open-systems hosts.

Work sheet purpose

IBM service representatives use the information on the SNMP trap notification work sheet to customize your storage system for SNMP trap notifications.

Work sheet and instructions

You must complete Table 62 for all installations that include a management console.

Notes:

1. Bolded options in the MC1 and MC2 columns indicate default settings.
2. Management console is abbreviated as MC for the following table.

Table 62. SNMP trap notification work sheet

Item or Setting	Instructions	MC1	MC2 (if applicable)
Enable SNMP trap notifications?	Check **Yes** to allow the storage unit to generate and send SNMP trap notifications when the system encounters problems. Check **No** if you do not want the storage unit to send SNMP trap notifications. If you check **No**, you have completed this work sheet.	_ Yes _ No	_ Yes _ No

Table 62. SNMP trap notification work sheet (continued)

Item or Setting	Instructions	MC1	MC2 (if applicable)
SNMP trap notification settings: Complete the following section if you checked **Yes** to enable SNMP trap notifications. Do not use the IP address that is shown in the example in this work sheet. The IP address is only an example and does not function. Your IBM service representative can provide the correct IP address.			
SNMP trap destinations	Provide the dotted decimal addresses of the destinations that are to receive SNMP traps (for example, **9.127.152.254**).		

E-mail notification work sheet

This work sheet allows you to specify the setting for e-mail notifications.

The e-mail notification work sheet allows you to specify whether you want to receive e-mail notifications when a management console encounters serviceable events.

Restriction: To receive e-mail notifications, the management console must be connected to your LAN.

Work sheet purpose

IBM service representatives use the information on this work sheet to customize your storage system for e-mail notifications. If you choose to use e-mail notifications, the notification settings are customized so that the specified people in your organization receive e-mails when there is general or error information to send about the storage complex.

Work sheet and instructions

You must complete Table 63 for all installations that include a management console.

Notes:

1. Bold options in the MC1 and MC2 columns indicate default settings.
2. Management console is abbreviated as MC in the following table.

Table 63. E-mail notification work sheet

Item or Setting	Instructions	MC1	MC2 (if applicable)
Enable e-mail notifications?	Check **Yes** to allow the MC to generate and send e-mails when the system encounters problems. Check **No** if you do not want the MC to send e-mail notifications. If you check **No**, you have completed this work sheet.	_ Yes _ No	_ Yes _ No

Table 63. E-mail notification work sheet (continued)

Item or Setting	Instructions	MC1	MC2 (if applicable)
E-mail notification settings Complete the following section if you previously checked **Yes** (to enable e-mail notifications).			
Host name or network address of smart relay host (Optional)	To use a smart relay host, provide the host name or network address for the smart relay host. **Tip:** You can enable a smart relay host if either: • Your e-mail is sent from a UNIX-based system on which you have specified a mail relay or mail gateway, or • You have installed a message-transfer agent on your mail server.		
E-mail destinations	Provide the full e-mail addresses where you want to receive the notifications (for example, **maria@host.com**). Check the notification setting that indicates the type of notifications to send to the e-mail address. This work sheet provides spaces for three e-mail addresses, but you can specify more, if necessary.	1. E-mail address: _____ Notifications: _ Only call home problem events _ All problem events 2. E-mail address: _____ Notifications: _ Only call home problem events _ All problem events 3. E-mail address: _____ Notifications: _ Only call home problem events _ All problem events	1. E-mail address: _____ Notifications: _ Only call home problem events _ All problem events 2. E-mail address: _____ Notifications: _ Only call home problem events _ All problem events 3. E-mail address: _____ Notifications: _ Only call home problem events _ All problem events

Appendix F. Power control work sheet

The power control work sheet allows you to specify the power mode for your DS8000 storage unit.

You can choose to:

- Use attached zSeries machines to power on and power off the storage unit. (This option is available only if you have the remote zSeries power control feature installed.)
- Automatically power on and power off the storage unit.
- Use a specified schedule to power on and power off the storage unit.
- Manually power on and power off the storage unit. Use the Power on/off page in the DS Storage Manager.

Work sheet purpose

IBM service representatives use the information on the power control work sheet to customize the power mode for your storage unit.

Work sheet and instructions

You must complete Table 64 for all installations.

Note: Bold options in the "Your information" column indicate default settings.

Table 64. Power control work sheet

Item or Setting	Instructions	Your information
Enable remote zSeries power control?	If you will use the remote zSeries power control feature, check **Yes**. If you check **Yes**, the zSeries power mode will be used and this will enable up to four zSeries machines to control the power on and power off sequences. If you check **Yes**, you have completed this work sheet. Check **No** if you choose not to use the remote zSeries power control feature. If you check **No**, you must complete the rest of this work sheet.	_ Yes _ No
Disabled remote zSeries power control Complete the following section if you checked **No** above (to not use the remote zSeries power control).		

Table 64. Power control work sheet (continued)

Item or Setting	Instructions	Your information
Power mode	Check **Automatic** if you want the storage unit to power on automatically whenever external power is restored, if the unit was originally on. (The **Automatic** power mode automatically powers on the unit when, for example, power is restored after a power outage.) Check **Scheduled** if you want the storage unit to power on and off according to a specified scheduled. Check **Scheduled automatic** to schedule the power on and power off of your storage unit and enable the unit to automatically power on if power is restored during the time that the unit is scheduled to be on. Check **Manual** if you want to manually power on and power off your unit. You can use the Power on/off page in the DS Storage Manager.	_ **Automatic** _ Scheduled (not automatic) _ Scheduled automatic _ Manual
Schedule If you selected one of the scheduled power modes, **Scheduled** or **Scheduled automatic**, specify the power on and power off schedule below.		
Schedule	Check the option that indicates whether the storage unit will use the same power on and power off schedule every day or whether the schedule will vary by day. Specify the on and off times for the unit in the appropriate section.	_ Same schedule all days: On _____ Off _____ _ Varying schedule: Monday: On _____ Off _____ Tuesday: On _____ Off _____ Wednesday: On _____ Off _____ Thursday: On _____ Off _____ Friday: On _____ Off _____ Saturday: On _____ Off _____ Sunday: On _____ Off _____

Appendix G. Control switch settings work sheet

Complete the control switch settings work sheet to indicate whether the particular option should be enabled or disabled. Your DS8000 may include two or more storage images; consequently, you many need to indicate your individual choice for each.

AS/400 LUN Serial Suffix number settings

This optional control switch setting is used when you attach a second DS8000 to an AS/400 or iSeries host with the same three-character suffix as the first DS8000. Changing a DS8000 serial number also changes the current LUN serial number, which uses the last three digits of an ESS serial number.

Work sheet instructions

Enter a three-digit number as a new serial number base for the DS8000.

Fibre LUN Access number settings

This control switch on the DS8000 determines whether hosts have access to all LUNs over fibre channels or whether access is restricted. Restricted access is based on the worldwide ID (WWID) of the adapter port in the host system. Access also depends on the logical configuration that is defined for that host port WWID.

Work sheet instructions

Check one of the two switch settings:

Check **Restricted** if you want to limit access to LUNs to those hosts that you define in the interface. Restricted is the default setting.

Check **Any** if all hosts are to have access to all LUNs.

Control-unit Initiated Reconfiguration settings

For zSeries and S/390 environments, complete the control-unit initiated reconfiguration (CUIR) setting work sheet to indicate whether subsystems will be enabled or disabled. The host systems would be affected during host adapter repair or I/O enclosure repair.

Work sheet instructions

Use Table 65 to enter the appropriate response into the Your information column.

Table 65. Control switch settings work sheet

Control Switch Setting	Default	Your information
AS/400 LUN Serial Suffix number	0 (Off)	_____ Enter the last three digits of the new DS8000 serial number
Fibre LUN Access Control	0 (Off)	[ ] Restricted [ ] Any

Table 65. Control switch settings work sheet (continued)

Control Switch Setting	Default	Your information
CUIR support	0 (Disable)	[ ] Enable [ ] Disable

Accessibility

Accessibility features provide users who have disabilities with the ability to successfully access information and use technology.

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

Features

These are the major accessibility features in the IBM System Storage DS8000 information:

- You can use screen-reader software and a digital speech synthesizer to hear what is displayed on the screen. IBM Home Page Reader version 3.0 has been tested.
- You can operate features using the keyboard instead of the mouse.

Navigating by keyboard

You can use keys or key combinations to perform operations and initiate menu actions that can also be done through mouse actions. You can navigate the IBM System Storage DS8000 information from the keyboard by using the shortcut keys for your browser or Home Page Reader. See your browser Help for a list of shortcut keys that it supports. See the following Web site for a list of shortcut keys supported by Home Page Reader: http://www-306.ibm.com/able/solution_offerings/keyshort.html

Accessing the publications

You can find HTML versions of the IBM System Storage DS8000 information at the following Web site: http://www.ehone.ibm.com/public/applications/publications/cgibin/pbi.cgi

You can access the information using IBM Home Page Reader 3.0.

Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law: INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATIONS "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurement may have been

171

estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

All statements regarding IBM's future direction or intent are subject to change or withdrawal without notice, and represent goals and objectives only.

This information is for planning purposes only. The information herein is subject to change before the products described become available.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

Terms and conditions

Permissions for the use of these publications is granted subject to the following terms and conditions.

Personal Use: You may reproduce these Publications for your personal, non commercial use provided that all proprietary notices are preserved. You may not distribute, display or make derivative work of these Publications, or any portion thereof, without the express consent of IBM.

Commercial Use: You may reproduce, distribute and display these Publications solely within your enterprise provided that all proprietary notices are preserved. You may not make derivative works of these Publications, or reproduce, distribute or display these Publications or any portion thereof outside your enterprise, without the express consent of IBM.

Except as expressly granted in this permission, no other permissions, licenses or rights are granted, either express or implied, to the Publications or any information, data, software or other intellectual property contained therein.

IBM reserves the right to withdraw the permissions granted herein whenever, in its discretion, the use of the Publications is detrimental to its interest or, as determined by IBM, the above instructions are not being properly followed.

You may not download, export or re-export this information except in full compliance with all applicable laws and regulations, including all United States export laws and regulations.

IBM MAKES NO GUARANTEE ABOUT THE CONTENT OF THESE PUBLICATIONS. THE PUBLICATIONS ARE PROVIDED "AS-IS" AND WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Trademarks

The following terms are trademarks of the International Business Machines Corporation in the United States, other countries, or both:

- AIX
- DB2
- DFSMS/MVS
- DFSMS/VM
- DS4000
- DS6000
- DS8000
- e (logo)
- Enterprise Storage Server
- ES/9000
- ESCON
- FICON
- FlashCopy
- Graphically Dispersed Parallel Sysplex
- HACMP
- i5/OS
- IBM
- IntelliStation
- MVS/ESA
- Netfinity
- NetVista
- Operating System/400
- OS/400
- RS/6000
- S/390
- Seascape
- SNAP/SHOT
- SP
- System/390
- System p5
- System Storage
- Versatile Storage Server
- Virtualization Engine
- VSE/ESA
- z/Architecture
- z/OS
- z/VM
- zSeries

Java and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

Microsoft, Windows, and Windows NT are trademarks of Microsoft Corporation in the United States, other countries, or both.

Intel, Intel logo, Intel Inside, Intel Inside logo, Intel Centrino, Intel Centrino logo, Celeron, Intel Xeon, Intel SpeedStep, Itanium, and Pentium are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, and service names may be trademarks or service marks of others.

Electronic emission notices

This section contains the electronic emission notices or statements for the United States and other countries.

Federal Communications Commission (FCC) statement

This equipment has been tested and complies with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors, or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the users authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device might not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

Industry Canada compliance statement

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conform à la norme NMB-003 du Canada.

European community compliance statement

This product is in conformity with the protection requirements of EC Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any

failure to satisfy the protection requirements resulting from a nonrecommended modification of the product, including the fitting of non-IBM option cards.

Germany only

Zulassungsbescheinigung laut Gesetz ueber die elektromagnetische Vertraeglichkeit von Geraeten (EMVG) vom 30. August 1995.

Dieses Geraet ist berechtigt, in Uebereinstimmung mit dem deutschen EMVG das EG-Konformitaetszeichen - CE - zu fuehren.

Der Aussteller der Konformitaetserklaeung ist die IBM Deutschland.

Informationen in Hinsicht EMVG Paragraph 3 Abs. (2) 2:

```
Das Geraet erfuellt die Schutzanforderungen nach EN 50082-1 und
EN 55022 Klasse A.
```

EN 55022 Klasse A Geraete beduerfen folgender Hinweise:

Nach dem EMVG:

```
"Geraete duerfen an Orten, fuer die sie nicht ausreichend entstoert
sind, nur mit besonderer Genehmigung des Bundesministeriums
fuer Post und Telekommunikation oder des Bundesamtes fuer Post und
Telekommunikation
betrieben werden. Die Genehmigung wird erteilt, wenn keine
elektromagnetischen Stoerungen zu erwarten sind." (Auszug aus dem
EMVG, Paragraph 3, Abs.4)
```

```
Dieses Genehmigungsverfahren ist nach Paragraph 9 EMVG in Verbindung
mit der entsprechenden Kostenverordnung (Amtsblatt 14/93)
kostenpflichtig.
```

Nach der EN 55022:

```
"Dies ist eine Einrichtung der Klasse A. Diese Einrichtung kann im
Wohnbereich Funkstoerungen verursachen; in diesem Fall kann vom
Betreiber verlangt werden, angemessene Massnahmen durchzufuehren
und dafuer aufzukommen."
```

Anmerkung:

```
Um die Einhaltung des EMVG sicherzustellen, sind die Geraete wie in den
Handbuechern angegeben zu installieren und zu betreiben.
```

Japanese Voluntary Control Council for Interference (VCCI) class A statement

　この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

Korean Ministry of Information and Communication (MIC) statement

Please note that this device has been certified for business use with regard to electromagnetic interference. If you find this is not suitable for your use, you may exchange it for one of residential use.

Taiwan class A compliance statement

警告使用者:
這是甲類的資訊產品，在居住的環境中使用
時，可能會造成射頻干擾，在這種情況下，
使用者會被要求採取某些適當的對策。 VS07171L

Taiwan Contact Information

This topic contains the product service contact information for Taiwan.

```
IBM Taiwan Product Service Contact Information:
IBM Taiwan Corporation
3F, No 7, Song Ren Rd., Taipei Taiwan
Tel: 0800-016-888
```

台灣IBM 產品服務聯絡方式：
台灣國際商業機器股份有限公司
台北市松仁路7號3樓
電話：0800-016-888

f2c00790

Glossary

This glossary includes terms for the IBM System Storage and other Resiliency Family products.

This glossary includes selected terms and definitions from:

- The *American National Standard Dictionary for Information Systems*, ANSI X3.172–1990, copyright 1990 by the American National Standards Institute (ANSI), 11 West 42nd Street, New York, New York 10036. Definitions derived from this book have the symbol (A) after the definition.
- *IBM Terminology*, which is available online at the following Web site: http://www-306.ibm.com/ibm/terminology/index.html. Definitions derived from this source have the symbol (GC) after the definition.
- The *Information Technology Vocabulary* developed by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions derived from this book have the symbol (I) after the definition. Definitions taken from draft international standards, committee drafts, and working papers that the ISO/IEC JTC1/SC1 is developing have the symbol (T) after the definition, indicating that final agreement has not been reached among the participating National Bodies of SC1.

This glossary uses the following cross-reference forms:

See Refers the reader to one of two kinds of related information:
- A term that is the expanded form of an abbreviation or acronym. This expanded form of the term contains the full definition.
- A synonym or more preferred term

See also
Refers the reader to one or more related terms.

Contrast with
Refers the reader to a term that has an opposite or substantively different meaning.

Numerics

750 A model of the Enterprise Storage Server featuring a 2-way processor with limited physical storage capacity. This model can be updated to the model 800.

800 A model of the Enterprise Storage Server featuring a standard processor or an optional Turbo processor. The Model 800 supports RAID 5, RAID 10, and 15000 rpm drives. Model 800 supersedes Model F20.

1750 The machine type for the IBM System Storage DS6000 series. Models for the DS6000 include the 511 and EX1.

2105 The machine number for the IBM TotalStorage Enterprise Storage Server. Models of the Enterprise Storage Server are expressed as the number 2105 followed by "Model <*xxx*>", such as 2105 Model 800. The 2105 Model 100 is an Enterprise Storage Server expansion enclosure that is typically referred to simply as the Model 100.

2107 A hardware machine type for the IBM System Storage DS8000 series. Hardware models for the 2107 include base units 921, 922, 931, 932, 9A2, 9B2 and expansion units 92E and 9AE.

2244 A function authorization machine type for the IBM System Storage DS8000 series. The 2244 function authorization machine type corresponds with the 2107 hardware machine type and is used only for purposes of billing and authorizing the licensed functions on the 2107. Function authorization models for the 2244 are related to the type of licensed functions that you order. For example, Model RMC is for the remote mirror and copy function on a 2107 storage unit.

239x Function authorization machine types for the IBM System Storage DS8000 series. These machine types indicate the

177

warranty period for the licensed functions and they include the following machine types: 2396 (one-year warranty), 2397 (two-year warranty), 2398 (3-year warranty), and 2399 (four-year warranty). Each 239x function authorization machine type corresponds to the 242x hardware machine type that represents the same warranty period. For example, you order a 2398 (3-year warranty) function authorization machine type for a 2423 (3-year warranty) hardware machine. The 239x machine types are used only for purposes of billing and authorizing the licensed functions on the 242x machines. The 239x machine types have one model (Model LFA) with several types of available licenses for that model. For example, Model LFA, RMC license is for the remote mirror and copy function on a 242x storage unit.

242x Hardware machine types for the IBM System Storage DS8000 series. The 242x hardware machine types include machine types 2421 (one-year warranty), 2422 (two-year warranty), 2423 (3-year warranty), and 2424 (four-year warranty). Hardware models for the 242x machine types include base units 931, 932, 9B2 and expansion units 92E and 9AE.

3390 The machine number of an IBM disk storage system. The Enterprise Storage Server, when interfaced to IBM zSeries hosts, is set up to appear as one or more 3390 devices, with a choice of 3390-2, 3390-3, or 3390-9 track formats.

3990 The machine number of an IBM control unit.

7133 The machine number of an IBM disk storage system. The Model D40 and 020 drawers of the 7133 can be installed in the 2105-100 expansion enclosure of the ESS.

A

access 1) To obtain computing services or data.

2) In computer security, a specific type of interaction between a subject and an object that results in flow of information from one to the other.

access-any mode
One of the two access modes that can be set for the storage unit during initial

configuration. It enables all fibre-channel-attached host systems with no defined access profile to access all logical volumes on the storage unit. With a profile defined in DS Storage Manager for a particular host, that host has access only to volumes that are assigned to the WWPN for that host. See also *pseudo host* and *worldwide port name*.

ACK See *request for acknowledgment and acknowledgment*.

agent A program that automatically performs some service without user intervention or on a regular schedule. See also *subagent*.

alert A message or log that a storage unit generates as the result of error event collection and analysis. An alert indicates that a service action is required.

allegiance
For zSeries, a relationship that is created between a device and one or more channel paths during the processing of certain conditions. See also *implicit allegiance*, *contingent allegiance*, and *reserved allegiance*.

allocated storage
The space that is allocated to volumes but not yet assigned. Contrast with *assigned storage*.

American National Standards Institute (ANSI)
An organization of producers, consumers, and general interest groups that establishes the procedures by which accredited organizations create and maintain voluntary industry standards in the United States. (A)

anonymous
In the DS Storage Manager, the label on an icon that represents all connections that are using fibre-channel adapters between the storage unit and hosts but are not completely defined to the storage unit. See also *anonymous host*, *pseudo host*, and *access-any mode*.

anonymous host
Synonym for *pseudo host*. Contrast with *anonymous* and *pseudo host*.

ANSI See *American National Standards Institute*.

APAR See *authorized program analysis report*. (GC)

API See *application programming interface*.

application programming interface
An interface that allows an application program that is written in a high-level language to use specific data or functions of the operating system or another program.

arbitrated loop
A fibre-channel topology that enables the interconnection of a set of nodes. See also *point-to-point connection* and *switched fabric*.

array An ordered collection, or group, of physical devices (disk drive modules) that is used to define logical volumes or devices. In the storage unit, an array is a group of disks that the user designates to be managed by the RAID technique. See also *redundant array of independent disks*.

ASCII (American National Standard Code for Information Interchange) The standard code, using a coded character set consisting of 7-bit coded characters (8 bits including parity check), that is used for information interchange among data processing systems, data communication systems, and associated equipment. The ASCII set consists of control characters and graphic characters. (A) Some organizations, including IBM, have used the parity bit to expand the basic code set.

assigned storage
The space that is allocated to a volume and that is assigned to a port.

authorized program analysis report (APAR)
A request for correction of a defect in a current release of an IBM-supplied program. (GC)

availability
The degree to which a system or resource is capable of performing its normal function. See *data availability*.

B

bay The physical space that is used for installing SCSI, ESCON, and fibre-channel host adapter cards. The DS8000 has four bays, two in each cluster. See also *service boundary*.

bit The smallest unit of computer information, which has two possible states that are represented by the binary digits 0 or 1. See also *byte*.

block A string of data elements recorded or transmitted as a unit. The elements may be characters, words, or physical records. (GC)

A group of consecutive bytes used as the basic storage unit in fixed-block architecture (FBA). All blocks on the storage device are the same size (fixed size). See also *fixed-block architecture* and *data record*.

byte A string that represents a character and usually consists of eight binary digits that are treated as a unit. A byte is the smallest unit of storage that can be addressed directly. (GC) See also *bit*.

C

cache A special-purpose buffer storage, smaller and faster than main storage, used to hold a copy of instructions and data obtained from main storage and likely to be needed next by the processor. (GC)

cache fast write
A form of the fast-write operation in which the storage server writes the data directly to cache, where it is available for later destaging.

cache hit
An event that occurs when a read operation is sent to the cluster, and the requested data is found in cache. Contrast with *cache miss*.

cache memory
Memory, typically volatile memory, that a storage server uses to improve access times to instructions or data. The cache memory is typically smaller and faster than the primary memory or storage medium. In addition to residing in cache memory, the same data also resides on the storage devices in the storage unit.

cache miss
An event that occurs when a read operation is sent to the cluster, but the data is not found in cache. Contrast with *cache hit*.

call home
A communication link established between the storage product and a service provider. The storage product can use this link to place a call to IBM or to another service provider when it requires service.

With access to the machine, service personnel can perform service tasks, such as viewing error logs and problem logs or initiating trace and dump retrievals. (GC) See also *heartbeat* and *remote technical assistance information network*.

cascading
1) Connecting network controllers to each other in a succession of levels to concentrate many more lines than a single level permits.

2) In high-availability cluster multiprocessing (HACMP), pertaining to a cluster configuration in which the cluster node with the highest priority for a particular resource acquires the resource if the primary node fails. The cluster node relinquishes the resource to the primary node upon reintegration of the primary node into the cluster.

catcher
A server that service personnel use to collect and retain status data that an DS8000 sends to it.

CCR See *channel command retry*.

CCW See *channel command word*.

CD See *compact disc*.

central electronics complex
The set of hardware facilities that are associated with a host computer.

channel
The part of a channel subsystem that manages a single I/O interface between a channel subsystem and a set of control units.

channel command retry (CCR)
The protocol used between a channel and a control unit that enables the control unit to request that the channel reissue the current command.

channel command word (CCW)
A data structure that specifies an I/O operation to the channel subsystem.

channel path
The interconnection between a channel and its associated control units.

channel subsystem
The part of a host computer that manages I/O communication between the program and any attached control units.

channel-subsystem image
In mainframe computing, the logical functions that a system requires to perform the function of a channel subsystem. With ESCON multiple image facility (EMIF), one channel subsystem image exists in the channel subsystem for each logical partition (LPAR). Each image appears to be an independent channel subsystem program, but all images share a common set of hardware facilities. (GC)

CKD See *count key data*.

CLI See *command-line interface*. See also *Copy Services command-line interface*.

cluster
1) A partition capable of performing all DS8000 functions. With two clusters in the DS8000, any operational cluster can take over the processing of a failing cluster.

cluster processor complex
The unit within a cluster that provides the management function for the DS8000. It consists of cluster processors, cluster memory, and related logic.

command-line interface (CLI)
An interface that defines a set of commands and enables a user (or a script-like language) to issue these commands by typing text in response to the command prompt (for example, DOS commands or UNIX shell commands). See also *Copy Services command-line interface*.

compact disc
An optically read disc, typically storing approximately 660 MB. CD-ROM (compact disc read-only memory) refers to the read-only format used to distribute DS8000 code and documentation.

compression
1) The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks.

2) Any encoding that reduces the number of bits used to represent a given message or record. (GC)

concurrent copy
A facility on a storage server that enables a program to make a backup of a data set while the logical volume remains available for subsequent processing. The

data in the backup copy is frozen at the point in time that the server responds to the request.

concurrent installation of licensed internal code
Process of installing licensed internal code on a DS8000 while applications continue to run.

concurrent maintenance
Service that is performed on a unit while it is operational.

concurrent media maintenance
Service performed on a disk drive module (DDM) without losing access to the data.

configure
In storage, to define the logical and physical devices, optional features, and program products of the input/output subsystem through the user interface that the storage unit provides for this function.

consistency group
A group of volumes participating in FlashCopy relationships in a logical subsystem, across logical subsystems, or across multiple storage units that must be kept in a consistent state to ensure data integrity.

consistency group interval time
The value in seconds that indicates the length of time between the formation of consistency groups.

consistent copy
A copy of a data entity (a logical volume, for example) that contains the contents of the entire data entity at a single instant in time.

console
A user interface to a server, for example, the interface provided on a personal computer. See also *IBM System Storage Management Console*.

contingent allegiance
In mainframe computing, a relationship that is created in a control unit between a device and a channel when the channel accepts unit-check status. The allegiance causes the control unit to guarantee access; the control unit does not present the busy status to the device. The allegiance enables the channel to retrieve sense data that is associated with the unit-check status on the channel path associated with the allegiance. (GC)

control path
The route that is established from the master storage unit to the subordinate storage unit when more than one storage unit participates in a Global Mirror session. If there is only one storage unit (the master) in the Global Mirror session, no control path is required.

control unit (CU)
1) A device that coordinates and controls the operation of one or more input/output devices, and synchronizes the operation of such devices with the operation of the system as a whole.

2) For zSeries, a storage server with ESCON or OEMI interfaces. The control unit adapts a native device interface to an I/O interface that a zSeries host system supports.

3) The portion of the storage unit that supports the attachment of emulated count key data devices over ESCON, FICON, or OEMI interfaces. See also *cluster*.

control-unit image
In mainframe computing, a logical subsystem that is accessed through an ESCON I/O interface. One or more control-unit images exist in each control unit. Each image appears as an independent control unit, but all control-unit images share a common set of hardware facilities. The DS8000 can emulate 3990-3, TPF, 3990-6, or 2105 control units.

control-unit-initiated reconfiguration (CUIR)
A software mechanism that the DS8000 uses to request that an operating system of a zSeries host verify that one or more subsystem resources can be taken offline for service. The DS8000 can use this process to automatically vary channel paths offline and online to facilitate bay service or concurrent code installation. Depending on the operating system, support for this process might be model dependent, might depend on the IBM TotalStorage Enterprise Storage Server Subsystem Device Driver, or might not exist.

Coordinated Universal Time (UTC)
The international standard of time that is kept by atomic clocks around the world.

Copy Services
A collection of optional software features, with a Web-browser interface, used for configuring, managing, and monitoring data-copy functions.

Copy Services CLI
See *Copy Services command-line interface*.

Copy Services domain
See *Copy Services server group*.

Copy Services client
Software that runs on each DS8000 cluster in the Copy Services server group and that performs the following functions:

- Communicates configuration, status and connectivity information to the Copy Services server
- Performs data-copy functions on behalf of the Copy Services server

Copy Services command-line interface (Copy Services CLI)
The command-line interface software that is provided with DS8000 Copy Services and used for invoking Copy Services functions from host systems attached to the DS8000. See also *command-line interface*.

Copy Services server
A cluster that the Copy Services administrator designates to perform the DS8000 Copy Services functions.

Copy Services server group
A collection of user-designated DS8000 clusters participating in Copy Services functions that a designated, active, Copy Services server manages. A Copy Services server group is also called a Copy Services domain. See also *domain*.

count field
The first field of a count key data (CKD) record. This eight-byte field contains a four-byte track address (CCHH). It defines the cylinder and head that are associated with the track, and a one-byte record number (R) that identifies the record on the track. It defines a one-byte key length that specifies the length of the record's key field (0 means no key field). It defines a two-byte data length that

specifies the length of the record's data field (0 means no data field). Only the end-of-file record has a data length of zero.

count key data (CKD)
In mainframe computing, a data-record format employing self-defining record formats in which each record is represented by up to three fields: a *count* field that identifies the record and specifies its format, an optional *key* field that identifies the data area contents, and an optional *data* field that typically contains the user data. For CKD records on the storage unit, the logical volume size is defined in terms of the device emulation mode (3390 or 3380 track format). The count field is always 8 bytes long and contains the lengths of the key and data fields, the key field has a length of 0 to 255 bytes, and the data field has a length of 0 to 65 535 or the maximum that will fit on the track. See also *data record*.

CPC   See *cluster processor complex*.

CRC   See *cyclic redundancy check*.

CU   See *control unit*.

CUIR   See *control-unit initiated reconfiguration*.

custom volume
A volume in count-key-data (CKD) format that is not a standard volume, which means that it does not necessarily present the same number of cylinders and capacity to its assigned logical control unit as provided by one of the following standard zSeries volume types: 3390-2, 3390-3, 3390-9, 3390-2 (3380-track mode), or 3390-3 (3380-track mode). See also *count-key-data, interleave, standard volume,* and *volume*.

CUT   See *Coordinated Universal Time*.

cyclic redundancy check (CRC)
A redundancy check in which the check key is generated by a cyclic algorithm. (T)

cylinder
A unit of storage on a CKD device with a fixed number of tracks.

D

DA   See *device adapter*.

daisy chain

See *serial connection*.

DASD

See *direct access storage device*.

DASD fast write (DFW)

A function of a storage server in which active write data is stored in nonvolatile cache, thus avoiding exposure to data loss.

data availability

The degree to which data is available when needed, typically measured as a percentage of time that the system would be capable of responding to any data request (for example, 99.999% available).

data compression

A technique or algorithm used to encode data such that the encoded result can be stored in less space than the original data. The original data can be recovered from the encoded result through a reverse technique or reverse algorithm. See also *compression*.

Data Facility Storage Management Subsystem (DFSMS)

An operating environment that helps automate and centralize the management of storage. To manage storage, DFSMS provides the storage administrator with control over data class, storage class, management class, storage group, and automatic class selection routine definitions.

data field

The optional third field of a count key data (CKD) record. The count field specifies the length of the data field. The data field contains data that the program writes.

data record

The basic unit of zSeries storage on a DS8000, also known as a count-key-data (CKD) record. Data records are stored on a track. The records are sequentially numbered starting with 0. The first record, R0, is typically called the track descriptor record and contains data that the operating system normally uses to manage the track. See also *count-key-data* and *fixed-block architecture*.

data set FlashCopy

For zSeries hosts, a feature of FlashCopy

that indicates how many partial volume FlashCopy relationships are active on a volume.

data sharing

The ability of multiple host systems to concurrently utilize data that they store on one or more storage devices. The storage unit enables configured storage to be accessible to any, or all, attached host systems. To use this capability, the host program must be designed to support data that it is sharing.

DDM See *disk drive module*.

DDM group

See *disk pack*.

dedicated storage

Storage within a storage unit that is configured such that a single host system has exclusive access to the storage.

demote

To remove a logical data unit from cache memory. A storage server demotes a data unit to make room for other logical data units in the cache or because the logical data unit is not valid. The storage unit must destage logical data units with active write units before they can be demoted. See also *destage*.

destage

To move data from an online or higher priority to an offline or lower priority device. The storage unit stages incoming data into cache and then destages it to disk.

device For zSeries, a disk drive.

device adapter (DA)

A physical component of the DS8000 that provides communication between the clusters and the storage devices. The DS8000 has eight device adapters that it deploys in pairs, one from each cluster. Device adapter pairing enables the DS8000 to access any disk drive from either of two paths, providing fault tolerance and enhanced availability.

device address

For zSeries, the field of an ESCON device-level frame that selects a specific device on a control-unit image.

device ID
The unique two-digit hexadecimal number that identifies the logical device.

device interface card
A physical subunit of a storage cluster that provides the communication with the attached device drive modules.

device number
For zSeries, a four-hexadecimal-character identifier, for example 13A0, that the systems administrator associates with a device to facilitate communication between the program and the host operator. The device number is associated with a subchannel.

device sparing
A subsystem function that automatically copies data from a failing device drive module to a spare device drive module. The subsystem maintains data access during the process.

DFS See *distributed file service*.

DFSMS
See *Data Facility Storage Management Subsystem*.

direct access storage device (DASD)
1) A mass storage medium on which a computer stores data.

2) A disk device.

disk cage
A container for disk drives. Each disk cage supports eight disk packs (64 disks).

disk drive
Standard term for a disk-based nonvolatile storage medium. The DS8000 uses hard disk drives as the primary nonvolatile storage media to store host data.

disk drive module (DDM)
A field replaceable unit that consists of a single disk drive and its associated packaging.

disk drive module group
See *disk pack*.

disk drive set
A specific number of identical disk drives that have the same physical capacity and rpm.

disk pack
A group of disk drive modules (DDMs) installed as a unit in a DDM bay.

disk group
A collection of 4 disk drives that are connected to the same pair of IBM Serial Storage adapters and can be used to create a RAID array. A disk group can be formatted as count key data or fixed block, and as RAID or non-RAID, or it can be left unformatted. A disk group is a logical assemblage of disk drives. Contrast with *disk pack*.

distributed file service (DFS)
A service that provides data access over IP networks.

DNS See *domain name system*.

domain
1) That part of a computer network in which the data processing resources are under common control.

2) In TCP/IP, the naming system used in hierarchical networks.

3) A Copy Services server group, in other words, the set of clusters the user designates to be managed by a particular Copy Services server.

domain name system (DNS)
In TCP/IP, the server program that supplies name-to-address translation by mapping domain names to internet addresses. The address of a DNS server is the internet address of the server that hosts the DNS software for the network.

dotted decimal notation
A convention used to identify IP addresses. The notation consists of four 8-bit numbers written in base 10. For example, `9.113.76.250` is an IP address that contains the octets 9, 113, 76, and 250.

drawer
A unit that contains multiple device drive modules and provides power, cooling, and related interconnection logic to make the device drive modules accessible to attached host systems.

drive 1) A peripheral device, especially one that has addressed storage media. See also *disk drive module*.

2) The mechanism used to seek, read, and write information on a storage medium.

DS8000
See *IBM System Storage DS8000*.

DS8000 Batch Configuration tool
A program that automatically configures a DS8000. The configuration is based on data that IBM service personnel enter into the program.

DS Storage Manager
See *IBM System Storage DS Storage Manager*.

duplex
1) Regarding Copy Services, the state of a volume pair after Remote Mirror and Copy has completed the copy operation and the volume pair is synchronized.

2) In general, pertaining to a communication mode in which data can be sent and received at the same time.

dynamic sparing
The ability of a storage server to move data from a failing disk drive module (DDM) to a spare DDM while maintaining storage functions.

E

E10
The predecessor of the F10 model of the Enterprise Storage Server. See also *F10*.

E20
The predecessor of the F20 model of the Enterprise Storage Server. See also *F20*.

EC
See *engineering change*.

ECKD
See *extended count key data*.

eight pack
See *disk pack*.

electrostatic discharge (ESD)
An undesirable discharge of static electricity that can damage equipment and degrade electrical circuitry.

emergency power off (EPO)
A means of turning off power during an emergency, usually a switch.

EMIF
See *ESCON multiple image facility*.

enclosure
A unit that houses the components of a storage subsystem, such as a control unit, disk drives, and power source.

end of file
A coded character recorded on a data medium to indicate the end of the medium. On a count-key-data direct access storage device, the subsystem indicates the end of a file by including a record with a data length of zero.

engineering change (EC)
An update to a machine, part, or program.

Enterprise Systems Architecture/390 (ESA/390)
An IBM architecture for mainframe computers and peripherals. Processor systems that follow the ESA/390 architecture include the ES/9000® family. See also *z/Architecture*.

Enterprise Systems Connection (ESCON)
1) A zSeries computer peripheral interface. The I/O interface uses zSeries logical protocols over a serial interface that configures attached units to a communication fabric.

2) A set of IBM products and services that provide a dynamically connected environment within an enterprise.

EPO
See *emergency power off*.

ERDS
See *error-recording data set*.

error-recording data set (ERDS)
On zSeries hosts, a data set that records data-storage and data-retrieval errors. A service information message (SIM) provides the error information for the ERDS.

error recovery procedure
Procedures designed to help isolate and, where possible, to recover from errors in equipment. The procedures are often used in conjunction with programs that record information on machine malfunctions.

ESA/390
See *Enterprise Systems Architecture/390*.

ESCD
See *ESCON director*.

ESCON
See *Enterprise System Connection*.

ESCON channel
A zSeries channel that supports ESCON protocols.

ESCON director (ESCD)
An I/O interface switch that allows the

interconnection of multiple ESCON interfaces in a distributed-star topology.

ESCON host systems
zSeries hosts that attach to the DS8000 with an ESCON adapter. Such host systems run on operating systems that include MVS, VSE, TPF, or versions of VM.

ESCON multiple image facility (EMIF)
For zSeries, a function that enables LPARs to share an ESCON channel path by providing each LPAR with its own channel-subsystem image.

EsconNet
In the DS Storage Manager, the label on a pseudo host icon that represents a host connection that uses the ESCON protocol and that is not completely defined on the DS8000. See also *pseudo host* and *access-any mode*.

ESD See *electrostatic discharge*.

eServer
See *IBM eServer*.

ESSNet
See *IBM TotalStorage Enterprise Storage Server Network*.

extended count key data (ECKD)
An extension of the count key data (CKD) architecture.

extent A continuous space on a disk that is occupied by or reserved for a particular data set, data space, or file. The unit of increment is a track. See also *multiple allegiance* and *parallel access volumes*.

extent pool
A groups of extents. See also *extent*.

F

fabric In fibre channel technology, a routing structure, such as a switch, receives addressed information and routes to the appropriate destination. A fabric can consist of more than one switch. When multiple fibre-channel switches are interconnected, they are said to be *cascaded*.

failback
Pertaining to a cluster recovery from failover following repair. See also *failover*.

failover
Pertaining to the process of transferring all control to a single cluster when the other cluster in the storage unit fails. See also *cluster* and *failback*.

fast write
A write operation at cache speed that does not require immediate transfer of data to a disk drive. The subsystem writes the data directly to cache, to nonvolatile storage, or to both. The data is then available for destaging. A fast-write operation reduces the time an application must wait for the I/O operation to complete.

FATA See *fibre-channel ATA*.

FBA See *fixed-block architecture*.

FC See *feature code*. **Note**: *FC* is a common abbreviation for fibre channel in the industry, but the DS8000 customer documentation library reserves *FC* for feature code.

FC-AL See *Fibre Channel ATA*.

FCP See *Fibre Channel Protocol*.

FCS See *Fibre Channel standard*.

feature code (FC)
A code that identifies a particular orderable option and that is used by service personnel to process hardware and software orders. Individual optional features are each identified by a unique feature code.

fibre channel
A data-transmission architecture based on the ANSI Fibre Channel standard, which supports full-duplex communication. The DS8000 supports data transmission over fiber-optic cable through its fibre-channel adapters. See also *Fibre Channel Protocol* and *Fibre Channel standard*.

fibre-channel ATA (FATA)
A hard drive that combines a fibre channel interface with an ATA drive. FATAs, which provide the high performance and capacity of an ATA drive, can be used wherever fibre channel drives can connect.

Fibre Channel Arbitrated Loop (FC-AL)
An implementation of the Fibre Channel Standard that uses a ring topology for the

communication fabric. Refer to American National Standards Institute (ANSI) X3T11/93-275. In this topology, two or more fibre-channel end points are interconnected through a looped interface. This topology directly connects the storage unit to an open systems host without going through a fabric switch.

Fibre Channel Connection (FICON)
A fibre-channel communications protocol that is designed for IBM mainframe computers and peripherals. It connects the storage unit to one or more S/390 hosts using a FICON S/390 channel either directly or through a FICON switch.

Fibre Channel Protocol (FCP)
A protocol used in fibre-channel communications with five layers that define how fibre-channel ports interact through their physical links to communicate with other ports.

Fibre Channel standard (FCS)
An ANSI standard for a computer peripheral interface. The I/O interface defines a protocol for communication over a serial interface that configures attached units to a communication fabric. The protocol has two layers. The IP layer defines basic interconnection protocols. The upper layer supports one or more logical protocols (for example, FCP for SCSI command protocols and SBCON for zSeries command protocols). Refer to American National Standards Institute (ANSI) X3.230-199x. See also *Fibre Channel Protocol*.

fibre-channel topology
An interconnection topology supported on fibre-channel adapters. See also *point-to-point connection*, *switched fabric*, and *arbitrated loop*.

Fibre Channel Switched Fabric (FC-SF)
An implementation of the Fibre Channel Standard that connects the storage unit to one or more open systems hosts through a fabric switch or connects one or more S/390 hosts that run LINUX on an Fibre Channel Protocol S/390 channel.

FICON
See *fibre-channel connection*.

FiconNet
In the DS Storage Manager, the label on a

pseudo host icon that represents a host connection that uses the FICON protocol and that is not completely defined on the DS8000. See also *pseudo host* and *access-any mode*.

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. (GC)

FIFO See *first-in-first-out*.

File Transfer Protocol (FTP)
In TCP/IP, an application protocol used to transfer files to and from host computers. See also *Transmission Control Protocol/Internet Protocol*.

firewall
A protection against unauthorized connection to a computer or a data storage system. The protection is usually in the form of software on a gateway server that grants access to users who meet authorization criteria.

first-in-first-out (FIFO)
A queuing technique in which the next item to be retrieved is the item that has been in the queue for the longest time. (A)

fixed-block architecture (FBA)
An architecture for logical devices that specifies the format of and access mechanisms for the logical data units on the device. The logical data unit is a block. All blocks on the device are the same size (fixed size). The subsystem can access them independently.

fixed-block device
An architecture for logical devices that specifies the format of the logical data units on the device. The logical data unit is a block. All blocks on the device are the same size (fixed size); the subsystem can access them independently. This is the required format of the logical data units for host systems that attach with a SCSI or fibre-channel interface. See also *fibre channel* and *small computer systems interface*.

FlashCopy
An optional feature of the DS8000 that

can make an instant copy of data, that is, a point-in-time copy of a volume.

FlashCopy relationship

A mapping of a FlashCopy source volume and a FlashCopy target volume that allows a point-in-time copy of the source volume to be copied to the target volume. FlashCopy relationships exist from the time that you initiate a FlashCopy operation until the storage unit copies all data from the source volume to the target volume or until you delete the FlashCopy relationship, if it is persistent.

FRU See *field replaceable unit*.

FTP See *File Transfer Protocol*.

full duplex

See *duplex*.

fuzzy copy

A function of the Global Copy feature wherein modifications to the primary logical volume are performed on the secondary logical volume at a later time. The original order of update is not strictly maintained. See also *Global Copy*.

G

GB See *gigabyte*.

GDPS See *Geographically Dispersed Parallel Sysplex*.

Geographically Dispersed Parallel Sysplex (GDPS)

A zSeries multisite application-availability solution.

gigabyte (GB)

A gigabyte of storage is 10^9 bytes. A gigabyte of memory is 2^{30} bytes.

Global Copy

An optional capability of the DS8000 remote mirror and copy feature that maintains a fuzzy copy of a logical volume on the same DS8000 or on another DS8000. In other words, all modifications that any attached host performs on the primary logical volume are also performed on the secondary logical volume at a later point in time. The original order of update is not strictly maintained. See also *Remote Mirror and Copy* and *Metro Mirror*.

Global Mirror

An optional capability of the remote mirror and copy feature that provides a 2-site extended distance remote copy. Data that is written by the host to the storage unit at the local site is automatically maintained at the remote site. See also *Metro Mirror* and *Remote Mirror and Copy*.

group In DS8000 documentation, a nickname for two different kinds of groups, depending on the context. See *disk pack* or *Copy Services server group*.

H

HA See *host adapter*.

HACMP

See *high availability cluster multiprocessing*.

hard disk drive (HDD)

1) A storage medium within a storage server used to maintain information that the storage server requires.

2) A mass storage medium for computers that is typically available as a fixed disk (such as the disks used in system units of personal computers or in drives that are external to a personal computer) or a removable cartridge.

hardware service manager

An option on an AS/400 or iSeries host that enables the user to display and work with system hardware resources and to debug input-output processors (IOP), input-output adapters (IOA), and devices.

HCD See *Hardware Configuration Data*.

HDA See *head disk assembly*.

HDD See *hard disk drive*.

hdisk An AIX term for storage space.

head disk assembly (HDA)

The portion of an HDD associated with the medium and the read/write head.

heartbeat

A status report sent at regular intervals from the DS8000. The service provider uses this report to monitor the health of the call home process. See also *call home*, *heartbeat call home record*, and *remote technical assistance information network*.

heartbeat call home record

Machine operating and service information sent to a service machine. These records might include such information as feature code information and product logical configuration information.

hierarchical storage management

1) A function in storage management software, such as Tivoli Storage Management or Data Facility Storage Management Subsystem/MVS (DFSMS/MVS), that automatically manages free space based on the policy that the storage administrator sets.

2) In AS/400 storage management, an automatic method to manage and distribute data between the different storage layers, such as disk units and tape library devices.

high availability cluster multiprocessing (HACMP)

Software that provides host clustering, so that a failure of one host is recovered by moving jobs to other hosts within the cluster.

high-speed loop (HSL)

A hardware connectivity architecture that links system processors to system input/output buses and other system units.

home address

A nine-byte field at the beginning of a track that contains information that identifies the physical track and its association with a cylinder.

hop Interswitch connection. A hop count is the number of connections that a particular block of data traverses between source and destination. For example, data traveling from one hub over a wire to another hub traverses one hop.

host See *host system*.

host adapter

A physical subunit of a storage server that provides the ability to attach to one or more host I/O interfaces.

host name

The Internet address of a machine in the network. The host name can be entered in the host definition as the fully qualified

domain name of the attached host system, such as `mycomputer.city.company.com`, or as the subname of the fully qualified domain name, for example, `mycomputer`. See also *host system*.

host processor

A processor that controls all or part of a user application network. In a network, the processing unit in which the data communication access method resides. See also *host system*.

host system

A computer, either of the mainframe (for example, zSeries) or of the open-systems type, that is connected to the DS8000. Hosts are connected through ESCON, FICON, or fibre-channel interfaces.

hot plug

Pertaining to the ability to add or remove a hardware facility or resource to a unit while power is on.

HSL See *high-speed loop*.

HyperPAV (IBM HyperPAV)

An optional licensed function that you can use in conjunction with the parallel access volumes (PAV) function. IBM HyperPAV associates the volumes with either an alias address or a specified base logical volume number. When a host system requests IBM HyperPAV processing and the processing is enabled, aliases on the logical subsystem are placed in an IBM HyperPAV alias access state on all logical paths with a given path group ID. IBM HyperPAV is only supported on FICON channel paths.

I

i5/OS The IBM operating system that runs the IBM i5/OS and eServer i5 server families of servers.

IBM eServer

The IBM brand name for a series of server products that are optimized for e-commerce. The products include the iSeries, pSeries, xSeries, and zSeries.

IBM product engineering (PE)

The third-level of IBM service support. Product engineering is composed of IBM engineers who have experience in supporting a product or who are knowledgeable about the product.

IBM Serial Storage adapter
A physical adapter based on the IBM Serial Storage architecture. IBM Serial Storage adapters connect disk drive modules to DS8000 clusters.

IBM System Storage
The brand name used to identify storage products from IBM, including the IBM System Storage DS8000. See also *IBM System Storage DS8000* and *IBM System Storage DS Storage Manager*.

IBM System Storage DS8000
A member of the IBM System Storage Resiliency Family of storage servers and attached storage devices (disk drive modules). The DS8000 delivers high-performance, fault-tolerant storage and management of enterprise data, affording access through multiple concurrent operating systems and communication protocols. High performance is provided by multiple symmetrical multiprocessors, integrated caching, RAID support for the disk drive modules, and disk access through a high-speed serial storage architecture interface.

IBM System Storage DS CLI
The command-line interface (CLI) that is specific to the DS8000.

IBM System Storage DS Storage Manager (DS Storage Manager)
Software with a Web-browser interface for configuring the DS8000.

IBM HyperPAV
See *HyperPAV*.

IBM TotalStorage Enterprise Storage Server Network (ESSNet)
A private network providing Web browser access to the Enterprise Storage Server. IBM installs the ESSNet software on an IBM workstation called the IBM TotalStorage ESS Master Console, supplied with the first ESS delivery.

IBM System Storage Management Console (MC)
An IBM workstation that acts as the focal point for configuration, Copy Services management, and maintenance for the DS8000 . It includes a Web browser that provides links to the user interface, including the DS Storage Manager and the DS8000 Copy Services.

IBM System Storage Multipath Subsystem Device Driver (SDD)
IBM software that provides multipath configuration support for a host system that is attached to storage devices. SDD provides enhanced data availability, dynamic input/output load balancing across multiple paths, and automatic path failover protection.

IBM System Storage Resiliency Family
A set of hardware and software features and products, as well as integrated software and services that are available on the IBM System Storage DS8000 and the IBM TotalStorage Enterprise Storage Server, Models 750 and 800.

image See *storage image*.

IML See *initial microcode load*.

implicit allegiance
In Enterprise Systems Architecture/390, a relationship that a control unit creates between a device and a channel path when the device accepts a read or write operation. The control unit guarantees access to the channel program over the set of channel paths that it associates with the allegiance.

initial microcode load (IML)
The action of loading microcode for a computer into that computer's storage.

initial program load (IPL)
The action of loading software into a computer, typically an operating system that controls the computer.

initiator
A SCSI device that communicates with and controls one or more targets. Contrast with *target*.

i-node The internal structure in an AIX operating system that describes the individual files in the operating system. It contains the code, type, location, and owner of a file.

input/output (I/O)
Pertaining to (a) input, output, or both or (b) a device, process, or channel involved in data input, data output, or both.

input/output configuration data set
A configuration definition built by the I/O configuration program (IOCP) and stored on disk files associated with the processor controller.

interleave

To automatically create two striped partitions across the drives in a RAID-5 array, both of which use the count-key-data (CKD) record format.

Internet Protocol (IP)

In the Internet suite of protocols, a protocol without connections that routes data through a network or interconnecting networks and acts as an intermediary between the higher protocol layers and the physical network. The upper layer supports one or more logical protocols (for example, a SCSI-command protocol and a zSeries command protocol). Refer to ANSI X3.230-199*x*. The IP acronym is the IP in TCP/IP. See also *Transmission Control Protocol/Internet Protocol*.

invalidate

To remove a logical data unit from cache memory because it cannot support continued access to the logical data unit on the device. This removal might be the result of a failure within the storage server or a storage device that is associated with the device.

I/O   See *input/output*.

I/O adapter (IOA)

An input-output adapter on the PCI bus.

IOCDS

See *input/output configuration data set*.

IOCP   See *I/O Configuration Program*.

I/O Configuration Program (IOCP)

A program that defines to a system all the available I/O devices and channel paths.

I/O device

An addressable read and write unit, such as a disk drive device, magnetic tape device, or printer.

I/O interface

An interface that enables a host to perform read and write operations with its associated peripheral devices.

I/O Priority Queueing

A facility in the Workload Manager of zSeries that enables the system administrator to set priorities for queueing I/Os from different system images. See also *multiple allegiance* and *parallel access volumes*.

I/O processor (IOP)

Controls input-output adapters and other devices.

I/O sequential response time

The time an I/O request is queued in processor memory waiting for previous I/Os to the same volume to complete.

IP   See *Internet Protocol*.

IPL   See *initial program load*.

iSeries

An IBM eServer product that emphasizes integration. It is the successor to the AS/400 family of servers.

J

Java Virtual Machine (JVM)

A software implementation of a central processing unit (CPU) that runs compiled Java code (applets and applications). (GC)

JVM   See *Java Virtual Machine*.

K

KB   See *kilobyte*.

key field

The second (optional) field of a count key data record. The key length is specified in the count field. The key length determines the field length. The program writes the data in the key field and uses the key field to identify or locate a given record. The subsystem does not use the key field.

kilobyte (KB)

1) For processor storage, real, and virtual storage, and channel volume, 2^{10} or 1024 bytes.

2) For disk storage capacity and communications volume, 1000 bytes.

Korn shell

Interactive command interpreter and a command programming language.

KPOH

See *thousands of power-on hours*.

L

LAN   See *local area network*.

last-in first-out (LIFO)

A queuing technique in which the next item to be retrieved is the item most recently placed in the queue. (A)

LBA See *logical block address*.

LCU See *logical control unit*.

least recently used (LRU)

1) The algorithm used to identify and make available the cache space that contains the least-recently used data.

2) A policy for a caching algorithm that chooses to remove from cache the item that has the longest elapsed time since its last access.

LED See *light-emitting diode*.

licensed machine code

Microcode that IBM does not sell as part of a machine, but licenses to the customer. LMC is implemented in a part of storage that is not addressable by user programs. Some IBM products use it to implement functions as an alternate to hard-wired circuitry.

LIFO See *last-in first-out*.

light-emitting diode (LED)

A semiconductor chip that gives off visible or infrared light when activated.

link address

On an ESCON interface, the portion of a source or destination address in a frame that ESCON uses to route a frame through an ESCON director. ESCON associates the link address with a specific switch port that is on the ESCON director. Equivalently, it associates the link address with the channel subsystem or control unit link-level functions that are attached to the switch port.

link-level facility

The ESCON hardware and logical functions of a control unit or channel subsystem that allow communication over an ESCON write interface and an ESCON read interface.

local area network (LAN)

A computer network located on a user's premises within a limited geographic area.

local e-mail

An e-mail configuration option for storage servers that are connected to a host-system network that does not have a domain name system (DNS) server.

logical address

On an ESCON interface, the portion of a source or destination address in a frame used to select a specific channel-subsystem or control-unit image.

logical block address (LBA)

The address assigned by the DS8000 to a sector of a disk.

logical control unit (LCU)

See *control-unit image*.

logical data unit

A unit of storage that is accessible on a given device.

logical device

The facilities of a storage server (such as the DS8000) associated with the processing of I/O operations directed to a single host-accessible emulated I/O device. The associated storage is referred to as a logical volume. The logical device is mapped to one or more host-addressable units, such as a device on a zSeries I/O interface or a logical unit on a SCSI I/O interface, such that the host initiating I/O operations to the I/O-addressable unit interacts with the storage on the associated logical device.

logical partition (LPAR)

For zSeries, a set of functions that create the programming environment in which more than one logical partition (LPAR) is established on a processor. An LPAR is conceptually similar to a virtual machine environment except that the LPAR is a function of the processor. Also, the LPAR does not depend on an operating system to create the virtual machine environment. (DS8000 series only)

logical path

1) The relationship between a channel image and a control-unit image that designates the physical path to be used for device-level communications between these images. The logical path is established as part of the channel and control-unit initialization procedures by the exchange of link-level frames.

2) With the Remote Mirror and Copy feature, the relationship between a source logical subsystem (LSS) and a target LSS that is created over a physical path through the interconnection fabric that is

used for Remote Mirror and Copy functions. An LSS is a primary control unit, which performs the functions of a channel image.

logical subsystem (LSS)
A topological construct that consists of a group of up to 256 logical devices. A DS8000 can have (if CDK only) up to 32 CKD-formatted logical subsystems (8192 CKD logical devices) or (if FBA only) up to 32 fixed-block logical subsystems (8192 fixed-block logical devices). If mixed CKD and FBA, a DS8000 can have up to 16 CKD-formatted logical subsystems (4096 CKD logical devices) and up to 16 fixed-block logical subsystems (4096 fixed-block logical devices). The logical subsystem facilitates configuration of the DS8000 and might have other implications relative to the operation of certain functions. There is a one-to-one mapping between a CKD logical subsystem and a zSeries control-unit image.

For zSeries hosts, a logical subsystem represents a logical control unit (LCU). Each control-unit image is associated with only one logical subsystem. See also *control-unit image*.

logical unit
In open systems, a logical disk drive.

logical unit number (LUN)
In the SCSI protocol, a unique number that is used on a SCSI bus to enable it to differentiate between separate devices, each of which is a logical unit.

logical volume
The storage medium that is associated with a logical disk drive. A logical volume typically resides on one or more storage devices. The DS8000 administrator defines this unit of storage. The logical volume, when residing on a RAID-formatted array, is spread over the drives in the array.

logical volume manager (LVM)
A set of system commands, library routines, and other tools that allow the user to establish and control logical volume storage. The LVM maps data between the logical view of storage space and the physical disk drive module.

longitudinal redundancy check (LRC)
1) A method of error checking during data transfer that involves checking parity on a row of binary digits that are members of a set that forms a matrix. Longitudinal redundancy check is also called a longitudinal parity check.

2) A mechanism that the DS8000 uses for locating errors. The LRC checks the data as it progresses from the host, through theDS8000 controller, into the device adapter, and to the array.

longwave laser adapter
A connector that is used between a host and the DS8000 to support longwave fibre-channel communication.

loop The physical connection between a pair of device adapters in the DS8000. See also *device adapter*.

LPAR See *logical partition*.

LRC See *longitudinal redundancy check*.

LRU See *least recently used*.

LSS See *logical subsystem*.

LUN See *logical unit number*.

LVM See *logical volume manager*.

M

machine level control (MLC)
A database that contains the EC level and configuration of products in the field.

machine reported product data (MRPD)
Product data gathered by a machine and sent to a destination such as an IBM support server or RETAIN. These records might include such information as feature code information and product logical configuration information.

mainframe
A computer, usually in a computer center, with extensive capabilities and resources to which other computers may be connected so that they can share facilities. (T)

maintenance analysis procedure (MAP)
A hardware maintenance document that gives an IBM service representative a step-by-step procedure for tracing a symptom to the cause of a failure.

management console
See *IBM System Storage Management Console*.

management information base (MIB)
1) A collection of objects that can be accessed by means of a network management protocol. (GC)

2) The MIB record conforms to the Open Systems Interconnection (OSI) standard defined by the International Organization for Standardization (ISO) for the exchange of information. See also *simple network management protocol*.

MAP See *maintenance analysis procedure*.

master storage unit
The physical unit that controls the creation of consistency groups in a Global Mirror session. The master storage unit sends commands to subordinate storage units. A storage unit can be a master for only one Global Mirror session. Contrast with *subordinate storage unit*.

maximum consistency group drain time
The value in seconds that indicates the maximum time that writes from the local site are delayed to the remote site while the current consistency group is being formed at the remote site. When this time is exceeded, the current attempt to form a consistency group is ended and another attempt is started. If this time is exceeded five times, this maximum time is ignored on the next attempt to form a consistency group. The default value is the larger of four minutes or two times the consistency group interval time if this value is set to zero.

maximum coordination time
The value in milliseconds that indicates the maximum time that is allowed for host I/O to be delayed during the coordination of the primary volumes of an Global Mirror session. The default is 50 milliseconds if this value is set to zero.

MB See *megabyte*.

MC See *IBM System Storage Management Console*.

MCA See *Micro Channel architecture*.

MDM See *Multiple Device Manager*.

mean time between failures (MTBF)
1) A projection of the time that an individual unit remains functional. The time is based on averaging the performance, or projected performance, of a population of statistically independent units. The units operate under a set of conditions or assumptions.

2) For a stated period in the life of a functional unit, the mean value of the lengths of time between consecutive failures under stated conditions. (I) (A)

medium
For a storage unit, the disk surface on which data is stored.

megabyte (MB)
1) For processor storage, real and virtual storage, and channel volume, 2^{20} or 1 048 576 bytes.

2) For disk storage capacity and communications volume, 1 000 000 bytes.

Metro Mirror
A function of a storage server that maintains a consistent copy of a logical volume on the same storage server or on another storage server. All modifications that any attached host performs on the primary logical volume are also performed on the secondary logical volume. See also *Remote Mirror and Copy* and *Global Copy*.

MES See *miscellaneous equipment specification*.

MIB See *management information base*.

Micro Channel architecture (MCA)
The rules that define how subsystems and adapters use the Micro Channel bus in a computer. The architecture defines the services that each subsystem can or must provide.

Microsoft Internet Explorer
Web browser software manufactured by Microsoft.

migration
The replacement of a system or subsystem with a different type of system or subsystem, such as replacing a SCSI host adapter with a fibre-channel host adapter. In the context of data migration regarding the DS8000, the transfer of data from one storage unit to another, such as from a 3390 to the DS8000.

MIH See *missing-interrupt handler*.

mirrored pair
Two units that contain the same data. The system refers to them as one entity.

mirroring
In host systems, the process of writing the same data to two disk units within the same auxiliary storage pool at the same time.

miscellaneous equipment specification (MES)
IBM field-installed change to a machine.

missing-interrupt handler (MIH)
An MVS and MVS/XA facility that tracks I/O interrupts. MIH informs the operator and creates a record whenever an expected interrupt fails to occur before a specified elapsed time is exceeded.

MLC See *machine level control*.

mobile solutions terminal (MoST)
The mobile terminal used by service personnel.

mode conditioning patch cable
A cable that converts a single-mode signal from a longwave adapter into a light signal that is appropriate for multimode fibre. Another mode conditioning patch cable is required at the terminating end of the multimode fibre to convert the signal back to a single-mode signal for a longwave adapter.

Model 100
A 2105 Model 100, often simply referred to as a Mod 100, is an expansion enclosure for the Enterprise Storage Server. See also *2105*.

MoST See *mobile solutions terminal*.

MRPD
See *machine reported product data*.

MSA See *multiport serial adapter*.

MTBF See *mean time between failures*.

Multipath Subsystem Device Driver
See *IBM System Storage DS8000 Multipath Subsystem Device Driver*.

multiple allegiance
A DS8000 hardware function that is independent of software support. This function enables multiple system images to concurrently access the same logical volume on the DS8000 as long as the

system images are accessing different extents. See also *extent* and *parallel access volumes*.

Multiple Device Manager (MDM)
A component of the IBM TotalStorage Productivity Center that allows administrators to configure, manage, and monitor the performance of SAN storage devices from a single console.

multiple relationship FlashCopy
An option of the DS8000 that creates backup copies from one source to multiple targets by simultaneously establishing multiple FlashCopy relationships.

multiple virtual storage (MVS)
Implies MVS/390, MVS/XA, MVS/ESA, and the MVS element of the zSeries operating system.

multiplex
The action of transmitting simultaneously.

multiport serial adapter (MSA)
An adapter on the IBM System Storage Management Console that has multiple ports to which aDS8000 can be attached.

multiprocessor
A computer that includes two or more processors that have common access to a main storage. For the DS8000, the multiprocessors operate in parallel.

MVS See *multiple virtual storage*.

N

name server
A server that stores names of the participating DS8000 clusters.

near-line
A type of intermediate storage between online storage (which provides constant, rapid access to data) and offline storage (which provides infrequent data access for backup purposes or long-term storage).

Netfinity
IBM Intel-processor-based server; predecessor to the IBM xSeries server.

Netscape Navigator
Web browser software manufactured by Netscape.

network manager
A program or group of programs that is

used to monitor, manage, and diagnose the problems of a network. (GC)

node The unit that is connected in a fibre-channel network. A DS8000 is a node in a fibre-channel network.

non-RAID
A disk drive set up independently of other disk drives and not set up as part of a disk pack to store data using the redundant array of disks (RAID) data-striping methodology.

nonremovable medium
A recording medium that cannot be added to or removed from a storage device.

nonvolatile storage (NVS)
Memory that stores active write data to avoid data loss in the event of a power loss.

NVS See *nonvolatile storage*.

O

octet In Internet Protocol addressing, one of the four parts of a 32-bit integer presented in dotted decimal notation. See also *dotted decimal notation*.

OEMI See *original equipment manufacturer's information*.

open system
A system whose characteristics comply with standards made available throughout the industry and that therefore can be connected to other systems complying with the same standards. Applied to the DS8000, such systems are those hosts that connect to the DS8000 through SCSI or FCP protocols. See also *small computer system interface* and *Fibre Channel Protocol*.

organizationally unique identifier (OUI)
An IEEE-standards number that identifies an organization with a 24-bit globally unique assigned number referenced by various standards. OUI is used in the family of 802 LAN standards, such as Ethernet and Token Ring.

original equipment manufacturer's information (OEMI)
A reference to an IBM guideline for a computer peripheral interface. The interface uses ESA/390 logical protocols over an I/O interface that configures attached units in a multidrop bus topology.

OS/390
The IBM operating system that includes and integrates functions that many IBM software products (including the MVS operating system) previously provided for the IBM S/390 family of enterprise servers.

OUI See *organizationally unique identifier*.

P

panel The formatted display of information that appears on a display screen.

parallel access volumes (PAV)
A licensed function of the DS8000 that enables OS/390 and z/OS systems to issue concurrent I/O requests against a count key data logical volume by associating multiple devices of a single control-unit image with a single logical device. Up to eight device addresses can be assigned to a PAV. The PAV function enables two or more concurrent write operations to the same logical volume, as long as the write operations are not to the same extents. See also *extent*, *I/O Priority Queueing*, and *multiple allegiance*.

parity A data checking scheme used in a computer system to ensure the integrity of the data. The RAID implementation uses parity to re-create data if a disk drive fails.

path group
In zSeries architecture, a set of channel paths that are defined to a control unit as being associated with a single logical partition (LPAR). The channel paths are in a group state and are online to the host. See also *logical partition*.

path group identifier
In zSeries architecture, the identifier that uniquely identifies a given logical partition (LPAR). The path group identifier is used in communication between the LPAR program and a device. The identifier associates the path group with one or more channel paths, thereby defining these paths to the control unit as being associated with the same LPAR. See also *logical partition*.

PAV   See *parallel access volumes*.

PCI   See *peripheral component interconnect*.

PDU   See *protocol data unit*.

PE   See *IBM product engineering*.

peripheral component interconnect (PCI)
An architecture for a system bus and associated protocols that supports attachments of adapter cards to a system backplane.

persistent FlashCopy
A state where a FlashCopy relationship remains indefinitely until the user deletes it. The relationship between the source and target volumes is maintained after a background copy completes.

physical path
A single path through the I/O interconnection fabric that attaches two units. For Copy Services, this is the path from a host adapter on one DS8000 (through cabling and switches) to a host adapter on anotherDS8000.

pinned data
Data that is held in cache until either an error condition is corrected and it can be moved to disk storage or until the data is discarded by a host command. Pinned data conditions can only occur on an ESS Model 800 during fast-write or dual-copy functions.

planar The main printed circuit board (PCB) that other PCBs or assemblies plug into. The planar distributes both power and signals and therefore creates a common communications path to whichever device that plugs into it.

point-in-time copy
A FlashCopy option that creates an instantaneous view of original source data at a specific moment in time.

point-to-point connection
A fibre-channel topology that enables the direct interconnection of ports. See also *arbitrated loop* and *switched fabric*.

port   A physical connection on a host adapter to the cable that connects the DS8000 to hosts, switches, or another DS8000. The DS8000 uses SCSI and ESCON host adapters that have two ports per adapter, and fibre-channel host adapters that have

one port. See also *ESCON*, *fibre-channel*, *host adapter*, and *small computer system interface*.

POST See *power-on self test*.

power-on self test (POST)
A diagnostic test that servers or computers run when they are turned on.

predictable write
A write operation that can cache without knowledge of the existing format on the medium. All write operations on FBA DASD devices are predictable. On CKD DASD devices, a write operation is predictable if it does a format write operation for the first data record on the track.

primary control unit
The DS8000 to which a Remote Mirror and Copy primary device is physically attached.

processor complex
A partition of a storage server that is capable of performing all defined functions of the storage server. Multiple processor complexes provide redundancy.

product engineering
See *IBM product engineering*.

program
On a computer, a generic term for software that controls the operation of the computer. Typically, the program is a logical assemblage of software modules that perform multiple related tasks.

program-controlled interruption
An interruption that occurs when an I/O channel fetches a channel command word with the program-controlled interruption flag on.

program temporary fix (PTF)
A temporary solution to, or bypass of, a problem diagnosed by IBM as the result of a defect in a current unaltered release of a licensed program. (GC)

promote
To add a logical data unit to cache memory.

protected volume
In AS/400, a disk storage device that is protected from data loss by RAID techniques. An AS/400 host does not

mirror a volume configured as a protected volume, while it does mirror all volumes configured as unprotected volumes. The DS8000, however, can be configured to indicate that an AS/400 volume is protected or unprotected and give it RAID protection in either case.

protocol data unit (PDU)
A unit of data specified in the protocol of a given layer and consisting of protocol control information for the layer and, possibly, user data for the layer.

pSeries
The product name of an IBM eServer product that emphasizes performance. It is the successor to the RS/6000 family of servers.

pseudo host
A host connection that is not explicitly defined to the DS8000 and that has access to at least one volume that is configured on the DS8000. The FiconNet pseudo host icon represents the FICON protocol. The EsconNet pseudo host icon represents the ESCON protocol. The pseudo host icon labelled Anonymous represents hosts connected through the FCP protocol. *Anonymous host* is a commonly used synonym for *pseudo host*. The DS8000 adds a pseudo host icon only when it is set to access-any mode. See also *access-any mode*.

PTF See *program temporary fix*.

PV Links
Short for Physical Volume Links, an alternate pathing solution from Hewlett-Packard that provides for multiple paths to a volume, as well as static load balancing.

R

R0 See *track-descriptor record*.

rack See *enclosure*.

RAID See *redundant array of independent disks*. RAID is also commonly expanded to redundant array of *inexpensive* disks. See also *array*.

RAID 5
A type of RAID that optimizes cost-effective performance while emphasizing use of available capacity through data striping. RAID 5 provides fault tolerance for up to two failed disk drives by distributing parity across all the drives in the array plus one parity disk drive. The DS8000 automatically reserves spare disk drives when it assigns arrays to a device adapter pair (DA pair). See also *device adapter*, *RAID 10*, and *redundant array of independent disks*.

RAID 10
A type of RAID that optimizes high performance while maintaining fault tolerance for up to two failed disk drives by striping volume data across several disk drives and mirroring the first set of disk drives on an identical set. The DS8000 automatically reserves spare disk drives when it assigns arrays to a device adapter pair (DA pair). See also *device adapter*, *RAID 5*, and *redundant array of independent disks*.

random access
A mode of accessing data on a medium in a manner that requires the storage device to access nonconsecutive storage locations on the medium.

rank One or more arrays that are combined to create a logically contiguous storage space.

redundant array of independent disks (RAID)
A methodology of grouping disk drives for managing disk storage to insulate data from a failing disk drive.

refresh FlashCopy target volume
An option (previously called *incremental FlashCopy*) of the DS8000 that creates a point-in-time data copy without copying an entire volume for each point-in-time copy.

Remote Mirror and Copy
A feature of a storage server that constantly updates a secondary copy of a logical volume to match changes made to a primary logical volume. The primary and secondary volumes can be on the same storage server or on separate storage servers. See also *Global Mirror*, *Metro Mirror* and *Global Copy*.

remote technical assistance information network (RETAIN)
The initial service tracking system for IBM service support, which captures

heartbeat and call-home records. See also *support catcher* and *support catcher telephone number*.

REQ/ACK
> See *request for acknowledgment and acknowledgment*.

request for acknowledgment and acknowledgment (REQ/ACK)
> A cycle of communication between two data transport devices for the purpose of verifying the connection, which starts with a request for acknowledgment from one of the devices and ends with an acknowledgment from the second device. The REQ and ACK signals help to provide uniform timing to support synchronous data transfer between an initiator and a target. The objective of a synchronous data transfer method is to minimize the effect of device and cable delays.

reserved allegiance
> For zSeries, a relationship that is created in a control unit between a device and a channel path, or path group, when the device completes a Sense Reserve command. The allegiance causes the control unit to guarantee access (that is, busy status is not presented) to the device. Access is over the set of channel paths that are associated with the allegiance; access is for one or more channel programs until the allegiance ends.

RETAIN
> See *remote technical assistance information network*.

S

S/390 IBM enterprise servers based on Enterprise Systems Architecture/390 (ESA/390). *S/390* is the currently accepted shortened form of the original name *System/390*.

S/390 storage
> Storage arrays and logical volumes that are defined as connected to S/390 servers. This term is synonymous with count-key-data storage.

SAID See *system adapter identification number*.

SAM See *sequential access method*.

SAN See *storage area network*.

SBCON
> See *Single-Byte Command Code Sets Connection*.

screen The physical surface of a display device upon which information is shown to users.

SCSI See *small computer system interface*.

SCSI device
> A disk drive connected to a host through an I/O interface using the SCSI protocol. A SCSI device is either an initiator or a target. See also *initiator* and *small computer system interface*.

SCSI-FCP
> Synonym for Fibre Channel Protocol, a protocol used to transport data between an open-systems host and a fibre-channel adapter on an DS8000. See also *Fibre Channel Protocol* and *small computer system interface*.

SCSI host systems
> Host systems that are attached to the DS8000 with a SCSI interface. Such host systems run on UNIX, i5/OS, Windows NT, Windows 2000, or Novell NetWare operating systems.

SCSI ID
> A unique identifier assigned to a SCSI device that is used in protocols on the SCSI interface to identify or select the device. The number of data bits on the SCSI bus determines the number of available SCSI IDs. A wide interface has 16 bits, with 16 possible IDs.

SDD See *IBM Subsystem Multipathing Device Driver*.

secondary control unit
> The DS8000 to which a Remote Mirror and Copy secondary device is physically attached.

self-timed interface (STI)
> An interface that has one or more conductors that transmit information serially between two interconnected units without requiring any clock signals to recover the data. The interface performs clock recovery independently on each serial data stream and uses information in

the data stream to determine character boundaries and inter-conductor synchronization.

sequential access
A mode of accessing data on a medium in a manner that requires the storage device to access consecutive storage locations on the medium.

sequential access method (SAM)
An access method for storing, deleting, or retrieving data in a continuous sequence based on the logical order of the records in the file.

serial connection
A method of device interconnection for determining interrupt priority by connecting the interrupt sources serially.

server A host that provides certain services to other hosts that are referred to as clients.

A functional unit that provides services to one or more clients over a network. (GC)

service boundary
A category that identifies a group of components that are unavailable for use when one of the components of the group is being serviced. Service boundaries are provided on the DS8000, for example, in each host bay and in each cluster.

service clearance
The area that is required to open the service covers and to pull out components for servicing.

service information message (SIM)
A message sent by a storage server to service personnel through an zSeries operating system.

service personnel
A generalization referring to individuals or companies authorized to service the DS8000. The terms *service provider*, *service representative*, and *IBM service support representative (SSR)* refer to types of service personnel. See also *service support representative*.

service processor
A dedicated processing unit that is used to service a storage unit.

service support representative (SSR)
Individuals or a company authorized to service the DS8000. This term also refers

to a service provider, a service representative, or an IBM service support representative (SSR). An IBM SSR installs the DS8000.

SES SCSI Enclosure Services.

session
A collection of volumes within a logical subsystem that are managed together during the creation of consistent copies of data. All volumes in a session must transfer their data successfully to the remote site before the increment can be called complete.

SFP Small form factor pluggables.

shared storage
Storage that is configured so that multiple hosts can concurrently access the storage. The storage has a uniform appearance to all hosts. The host programs that access the storage must have a common model for the information on a storage device. The programs must be designed to handle the effects of concurrent access.

shortwave laser adapter
A connector that is used between host and DS8000 to support shortwave fibre-channel communication.

SIM See *service information message*.

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). (GC) See also *management information base*.

simplex volume
A volume that is not part of a FlashCopy, XRC, or PPRC volume pair.

Single-Byte Command Code Sets Connection (SBCON)
The ANSI standard for the ESCON I/O interface.

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

smart relay host
A mail relay or mail gateway that has the capability to correct e-mail addressing problems.

SMIT See *System Management Interface Tool*.

SMP See *symmetrical multiprocessor*.

SNMP
See *Simple Network Management Protocol*.

SNMP agent
A server process that resides on a network node and is responsible for communicating with managers regarding that node. The node is represented as a managed object, which has various fields or variables that are defined in the appropriate MIB.

SNMP manager
A managing system that runs a managing application or suite of applications. These applications depend on Management Information Base (MIB) objects for information that resides on the managed system. Managers generate requests for this MIB information, and an SNMP agent on the managed system responds to these requests. A request can either be the retrieval or modification of MIB information.

software transparency
Criteria applied to a processing environment that states that changes do not require modifications to the host software in order to continue to provide an existing function.

source device
One of the devices in a dual-copy or remote-copy volume pair. All channel commands to the logical volume are directed to the source device. The data on the source device is duplicated on the target device. See also *target device*.

spare A disk drive on the DS8000 that can replace a failed disk drive. A spare can be predesignated to allow automatic dynamic sparing. Any data preexisting on a disk drive that is invoked as a spare is destroyed by the dynamic sparing copy process.

spatial reuse
A feature of serial storage architecture that enables a device adapter loop to

support many simultaneous read/write operations. See also *serial storage architecture*.

SSID See *subsystem identifier*.

SSR See *service support representative*.

stacked status
For zSeries, the condition when the control unit is in a holding status for the channel, and the last time the control unit attempted to present the status, the channel responded with the stack-status control.

stage operation
The operation of reading data from the physical disk drive into the cache.

staging
To move data from an offline or low-priority device back to an online or higher priority device, usually on demand of the system or on request of the user.

standard volume
A volume that emulates one of several zSeries volume types, including 3390-2, 3390-3, 3390-9, 3390-2 (3380-track mode), or 3390-3 (3380-track mode), by presenting the same number of cylinders and capacity to the host as provided by the native zSeries volume type of the same name.

STI See *self-timed interface*.

storage area network
A network that connects a company's heterogeneous storage resources.

storage capacity
The amount of data that a storage medium can hold; usually expressed in kilobytes, megabytes, or gigabytes.

storage complex
A configuration of one or more storage units that is managed by a management console.

storage device
A physical unit that provides a mechanism to store data on a given medium such that it can be subsequently retrieved. See also *disk drive module*.

storage extent
The minimum contiguous range of

storage on a physical storage device, array, or rank that can be allocated to a local volume

storage image
A partitioning of a storage unit that provides emulation of a storage server with one or more storage devices that provides storage capability to a host computer. You can configure more than one storage image on a storage unit. (DS8000 series only)

storage server
A physical unit that manages attached storage devices and provides an interface between them and a host computer by providing the function of one or more logical subsystems. The storage server can provide functions that the storage device does not provide. The storage server has one or more clusters.

storage unit
A physical unit that consists of a storage server that is integrated with one or more storage devices that provide storage capability to a host computer.

storage unit identifier
A unique identifier for a storage unit that consists of a manufacturer, a model number, a type number, a plant of manufacture, and a sequence number.

striping
A technique that distributes data in bit, byte, multibyte, record, or block increments across multiple disk drives.

subagent
An extension to an SNMP agent that permits a user to dynamically add, or in some cases replace, additional management variables in the local MIB, thereby providing a means of extending the range of information that network managers can access. See also *agent*.

subchannel
A logical function of a channel subsystem associated with the management of a single device.

subordinate storage unit
The physical unit that receives commands from the master storage unit and is specified when a Global Mirror session is started. The subordinate storage unit forms consistency groups and performs

other Global Mirror processing. A subordinate storage unit can be controlled by only one master storage unit. Contrast with *master storage unit*.

subsystem identifier (SSID)
A number that uniquely identifies a logical subsystem within a computer installation.

support catcher
See *catcher*.

support catcher telephone number
The telephone number that connects the support catcher server to the DS8000 to receive a trace or dump package. See also *support catcher* and *remote technical assistance information network*.

switched fabric
A fibre-channel topology in which ports are interconnected through a switch. Fabric switches can also be interconnected to support numerous ports on a single network. See also *arbitrated loop* and *point-to-point connection*.

symmetrical multiprocessor (SMP)
An implementation of a multiprocessor computer consisting of several identical processors configured in a way that any subset of the set of processors is capable of continuing the operation of the computer. TheDS8000 contains four processors set up in SMP mode.

synchronous write
A write operation whose completion is indicated after the data has been stored on a storage device.

System/390
See *S/390*.

system adapter identification number (SAID)
The unique identification number that is automatically assigned to each DS8000 host adapter for use by Copy Services.

System Management Interface Tool (SMIT)
An interface tool of the AIX operating system for installing, maintaining, configuring, and diagnosing tasks.

System Modification Program
A program used to install software and software changes on MVS systems.

T

target A SCSI device that acts as a subordinate to an initiator and consists of a set of one or more logical units, each with an assigned logical unit number (LUN). The logical units on the target are typically I/O devices. A SCSI target is analogous to a zSeries control unit. See also *small computer system interface*.

target device
One of the devices in a dual-copy or remote-copy volume pair that contains a duplicate of the data that is on the source device. Unlike the source device, the target device might only accept a limited subset of data. See also *source device.*

TB See *terabyte*.

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

terabyte (TB)
1) Nominally, 1 000 000 000 000 bytes, which is accurate when speaking of bandwidth and disk storage capacity.

2) For DS8000 cache memory, processor storage, real and virtual storage, a terabyte refers to 2^{40} or 1 099 511 627 776 bytes.

terminal emulator
A function of the management console that allows it to emulate a terminal.

thousands of power-on hours (KPOH)
A unit of time used to measure the mean time between failures (MTBF).

time sharing option (TSO)
An operating system option that provides interactive time sharing from remote terminals.

System Storage
See *IBM System Storage*.

TPF See *transaction processing facility*.

track A unit of storage on a CKD device that can be formatted to contain a number of data records. See also *home address*, *track-descriptor record*, and *data record*.

track-descriptor record (R0)
A special record on a track that follows the home address. The control program uses it to maintain certain information about the track. The record has a count field with a key length of zero, a data length of 8, and a record number of 0. This record is sometimes referred to as R0.

transaction processing facility (TPF)
A high-availability, high-performance IBM operating system, designed to support real-time, transaction-driven applications. The specialized architecture of TPF is intended to optimize system efficiency, reliability, and responsiveness for data communication and database processing. TPF provides real-time inquiry and updates to a large, centralized database, where message length is relatively short in both directions, and response time is generally less than three seconds. Formerly known as the Airline Control Program/Transaction Processing Facility (ACP/TPF).

Transmission Control Protocol (TCP)
A communications 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 packet-switched communications 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)
1) A combination of data-transmission protocols that provide end-to-end connections between applications over interconnected networks of different types.

2) A suite of transport and application protocols that run over the Internet Protocol. (GC) See also *Internet Protocol* and *Transmission Control Protocol*.

transparency
See *software transparency*.

TSO See *time sharing option*.

turbo processor
A faster multiprocessor that has six processors with common access to the main storage.

U

UFS   UNIX filing system.

Ultra-SCSI
An enhanced small computer system interface.

unconfigure
To delete the configuration.

unit address
For zSeries, the address associated with a device on a given control unit. On ESCON interfaces, the unit address is the same as the device address. On OEMI interfaces, the unit address specifies a control unit and device pair on the interface.

unprotected volume
An AS/400 term that indicates that the AS/400 host recognizes the volume as an unprotected device, even though the storage resides on a RAID-formatted array and is, therefore, fault tolerant by definition. The data in an unprotected volume can be mirrored. Also referred to as an *unprotected device*.

upper-layer protocol
The layer of the Internet Protocol (IP) that supports one or more logical protocols (for example, a SCSI-command protocol and an ESA/390 command protocol). Refer to ANSI X3.230-199*x.*

UTC   See *Coordinated Universal Time*.

V

virtual machine facility
A virtual data processing machine that appears to the user to be for the exclusive use of that user, but whose functions are accomplished by sharing the resources of a shared data processing system. An alternate name for the VM/370 IBM operating system.

vital product data (VPD)
Information that uniquely defines the system, hardware, software, and microcode elements of a processing system.

VM   The root name of several IBM operating systems, such as VM/XA, VM/ESA, VM/CMS, and z/VM. See also *virtual machine facility*.

volume
For zSeries, the information recorded on a single unit of recording medium. Indirectly, it can refer to the unit of recording medium itself. On a nonremovable-medium storage device, the term can also indirectly refer to the storage device associated with the volume. When multiple volumes are stored on a single storage medium transparently to the program, the volumes can be referred to as logical volumes.

volume group
A collection of either physical or logical volumes.

volume label
A unique identifier that a user assigns to a logical volume.

VPD   See *vital product data*.

VSE/ESA
An IBM operating system, the letters of which represent virtual storage extended/enterprise systems architecture.

W

weight distribution area
The area that is required to distribute the weight of the storage unit.

worldwide node name (WWNN)
A unique 64-bit identifier for a host that contains a fibre-channel port. See also *worldwide port name*.

worldwide port name (WWPN)
A unique 64-bit identifier associated with a fibre-channel adapter port. It is assigned in an implementation- and protocol-independent manner. See also *worldwide node name*

write hit
A write operation in which the requested data is in the cache.

write penalty
The performance impact of a classical RAID-5 write operation.

WWNN
See *worldwide node name*.

WWPN
See *worldwide port name*.

X

xSeries
　　The product name of an IBM eServer product that emphasizes industry-standard server scalability and self-managing server technologies. It is the successor to the Netfinity family of servers.

Z

z/Architecture
　　An IBM architecture for mainframe computers and peripherals. The IBM eServer zSeries family of servers uses the z/Architecture architecture. It is the successor to the S/390 and 9672 family of servers. See also *iSeries*.

zoning
　　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.

z/OS　　An operating system for the IBM eServer product line that supports 64-bit real storage.

z/OS Global Mirror
　　A function of a storage server that assists a control program to maintain a consistent copy of a logical volume on another storage unit. All modifications of the primary logical volume by any attached host are presented in order to a single host. The host then makes these modifications on the secondary logical volume. This function was formerly called *extended remote copy* or *XRC*.

zSeries
　　An IBM eServer family of servers that emphasizes near-zero downtime.

　　IBM enterprise servers based on z/Architecture.

zSeries storage
　　Storage arrays and logical volumes that are defined in the DS8000 as connected to zSeries servers.

Index

Numerics

Readers' comments — we would like to hear from you

IBM System Storage DS8000
Introduction and Planning Guide
Version 1 Release 2

Publication No. GC35-0515-01

We appreciate your comments about this publication. Please comment on specific errors or omissions, accuracy, organization, subject matter, or completeness of this book. The comments you send should pertain to only the information in this manual or product and the way in which the information is presented.

For technical questions and information about products and prices, please contact your IBM branch office, your IBM business partner, or your authorized remarketer.

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute your comments in any way it believes appropriate without incurring any obligation to you. IBM or any other organizations will only use the personal information that you supply to contact you about the issues that you state on this form.

Comments:

Thank you for your support.

Submit your comments using one of these channels:
- Send your comments to the address on the reverse side of this form.

If you would like a response from IBM, please fill in the following information:

_____   _____
Name   Address

_____   _____
Company or Organization

_____   _____
Phone No.   E-mail address

IBM®

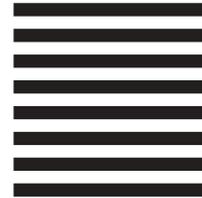Fold and Tape   **Please do not staple**   Fold and Tape

NO POSTAGE
NECESSARY
IF MAILED IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL   PERMIT NO. 40   ARMONK, NEW YORK

POSTAGE WILL BE PAID BY ADDRESSEE

International Business Machines Corporation
Information Development
Department 61D
9000 South Rita Road
Tucson, Arizona 85775-4401

Fold and Tape   **Please do not staple**   Fold and Tape

IBM ®

Printed in USA