

IBM Enterprise Storage Server™



Introduction and Planning Guide

2105 Models E10, E20, F10, and F20

IBM Enterprise Storage Server™



Introduction and Planning Guide

2105 Models E10, E20, F10, and F20

Note!

Before using this information and the product it supports, read the information in "Notices" on page 95.

Sixth Edition (December 2000)

This edition replaces GC26-7294-04.

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Safety and environmental notices

This section contains information about:

- Safety notices that are used in this guide
- Environmental guidelines for this product

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

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

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 Storage Solution Safety Notices* book, GC26-7229.

Product recycling

This unit contains recyclable materials. Recycle these materials at your local recycling sites. Recycle the materials according to local regulations. In some areas, IBM provides a product take-back program that ensures proper handling of the product. Contact your IBM representative for more information.

Disposing of products

This unit may contain batteries. Remove and discard these batteries, or recycle them, according to local regulations.

About this guide

This publication introduces the IBM® Enterprise Storage Server™ (ESS) and lists the features you can order. It also gives guidelines for the following tasks:

- Planning for installation
- Planning communications
- Planning data migration

Who should use this guide

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

Frequently used terms

The following terms appear in this publication to describe the IBM Enterprise Storage Server (ESS) and its configuration. Also see the “Glossary” on page 107 for additional terms and definitions.

Term	Definition
array	An arrangement of related disk drive modules (DDMs) that you have assigned to a group. Also referred to as a rank. For the ESS, an array is a group of up to eight DDMs.
cluster	A partition of a storage server that is capable of performing all functions of a storage server. When a cluster fails in a multiple-cluster storage server, the cluster that remains in the configuration takes over the processes of that cluster.
controller image	A System/390® term for a logical subsystem that you access with an ESCON® I/O interface. One or more controller images exist in each controller. Each image appears to be an independent controller, but all images share a common set of hardware facilities. The ESS can emulate 3990-3, 3990-6, or 3990-3 TPF controller images.
count key data (CKD)	A System/390 term for a logical device that specifies the format of the logical data units on the device. The logical data unit is a track that contains one or more records, consisting of a count field, a key field (optional), and a data field (optional).
device adapter	A physical component of a storage controller that attaches to one or more interfaces. It enables communication between the interfaces and the associated storage devices.
destage	The process of writing modified storage from cache to the disk drive module (DDM).
disk drive module (DDM)	The primary, nonvolatile storage medium that you use for any host data that is stored within a storage server. The number and type of storage devices within a storage server may vary.

Enterprise Systems Connection architecture (ESCON)

1. An ESA/390 computer-peripheral interface. The I/O interface uses ESA/390 logical protocols over a serial interface.
2. A set of IBM products and services that provide a dynamically connected environment within an enterprise.

ESCON

See *Enterprise Systems Connection architecture*.

ESCON channel

A channel that has an ESCON channel-to-controller I/O interface that uses optical cables as a transmission medium.

ESCON host systems

System/390 hosts that you attach to the ESS with an ESCON adapter. Such host systems run on Multiple Virtual Storage (MVS), virtual machine (VM), VSE, or TPF operating systems.

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 *cascaded*.

fibre-channel

Fibre-channel is an architecture that supports full-duplex communication over a serial interface that configures attached units to a communication fabric.

The ESS supports fibre-channel communications for open system hosts through its fibre-channel adapters.

fixed-block (FB) devices

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 you attach with a small computer system interface (SCSI) or fibre-channel interface.

gigabyte (GB)

When referring to hard-disk-drive capacity, GB means 1 000 000 000 bytes; total user-accessible capacity may vary depending on operating environment.

host adapter

A physical component in a storage server that enables the server to attach to one or more host I/O interfaces.

IBM Enterprise Storage Server (ESS)

A member of the Seascope™ product family of storage servers and attached storage devices (disk drive modules). The ESS provides integrated caching and RAID support for the disk drive modules (DDMs). The DDMs are attached through a serial storage architecture (SSA) interface.

logical device	A pointer to a logical volume on a storage server. The pointer enables a host system to access the logical volume. For the ESS, the logical device represents a logical volume.
logical subsystem (LSS)	<p>The LSS is a logical “container” for RAID-5 arrays, disk groups, and the volumes that are located on those arrays or disk groups. One SSA Adapter accesses an LSS primarily. One or more logical subsystems can exist on the ESS. In general, the ESS associates a given set of devices with only one logical subsystem.</p> <p>For System/390 hosts, a logical subsystem represents a controller.</p>
logical unit	The Small Computer System Interface (SCSI) term for a logical disk drive.
logical unit number (LUN)	LUN is a SCSI term for the field in an identifying message that is used to select a logical unit on a given target.
logical volume	<p>The storage medium associated with a logical disk drive. A logical volume typically resides on one or more storage devices. For the ESS, you define this unit of storage; the logical volume resides on a RAID-5 array, and is spread over 6 + P or 7 + P drives, where P is parity. A logical volume can also reside on a non-RAID array on one storage device.</p> <p>For CKD, you can define the logical volume size by the device emulation mode (3390 or 3380 track format). For UNIX[®], Microsoft[®] Windows NT[®], and Microsoft Windows 2000[®] operating systems in the fixed-block format, the size is 0.5 GB to 224 GB. For AS/400[®] operating systems in the fixed-block format, the size is 4.19, 8.59, 17.55, or 36 GB.</p> <p>Note: The AIX[®] operating system views a logical volume as a logical disk or a hard disk (hdisk).</p>
SCSI	See <i>small computer system interface</i> .
SCSI host systems	Identifies host systems that you attach to the ESS with a SCSI interface. Such host systems run on UNIX, OS/400, Windows NT, Windows 2000, or Novell NetWare operating systems.
SCSI ID	A unique identifier (ID) 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. A SCSI device is either an initiator or a target.
service personnel	Individuals or a company that you have authorized to service your ESS. This term also refers to a

service provider, a service representative, or an IBM service support representative (SSR). An IBM SSR installs your ESS.

Small Computer System Interface

An American National Standards Institute (ANSI) standard for a logical interface to computer peripherals and for a computer-peripheral interface. The interface uses a SCSI logical protocol.

staging

To move data from an offline or low-priority device to an online or higher priority device is called staging.

storage server

A unit that manages attached storage devices and provides access to the storage or storage-related functions for one or more attached hosts.

terabyte (TB)

When referring to hard-disk-drive capacity, TB means 1 000 000 000 000 bytes; total user-accessible capacity may vary depending on operating environment.

volume

Refers to a *logical* volume.

Publications

This section describes the ESS library and publications for related products. It also gives ordering information for these publications.

The ESS product library

The ESS is an IBM Seascope architecture-based product. See the following publications for more information on the ESS:

- *IBM Enterprise Storage Server Introduction and Planning Guide*, GC26-7294
This guide introduces the product and lists the features you can order. It also provides guidelines on planning for the installation and configuration of the ESS.
- *IBM Enterprise Storage Server User's Guide*, SC26-7295
This guide provides instructions for setting up and operating the ESS and for analyzing problems.
- *IBM Enterprise Storage Server Host Systems Attachment Guide*, SC26-7296
This book provides guidelines for attaching the ESS to your host system and for migrating from SCSI to fibre-channel attachment.
- *IBM Enterprise Storage Server SCSI Command Reference*, SC26-7297
This book describes the functions of the ESS. It provides reference information for UNIX and Application System/400® (AS/400®) hosts, such as channel commands, sense bytes, and error recovery procedures.
- *IBM Enterprise Storage Server System/390 Command Reference*, SC26-7298
This book describes the functions of the ESS and provides reference information for System/390 hosts, such as channel commands, sense bytes, and error recovery procedures.
- *IBM Storage Solutions Safety Notices*, GC26-7229
This book provides translations of the danger notices and caution notices that IBM uses in ESS publications.
- *IBM Enterprise Storage Server Web Interface User's Guide*, SC26-7346

This book provides instructions for using the IBM StorWatch™ Enterprise Storage Server Web interfaces, ESS Specialist and ESS Web Copy Services.

- *IBM Enterprise Storage Server Configuration Planner*, SC26-7353

This book provides work sheets for planning the logical configuration of the ESS. This book is not available in hardcopy. This book is only available on the following Web site:

www.storage.ibm.com/hardsoft/products/ess/refinfo.htm

- *IBM Enterprise Storage Server Quick Configuration Guide*, SC26-7354

This booklet provides flow charts for using the StorWatch Enterprise Storage Server Specialist. The flow charts provide a high-level view of the tasks the IBM service support representative performs during initial logical configuration. You can also use the flow charts for tasks that you might perform during modification of the logical configuration.

The hardcopy of this booklet is a 9-inch × 4-inch fanfold.

- *IBM Enterprise Storage Server Service Guide*, SY27-7605

This service guide is for the service support representatives who are trained to install and repair the IBM 2105 Models E10/E20 and F10/F20. This service guide is broken into three volumes that contain the following chapters:

- Volume 1: Information, Start, and Isolation
- Volume 2: Repair, Install, and Configure
- Volume 3: Locations, Service Terminal, Codes, Power

Ordering publications

All of the publications that are listed in “The ESS product library” on page xvi are available on a compact disc that comes with the ESS, unless otherwise noted. You can also order a hardcopy of each publication. For publications on compact disc, order *IBM Enterprise Storage Server Customer Documents*, SK2T-8770.

All the customer documents listed above are available on the following ESS Web site:

www.storage.ibm.com/hardsoft/products/ess/refinfo.htm

Related publications

The following related publications are also available:

- *DFSMS/MVS® Version 1 Release 5 Software Support for the IBM Enterprise Storage Server*, SC26-7318

This book describes the changes you need to make to operating systems for System/390 hosts to support the ESS functions.

- *IBM Storage Area Network Data Gateway Installation and User's Guide, 2108 Model G07*, SC26-7304

This book introduces the IBM Storage Area Network (SAN) Data Gateway and provides the procedures for installing and using it.

- *IBM Subsystem Device Driver*

This book describes how to use the IBM Subsystem Device Driver on open-systems hosts to enhance performance and availability on the ESS. The Subsystem Device Driver creates redundant paths for shared logical unit numbers. The Subsystem Device Driver permits applications to run without interruption when path errors occur. It balances the workload across paths, and it transparently integrates with applications.

This publication is not available in hardcopy. However, it is available on the compact disc that is delivered with your ESS. You can also view and copy this publication from the Web site:

www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates/

- *DFSMS Advanced Copy Services*, SC35-0355

This book provides detailed information about Copy Services functions such as Peer-to-Peer Remote Copy (PPRC), Extended Remote Copy (XRC), and FlashCopy.

- *OS/390 MVS System Messages Volume 1 (ABA - ASA)*, SG24-5465

This publication helps you understand and use IBM Advanced Copy Services functions on an IBM System/390. It describes two dynamic-copy functions and several point-in-time copy functions. These functions provide backup and recovery of data should a disaster occur to your data center. The dynamic-copy functions are Peer-to-Peer Remote Copy and Extended Remote Copy, and are known collectively as remote copy. FlashCopy, SNAPSHOT®, and Concurrent Copy are the point-in-time copy functions.

- *IBM Enterprise Storage Server*, SG24-5465

This book, from the IBM International Technical Support Organization, introduces the IBM Enterprise Storage Server (ESS) and provides an understanding of its benefits. It also describes in detail the architecture, hardware and functions of the ESS.

- *Implementing the IBM Enterprise Storage Server*, SG24-5420

This book, from the IBM International Technical Support Organization, can help you install, tailor, and configure the IBM Enterprise Storage Server (ESS) in your environment.

- *IBM Enterprise Storage Server Performance Monitoring and Management*, SG24-5656.

This book, from the IBM International Technical Support Organization, provides guidance on the best way to configure, monitor, and manage your Enterprise Storage Server (ESS) to ensure optimum performance.

- *IBM System/360™ and System/370™ I/O Interface Channel to Control Unit Original Equipment Manufactures' Information*, GA22-6974

This publication provides a description of the interface between System/360, System/370, and System/390 channels and controllers that are designed to operate with this interface. This publication covers the parallel I/O interface. It does not cover the interface between the controller and the I/O device, nor does it cover the ESCON-I/O interface for the System/390.

This publication is for designers of programs and equipment that are associated with parallel I/O interfaces and for service personnel that maintain the equipment. Anyone concerned with the functional details of this interface will also find it useful.

- *Fibre Transport Services (FTS) Direct Attach, Physical and Configuration Planning*, GA22-7234

This publication provides information about fibre-optic and ESCON-trunking systems.

- *DFSMS/MVS Version 1 Remote Copy Guide and Reference*, SC35-0169

This publication provides guidelines for using remote copy functions with System/390 hosts.

- *Implementing ESS Copy Services on S/390*, SG24-6480

This publication tells you how to install, customize and configure Copy Services on IBM Enterprise Storage Server on a S/390 host system. Copy Services

functions include, Peer-to-Peer Remote Copy, Extended Remote Copy, FlashCopy, and Concurrent Copy. This publication describes the functions, pre-requisites and co-requisites. The publication also describes how to implement each of the functions into your environment.

- *Implementing ESS Copy Services on UNIX and Windows NT*, SG24-5757

This publication tells you how to install, customize, and configure Copy Services on an IBM Enterprise Storage Server on the UNIX and Windows NT host system. Copy Services functions include, Peer-to-Peer Remote Copy, FlashCopy, Extended Remote Copy, and Concurrent Copy. Extended Remote Copy and Concurrent Copy are not available for UNIX and Windows NT host systems. They are only available on System/390. This publication describes the functions, pre-requisites and co-requisites. The publication also shows you how to implement each of the functions into your environment. This publication also shows how to implement these solutions in an HACMP cluster.

- *NUMA-Q ESS Integration Release Notes*, Part Number 1003-80094-01

This publication contains information about special procedures and limitations involved in running ESS with Copy Services on a NUMA-Q host system. It is not available through IBM ordering systems. Contact your IBM NUMA-Q sales representative to obtain this document

Web sites

For general information about IBM storage servers, see the following Web site:

- www.storage.ibm.com/hardsoft/products/ess/ess.htm

To view and print the IBM Enterprise Storage Server publications, see the following Web site:

- www.storage.ibm.com/hardsoft/products/ess/refinfo.htm

To get current information about the host system models, operating systems, and adapters that the ESS supports, see the following Web site:

- www.storage.ibm.com/hardsoft/products/ess/supserver.htm

For information about the IBM Subsystem Device Driver, see the following Web site:

www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates/

To attach a SAN or host system that uses an industry-standard, fibre-channel arbitrated loop (FC-AL) through the IBM 2108 SAN Data Gateway Model G07, see the following Web site:

www.storage.ibm.com/hardsoft/products/sangateway/sangateway.htm

For information about the latest updates to Copy Services components XRC, PPRC, SnapShot, Concurrent Copy, and FlashCopy for S/390, see the following Web site:

www.storage.ibm.com/software/sms/sdm/sdmtech.htm

Summary of Changes

Revision bars in the left margin indicate technical changes to this publication. Minor editorial changes are not marked. This edition includes the following major changes:

- Support for the new IBM System/390 eserver zSeries 900 (z900 server)
- Feature codes for a SCSI cable with an additional interposer
- Feature codes for step-ahead storage planning
- Modification to the ESS weight information
- Additional information about the environment for storing an ESS
- Modifications to the information about planning for ESS Copy Services
- New fields for the Communication Resources work sheet:
 - Support Catcher Telephone Number
 - Enable ESS Copy Services commands for IBM System/390 volumes
- A new work sheet for Network Communications for ESS Copy Services

Chapter 1. Introduction

This book provides an overview of the IBM Enterprise Storage Server (ESS) and lists the features that you can order. It also provides guidelines for these tasks:

- Installation planning
- Communications planning
- Data migration planning

For guidelines and work sheets for logical configuration, see the *IBM Enterprise Storage Server Configuration Planner* on the product Web site:

<http://www.storage.ibm.com/hardsoft/products/ess/refinfo.htm>

IBM Enterprise Storage Server overview

This section provides an overview of the IBM Enterprise Storage Server (ESS) and describes its interfaces and components.

The ESS is a member of the Seascape family of storage servers. The ESS provides integrated caching and support for redundant arrays of independent disks (RAID) for the disk drive modules (DDMs). The DDMs are attached through a serial storage architecture (SSA) interface.

The ESS uses peripheral component interconnect (PCI) architecture that is designed to provide high availability and to avoid single points of failure.

The ESS Models E10 and E20 provide 6 GB of cache. The ESS Models F10 and F20 provide 8 GB of cache; an optional 16 GB of cache; and faster PCI architecture.

The ESS provides the following features:

- RAID 5 or non-RAID disk groups
- Fast SSA drives
- Fast reduced instruction-set computer (RISC) processors
- A fault-tolerant system
- Sharing of storage between open-systems hosts
- OS/390[®] parallel input/output (I/O) interface
- Instant copy solutions
- Disaster recovery solutions

Models E20 and F20, with expansion enclosures, can provide up to 11 terabytes (TB) of storage capacity, with a choice of 9.1, 18.2, or 36.4 GB DDMs. When IBM refers to DDM capacity, TB means 1 000 000 000 000 bytes. For processor storage, real and virtual, a TB equals 2⁴⁰ or 1 099 511 627 766 bytes. Total user-accessible capacity may vary depending on the operating environment.

See Figure 1 on page 2 and Figure 2 on page 2 for illustrations of the ESS models and the expansion enclosure. ESS Models E10 and F10 do not support an expansion enclosure.

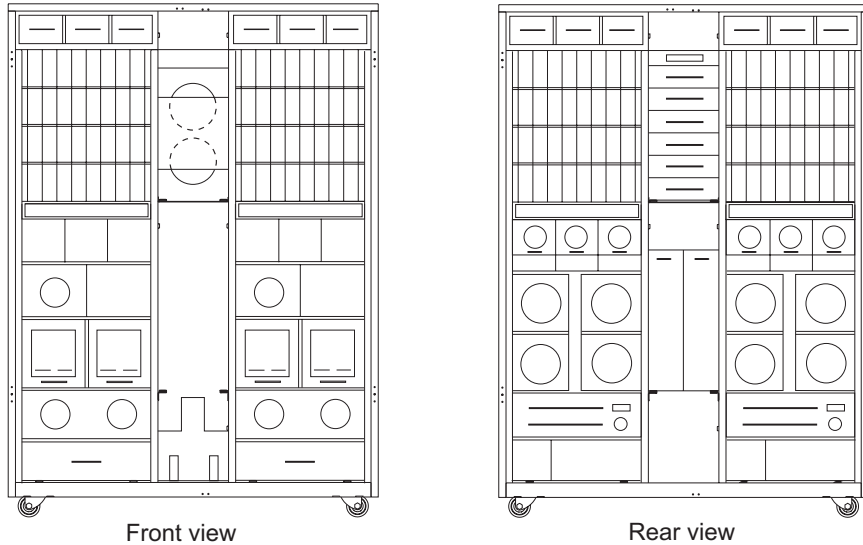


Figure 1. Models E10, E20, F10, and F20; front and rear views

Each ESS expansion enclosure has dual power cables and redundant power. The redundant power system allows both the storage controller and DDMs to continue normal operation when one of the power cables is inactive. Redundancy also ensures continuous data availability.

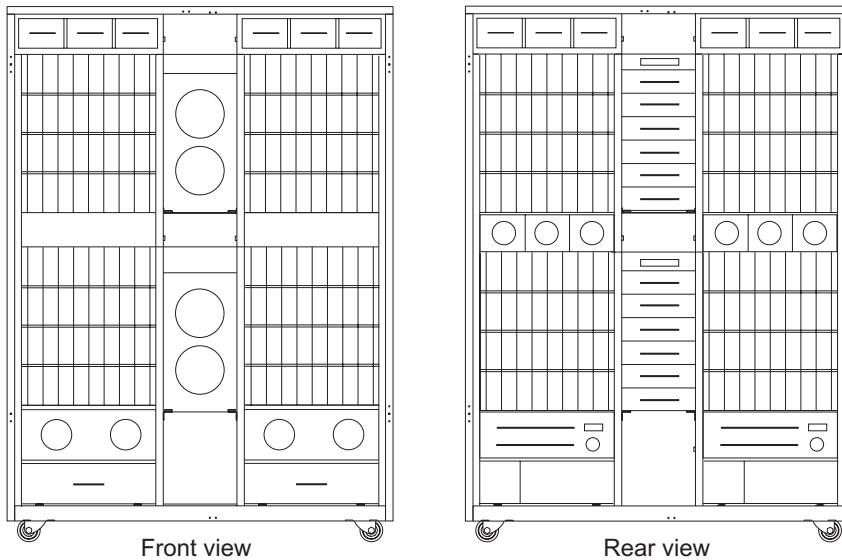


Figure 2. Expansion enclosure, front and rear views

ESS Models E10 and F10 support a maximum of 64 DDMs. The minimum configuration for a Model E10 or F10 base enclosure is 16 DDMs. ESS Models E20 and F20 support a maximum of 128 DDMs. With the expansion enclosure, Models E20 and F20 support a maximum of 384 DDMs.

Host systems supported by the ESS

The ESS provides heterogeneous data storage that you can share between workloads for open-systems hosts. The following sections contain information about:

- Open-systems hosts with small computer system interface (SCSI) adapters

- Open-systems hosts with fibre-channel adapters

Note: Because of possible interactions between host bus adapters in switched configurations, IBM recommends that you establish zones that contain a single port attached to a host bus adapter with the desired number of ports attached to ESS. You can establish the zones by using either the hard (by port) or soft (by WWN) zoning method. You can configure ports that are attached to the ESS in more than one zone, which allows multiple host bus adapters to share access to the ESS fibre-channel ports. Shared access to an ESS fibre-channel port might be from host platforms that use a combination of supported host bus adapter types and operating systems.

SCSI host systems

Each SCSI adapter has two ports. With SCSI adapters you can connect up to 128 host systems when you serially interconnect them. The ESS supports the following host systems for SCSI attachment:

- Hewlett Packard with the HP-UX operating system
- IBM RISC System/6000[®] and RISC System/6000 SP with the IBM AIX operating system
- IBM AS/400 with the IBM Operating System/400 (OS/400) Version 3 or Version 4
- Personal computer servers with Microsoft Windows NT 4.0 operating systems
- Personal computer servers with Microsoft Windows 2000 operating systems
- Sun with the Solaris operating system
- Data General with the DG UX operating system
- Personal computer servers with Novell Netware

See the following ESS Web site for details about types, models, adapters, and the operating systems that the ESS supports for SCSI-attached host systems:

www.storage.ibm.com/hardsoft/products/ess/supserver.htm

Fibre-channel host systems

Each ESS fibre-channel adapter has one port. With fibre-channel adapters you can connect up to 127 host systems. See “Fibre-channel connection” on page 10 for information on the fibre-channel protocols that the ESS supports. The ESS supports the following host systems for fibre-channel attachment:

- IBM RISC System/6000 and RISC System/6000 SP with the IBM AIX operating system
- Personal computer servers with Microsoft Windows NT 4.0 operating systems
- Personal computer servers with Windows 2000 operating systems
- IBM NUMA-Q with DYNIX/ptx
- Hewlett Packard with the HP-UX operating system
- Personal computer servers with Novell NetWare
- Sun with the Solaris operating system

See the following ESS Web site for details about types, models, adapters, and the operating systems that the ESS supports for fibre-channel attached host systems:

www.storage.ibm.com/hardsoft/products/ess/supserver.htm

System/390 host systems

With ESCON adapters, the ESS supports up to 32 connections for System/390 host systems, each with up to 64 logical paths. IBM attaches an ESS to a System/390 server for fibre-channel connection (FICON™) through the bridge card on the IBM 9032 Model 005 ESCON Director.

The ESS supports the following operating systems:

- OS/390
- Multiple Virtual Storage/Enterprise Storage Architecture (MVS/ESA™)
- Virtual Machine/Enterprise Storage Architecture (VM/ESA®)
- Virtual Storage Extended/Enterprise Storage Architecture (VSE/ESA™)
- Transaction Processing Facility (TPF)

The ESS also supports the following operating systems for the new IBM eserver zSeries 900 (z900 server):

- z/OS Version 1 Release 1
- OS/390 Version 2 Release 6 or higher
- VM
 - z/VM Version 3 Release 1
 - VM/ESA Version 2 Release 2
 - VM/ESA Version 2 Release 3
 - VM/ESA Version 2 Release 4
- VSE/ESA Version 2 Release 3 and higher
- Transaction Processing Facility (TPF) Version 4 Release 1

See the preventive service planning (PSP) bucket for operating system support and planning information that includes APARs and programming temporary fixes (PTFs).

For additional information about the changes you need to make to System/390 hosts to support ESS functions, see *DFSMS/MVS Version 1 Release 5 Software Support for the IBM Enterprise Storage Server*.

For information about the latest updates to Copy Services components XRC, PPRC, SnapShot, Concurrent Copy, and FlashCopy for S/390, see the following Web site:

www.storage.ibm.com/software/sms/sdm/sdmtech.htm

Web interfaces

This section describes the Web security, the ESSNet, and the Web interfaces for ESS. The Web interfaces include:

- StorWatch Enterprise Storage Server Specialist (ESS Specialist)
- StorWatch Enterprise Storage Server Web Copy Services (ESS Web Copy Services) that supports Web Interfaces to manager peer-to-peer remote copy or FlashCopy.
- StorWatch Expert, an optional software product

See your IBM Field office for information about how to order StorWatch Expert. See the *IBM Enterprise Storage Server Web Interface User's Guide* which provides detailed descriptions of the ESS Specialist and the ESS Web Copy Services interfaces and how to use them.

Web connection security

You connect to the ESS through the ESSNet.

All data that is sent between the ESS and the Web browser through the ESSNet is encrypted to avoid unauthorized modification of configuration commands. Passwords and authorization levels protect access to the interface.

You control user access by assigning levels of access and passwords.

IBM Enterprise Storage Server Network

The IBM Enterprise Storage Server Network (ESSNet) is a private network resident on an IBM workstation. It is a required feature. IBM installs the ESSNet when they install your IBM Enterprise Storage Server. The ESSNet hardware includes:

- The IBM workstation (a PC) and monitor
- An external Ethernet hub that provides cable connections from the ESSNet to the IBM Enterprise Storage Server. The hub speed is 10 megabits per second (Mbps) or 10/100 megabits per second, depending on your system.

Note: You can attach your Ethernet LAN to the external hub. You provide any hardware that is needed for this connection.

- A modem and a modem expander that allow your ESS to communicate between you and IBM

Note: The feature code for Remote Service Support includes the modem and modem expander.

The ESSNet includes the following software on the workstation:

- Windows NT 4.0 operating system
- Browser software (Microsoft Internet Explorer and Netscape Navigator) that allows access to the ESS Specialist
- The ESSNet application for installation and configuration. The ESSNet workstations includes an HTML page that provides links to all ESS connected to the ESSNet for Specialist access.

The ESSNet provides the following features:

- Support for multiple ESSs. A hub with 16 ports will support 7 ESSs.
- Connectivity between your ESS and the ESS Specialist Web interface. The ESSNet provides browser software at the appropriate level for this connection.
- Improvements in Web performance compared to previous Web browser connections.
- Faster network connectivity and elimination of network setup problems when using previous Web connections.
- Ethernet connectivity through an Ethernet hub to the ESSNet.
- An independent platform that facilitates installation and configuration of the ESS.
- Software for maintenance and configuration.

IBM installs the ESSNet when they install your first IBM Enterprise Storage Server.

Accessing ESS Specialist and ESS Web Copy Services

You access the IBM StorWatch Enterprise Storage Server Specialist (ESS Specialist) from the ESSNet. The ESSNet includes browser software for this access. You access ESS Web Copy Services from the ESS Specialist Navigation frame.

You can access ESS Specialist from your own workstation if you connect the ESSNet into your intranet by using one of the ports on the ESSNet hub. If you use your own workstation IBM recommends at least 128MB of memory in the workstation. You can access the ESS Specialist by using a browser that is fully enabled for Java(TM) 1.1.x. The ESS Specialist supports the following browsers:

- Netscape Navigator Version 4.04 or greater, which supports Windows NT and Windows 95.

Note: Version 4.04 requires Java 1.1 fixpack; later versions such as 4.5 may not require this fixpack. For better web performance, IBM recommends using Netscape Navigator Version 4.5.1 or greater.

- Microsoft Internet Explorer (MSIE) Version 4.0 or greater, which supports Windows NT and Windows 95.

Note: Version 4.0 requires Service Pack 1.

The ESSNet PC is pre-loaded with current release levels of Microsoft Internet Explorer and Netscape Navigator.

If you do not choose to attach ESSNet into your intranet, you can only access ESS Specialist from a browser on the ESSNet workstation.

You must provide another network connection to the remote ESS through ESSNet hubs for Copy Services support.

IBM updates ESS Specialist and ESS Copy Services through engineering changes (ECs).

ESS Specialist

The ESS includes the ESS Specialist. The ESS Specialist is a Web-based interface that allows you to configure the ESS.

From the Web interface, you can perform the following tasks:

- Monitor error logs
- View and change the configuration:
 - Add or delete SCSI and fibre-channel host systems
 - Configure SCSI host ports and fibre-channel host ports on the ESS
 - Define controller images for System/390
 - Define fixed-block (FB) and count-key-data (CKD) disk groups
 - Add FB and CKD volumes
 - Assign volumes to be accessible to more than one host system
 - Change volume assignments
- Change and view communication resource settings, such as electronic mail (e-mail) addresses and telephone numbers
- Authorize user access

With the ESS Specialist, you can view the following information:

- The external connection between a host system and an ESS port
- The internal connection of SCSI ports and fibre-channel ports to cluster 1 or cluster 2
- The allocation of storage space to FB and CKD volumes

IBM updates the ESS Specialist through licensed internal code (LIC) updates.

ESS Copy Services

ESS Copy Services collects information from your IBM storage servers onto a single Copy Services server. The ESS supports Copy Services through both a Web-based interface and a command-line interface.

This section describes the two interfaces for ESS Copy Services, shows an example of the connections between two Copy Services server groups, and gives you an overview of the functions you can perform using the ESS Web Copy Services panels.

Web-based interface: The ESS Web Copy Services interface initiates and manages Peer-to-Peer Remote Copy (PPRC) and FlashCopy functions for open systems and IBM System/390 hosts.

You access ESS Web Copy Services from the ESS Specialist Navigation frame.

Command-line interface: If you choose to install the command-line interface (CLI) application on your host system, you can write customized scripts using CLI commands. You can execute the CLI commands from a host system. You can use the CLI commands to invoke Copy Services tasks in an ESS Web Copy Services server.

The command-line functions (TSO or API) on IBM System/390 hosts initiate and manage Extended Remote Copy (XRC), Concurrent Copy, FlashCopy and PPRC. An API has been developed which uses the TSO command line function. For more information, see *OS/390 DFSMSdfp Advanced Services*.

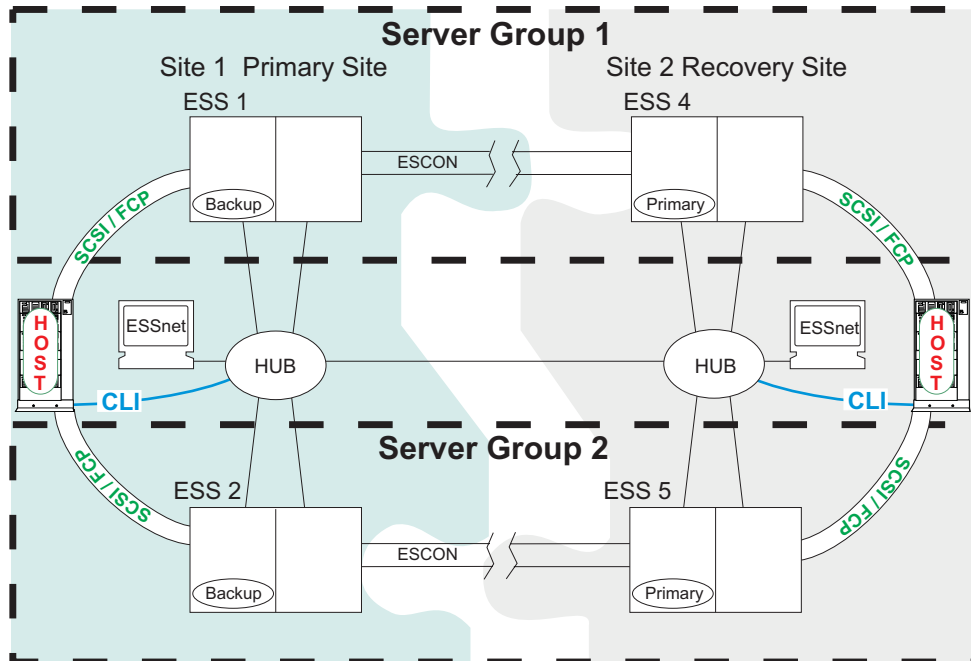
The CLI on the open-systems hosts initiates and manages PPRC and FlashCopy on ESS.

See *IBM Enterprise Storage Server Host Systems Attachment Guide* for information about using the Copy Services command-line interface from your open systems hosts to invoke Copy Services functions. See the web site at

<http://www.ibm.com/storage/hardsoft/products/ess/refinfo.htm>

for information on which open systems host platforms are supported for CLI. The command-line interface (CLI) is updated when a new LIC is provided.

Copy Services server groups: Figure 3 on page 8 shows the connections between two ESS Web Copy Services server groups. A Copy Services server group is a collection of ESS clusters that participate in Copy Services functions that include the volumes within the clusters.



CS000005

Figure 3. Connecting to ESS Web Copy Services server groups

Copy Services panels: Use the ESS Web Copy Services panels to view and define:

- **Volumes**

The volumes panel allows you to view volumes and define them as source or target volumes for PPRC or FlashCopy.

- **Storage Server**

The Storage Server panel allows you to work with logical servers as complete entities. You can build tasks to place all the volumes of a logical server within a peer-to-peer relationship with all the volumes of another logical server.

You can also build a task to remove similar groups of volumes from an existing peer-to-peer relationship.

You can determine the function of Consistency Groups and freeze and create commands.

- **Paths**

The Paths panel displays the current status of paths between an ESS and the other ESSs or switches to which it is connected. The paths panel also shows ESCON connected hosts and channel extenders.

You can use the paths panel to add or remove copy services paths or to create consistency group relationships for the LSS pairs.

- **Tasks**

The Tasks panel allows you to manage tasks you have defined. You can run, remove, save, group, or ungroup tasks. The host system command line interface function uses these predefined tasks.

- **Configuration**

The Configuration panel allows the customer to view the copy services event and timing logs, set password protection, refresh the panels and mail logs to a specified userid.

ESS Expert

The IBM StorWatch Enterprise Storage Server Expert (ESS Expert) is an optional software feature of the IBM StorWatch Expert. The StorWatch Expert can be purchased to use with the ESS. The StorWatch Expert Web interface provides storage-resource management for the IBM storage servers.

- Asset management
StorWatch Expert collects and displays asset management data on all of your ESSs.
- Capacity management
StorWatch Expert collects and displays capacity management data on all of your ESSs.
- Performance management
StorWatch Expert collects and displays performance management data on all of your ESSs. For example:
 - Number of I/O requests
 - Number of bytes transferred
 - Read and write response time
 - Cache usage statistics

The IBM StorWatch Expert allows you to schedule the information collection. With this information, you can make informed decisions about volume placement and capacity planning as well as isolate I/O performance bottlenecks.

Service interface

The ESS provides service interface ports for external connection of a service terminal.

IBM or your service provider can perform service on the ESS by using an IBM mobile service terminal (MoST) or equivalent.

Remote services support

The ESS service interface also provides remote service support with call-home capability for directed maintenance for service personnel.

You provide an analog telephone line to enable this support. The service interface provides an RS232 connection through a modem switch and modem to the analog telephone line.

You need to order a modem and modem switch. The first ESS you order requires this equipment. The modem and modem switch support up to seven ESSs. The cable length from the ESS to the modem switch should be a maximum of 15 m (50 ft.).

The ESS provides the following service functions:

- Continuous self-monitoring initiates a call (call home) to service personnel if a failure has occurred. Because service personnel who respond to the call know about the failing component, the service personnel can reduce the repair time.
- Error and problem logs are available that service personnel can access remotely to analyze potential failures.
- Remote support allows the ESS to correct many types of problems. When the ESS reports a problem, service personnel can often correct the problem from a remote location.

Configuration

IBM logically configures your ESS during installation using the work sheets that you completed from the *IBM Enterprise Storage Server Configuration Planner*. After IBM installs the ESS, you can perform additional configuration by using the ESS Web interfaces. You can also change the remote service functions.

Fibre-channel connection

The ESS provides fibre-channel connection to open-systems hosts that it supports. Fibre-channel interconnection architecture provides a variety of communication protocols on the ESS. The units that are interconnected are referred to as *nodes*. Each node has one or more ports.

An ESS is a node in a fibre-channel network. Each port on an ESS fibre-channel host adapter is a fibre-channel port. A host is also a node in a fibre-channel network. Each port attaches to a serial-transmission medium that provides duplex communication with the node at the other end of the medium.

With fibre-channel technology, the distance between an ESS and attached host systems increases from the 25 m (75 ft) maximum imposed by SCSI connections up to 500 m (1500 ft). The ESS can be up to 11 km (6.8 mi) from your host when you connect to it with an IBM SAN fibre-channel switch. The ESS can also be the same distance from your host when you connect to it with an IBM fibre-channel storage hub.

ESS architecture supports three basic interconnection topologies:

- Point-to-point
- Switched fabric
- Arbitrated loop

Point-to-point topology

The point-to-point topology, also known as direct connect, allows you to interconnect ports directly. Figure 4 shows an illustration of a point-to-point topology.



S008944L

Legend

- 1** is the host system.
- 2** is the ESS.

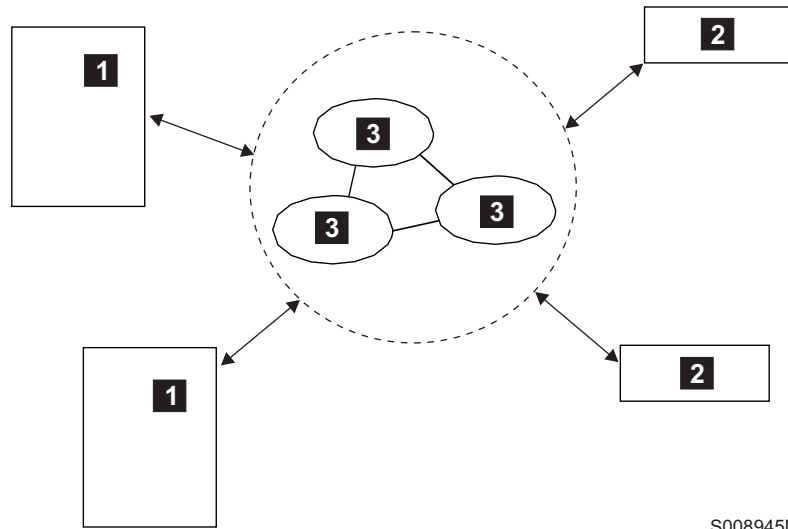
Figure 4. Point-to-point topology

Switched fabric topology

The switched fabric topology provides the underlying structure that allows you to interconnect multiple nodes. You can use a fabric that provides the necessary switching functions to support communication between multiple nodes. You can implement a fabric by using available vendor products that the ESS supports. For a list of these vendor products, see the ESS Web site at:

- www.storage.ibm.com/hardsoft/products/ess/supserver.htm

The ESS supports the switched-fabric topology with point-to-point protocol. The ESS fibre-channel adapter should be configured to operate in point-to-point mode when you connect it to point-to-point topologies or fabric topologies. See Figure 5.



Legend

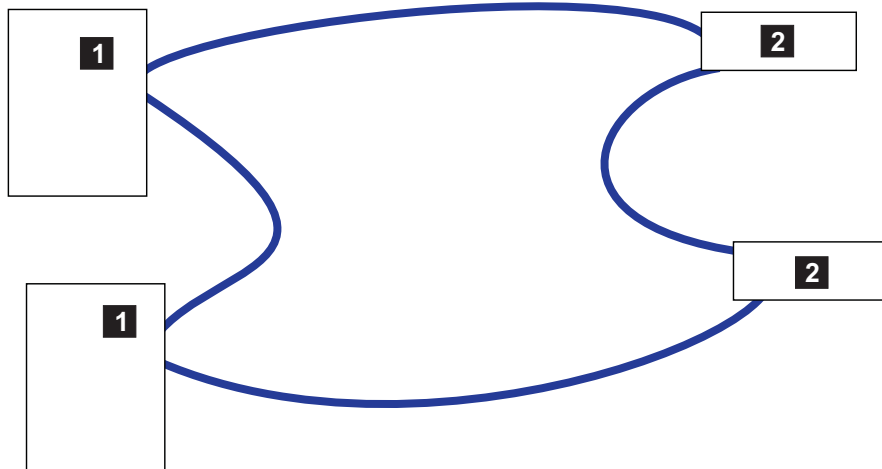
- 1** is the host system.
- 2** is the ESS.
- 3** is a switch.

Figure 5. Switched fabric topology

Arbitrated loop

Fibre-channel arbitrated loop (FC-AL) is a ring topology that allows you to interconnect a set of nodes. The maximum number of ports you can have for a fibre-channel arbitrated loop is 127. See Figure 6 on page 12.

The ESS supports FC-AL as a private loop. It does not support the fabric-switching functions in FC-AL.



S008943N

Legend

- 1** is the host system.
- 2** is the ESS.

Figure 6. Arbitrated loop topology

Introducing the IBM Subsystem Device Driver

The IBM Subsystem Device Driver resides in the host server with the native disk device driver for the ESS. It uses redundant connections between the host server and disk storage in an ESS to provide enhanced performance and data availability. Figure 7 on page 13 is an example of the type of configuration that IBM Subsystem Device Driver supports. These connections comprise many different components through which data flows during input and output processes. Redundancy and the ability to switch between these components provides many different paths for the data to travel. In the event of failure in one input-output path, it automatically switches to another input-output path. This automatic switching in the event of failure is called *failover*.

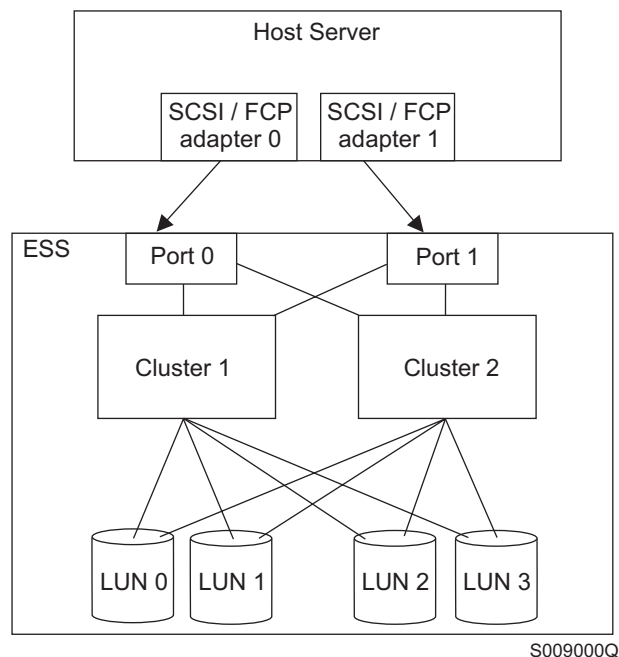


Figure 7. Multipath connections between a host server and ESS LUNs

The IBM Subsystem Device Driver provides the following functions:

- Enhanced data availability
- Automatic path failover and recovery to an alternate path
- Dynamic load balancing of multiple paths
- Path selection policies for the AIX operating system
- Concurrent download of licensed internal code

In most cases, host servers are configured with multiple host adapters with SCSI or fibre-channel connections to an ESS that, in turn, provides internal component redundancy. With dual clusters and multiple host interface adapters, the ESS provides more flexibility in the number of input-output (I/O) paths that are available.

When there is a failure, the IBM Subsystem Device Driver reroutes I/O operations from the failed path to the remaining paths. This function eliminates the following connections as single points of failure: a bus adapter on the host server, an external SCSI cable, a fiber-connection cable, or a host interface adapter on the ESS.

In addition, multipath load balancing of data flow prevents a single path from becoming overloaded with I/O operations.

The IBM Subsystem Device Driver path recovery algorithms now test *Dead* paths that are not manually offline every 30 minutes.

Concurrent download of licensed internal code is the capability to download and install licensed internal code on an ESS while applications continue to run. During the time when new licensed internal code is being installed in an ESS, the upper interface adapters inside the ESS may not respond to host I/O requests for approximately 30 seconds. The IBM Subsystem Device Drivers makes this transparent to the host through its path selection and retry algorithms.

Note: For updated and additional information not included in this publication, see the README file on the IBM Subsystem Device Driver compact disk recordable (CDR) or visit the Subsystem Device Driver Web site at:
www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates/

IBM Enterprise Storage Server availability features

This section describes the following enhanced data availability features that the ESS offers for hosts with UNIX, OS/400, Windows NT, and Windows 2000 operating systems and for System/390 hosts:

- Redundant array of independent disks (RAID)
- Predictive failure analysis
- Failover protection
- Sparing
- Fibre-channel support (on supported host systems)
- Storage area network (SAN) support
- Cache
- Nonvolatile storage
- Concurrent maintenance
- FlashCopy (not supported for OS/400)
- Peer-to-Peer Remote Copy (not supported for OS/400)
- IBM Subsystem Device Driver

This section also describes data availability features that are available *only* for:

- Open host systems. See “UNIX, Windows NT, and Windows 2000 availability features” on page 18.
- System/390 hosts. See “System/390 availability features” on page 19.

Enhanced data availability for some host systems is also available with the following software. The software automatically uses a secondary path (from a secondary server) if a failure occurs.

- HACMP, for mirroring, for RS/6000 host systems
- Similar software for other non-IBM host systems
- System/390 hosts running TPF can use routines that ensure volume redundancy

Redundant array of independent disks implementation

The IBM Enterprise Storage Server protects all storage with redundant arrays of independent disks (RAID). An array is an ordered collection of physical devices (disk drives) that are used to define logical volumes or devices.

The ESS attaches disk drive modules (DDMs) in RAID-5 configurations. The implementation of RAID-5 configurations distributes (stripes) parity across all DDMs in the array. The ESS requires two spare DDMs per loop. With two spares, a loop can have two DDM failures and still allow you to access data.

Implementation of RAID-5 data striping supports independent accesses to the DDMs. The dual-loop device interface card provides the RAID-5 protection on the ESS.

All DDMs on a single loop must be of the same capacity.

In the event of a DDM failure, the ESS can regenerate data from the other DDMs in the array.

Non-RAID disk group support

The ESS supports non-RAID arrays also. If you format the DDMs as a non-RAID group, then the array is a single DDM.¹

Predictive failure analysis

The DDMs in the ESS provide state-of-the-art failure analysis techniques that predict errors *before* they affect data availability.

The DDM, which is continuously performing predictive failure analysis of device failure conditions, notifies the IBM Enterprise Storage Server of impending hardware failures.

Failover protection

The ESS includes the failover protection feature.

If one of the clusters fails, the ESS temporarily transfers all ports over to the remaining cluster so that data access can continue. See “Nonvolatile storage” on page 16 for additional information on cluster redundancy.

Sparing

The sparing function of the ESS is automatically called whenever a DDM failure is detected. The ESS maintains data access during the sparing operation.

Note: The first two arrays on a loop include a spare.

When the ESS detects a DDM failure in a loop, it automatically uses a spare DDM to replace the failing DDM. The ESS reconstructs the data on the spare DDM by using redundant information from the remaining DDMs in the array.

If a DDM fails, a loop reconfigures itself into two loops. Once service personnel have replaced the DDM, the loop automatically resumes normal operation as a single loop. Neither the host system nor the operator needs to take any action.

Fibre-channel support

The ESS provides fibre-channel connection when your IBM SSR installs a Fibre-channel adapter card (short wave) in the ESS. See “Fibre-channel connection” on page 10 for a description of fibre-channel topologies that are supported by the ESS.

For more information on host adapters and operating system attachments that the ESS supports on the fibre-channel adapter see the ESS Web site:

<http://www.storage.ibm.com/hardsoft/products/ess/supserver.htm>

IBM also provides fibre-channel connection through the IBM 2108 SAN Data Gateway, Model G07. You can get the details on fibre-capable server models, adapters, and operating systems on the Web at:

<http://www.ibm.com/storage/SANGateway>

1. Disk storage on an ESS is available in a package of eight DDMs, which IBM calls an 8-pack.

The ESS provides fibre-channel connectivity to System/390 host systems with the IBM 9032 Model 005 ESCON director. The 9032 FICON-bridge option provides connection and switching among FICON channels and ESCON controllers.

Cache

The ESS provides the following cache features that improve performance:

- 8-GB standard cache and 16-GB optional cache for Models F10 and F20
- 6-GB standard cache for Models E10 and E20
- Fast read from cache

The ESS improves performance by using algorithms to store data in cache tracks that have the greatest probability of access by a read operation.

- Asynchronous write

The ESS provides improved write performance by completing an operation without accessing DDMs.

- Least-recently-used (LRU) replacement

The ESS checks tracks at the top of the cache LRU list for updates in cache that are not on the DDM. The ESS schedules tracks at the top of the nonvolatile storage LRU list for destaging. The ESS can then allocate the tracks without a delay during destaging.

- Internal error recovery

The ESS performs error recovery on DDM-to-cache operations.

Nonvolatile storage

The ESS provides 384 MB of nonvolatile storage (NVS) with all models. Cluster 1 and cluster 2 each have 192 MB of NVS, which enables them to store a second copy of write data. This ensures data integrity in the event of a power failure.

The NVS for cluster 1 is located in cluster 2; cluster 2 NVS is stored in cluster 1. Should a cluster fail, the remaining cluster can access the data from the failed cluster. Battery backup power protects NVS in each cluster.

Concurrent maintenance

The ESS supports concurrent maintenance. Service personnel can replace a failed component, such as a disk drive module (DDM), without shutting down the entire system. Your host system continues to access data while service personnel replace the component in the ESS.

FlashCopy

The FlashCopy feature provides an instant or point-in-time copy of a logical volume. FlashCopy makes it possible for you to access both the source copies and the target copies. This enables applications that use either the source copy or target copy to operate almost without interruption. The source and target volume must both be within the same logical subsystem.

The ESS supports FlashCopy on System/390 hosts and open system hosts (SCSI or fibre channel). FlashCopy is not supported on AS/400 host systems. You can initiate and use FlashCopy from the ESS Web Copy Services interface. See the *IBM Enterprise Storage Server Web Interface User's Guide* for more information.

If a volume is reserved by host application software it cannot be used as a target volume for FlashCopy.

You can also use the command line interface to initiate Copy Services commands from your open host system. See the *IBM Enterprise Storage Server Host Systems Attachment Guide* for more information on the command-line interface.

A FlashCopy relationship is between CKD volumes or FB LUNs. This relationship exists from the time you initiate a FlashCopy operation:

- Until the ESS copies all data from the source to the target, or
- Until you withdraw the FlashCopy relationship

For System/390 hosts, the FlashCopy feature provides instant replication of a full CKD volume.

After a FlashCopy operation, track images on the source volumes and the target volumes are independently available for data read and write operations. You can use FlashCopy to create copies for:

- Disaster recovery
- Business intelligence applications
- Use in a test environment
- Instant checkpoints

Note: For System/390 hosts you can use TSO to invoke these functions for MVS™.

While your critical applications continue using the source volume, you can define and initiate a FlashCopy from the ESS Specialist Web interface. Once you have defined and initiated the target volume, it is available to you for tasks such as asynchronous backup.

See “FlashCopy and PPRC restrictions for open system hosts” on page 18 for additional information about FlashCopy.

Peer-to-Peer Remote Copy

The Peer-to-Peer Remote Copy (PPRC) feature allows synchronous copying of a physical volume (the source) on one storage server to another volume (the target) on a second storage server. PPRC ensures write operations on both local and remote copies. The ESS supports PPRC on System/390 hosts and open system hosts (SCSI or fibre channel). PPRC is not supported on AS/400 host systems.

Note: A PPRC target cannot be accessed until the PPRC relationship is ended, that is the target volume is no longer part of a PPRC pair.

If a volume is reserved by host application software it cannot be used as a secondary volume for PPRC.

You need to connect the ESSNet to both the primary and recovery sites through your LAN to initiate PPRC operations for SCSI and fibre-channel attached hosts.

- The primary storage server (application site) establishes the paths and links to a secondary storage server (recovery site). The primary storage server also manages the synchronous copying of the volume from the primary site to the secondary site. The remote secondary server can be up to 103 km from the primary server.
- From the primary host, the I/O operation to the secondary storage server is transparent.

The PPRC feature requires that you install ESCON adapters on the ESS. The ESCON adapter provides the link between a primary and a secondary server. More than one ESCON link increases the reliability and availability of the PPRC feature.

You can use the ESS Web Copy Services interface to:

- Initiate and terminate the functions
- Suspend a copy operation
- Query the status of volumes
- Perform predefined tasks

Also, with PPRC, a recovery host has the ability to recover control of the secondary volume.

For System/390 hosts you can use TSO to invoke these functions for MVS. For the procedures for using TSO for PPRC functions, see *DFSMS/MVS V1 Remote Copy Guide and Reference*.

For open system hosts you can use the ESS Web Copy Services command-line interface to invoke these functions. For more information on the command-line interface see the *IBM Enterprise Storage Server Host Systems Attachment Guide*.

See “FlashCopy and PPRC restrictions for open system hosts” for additional information about PPRC.

FlashCopy and PPRC restrictions for open system hosts

When you copy a source volume to a target volume with FlashCopy or PPRC, and you require concurrent read/write access of both volumes, the source and target volumes should be on different host systems. A copy operation with the source and target volume on the same host system creates a target volume with the same identification as the source volume. The host system sees two identical volumes.

When the copy process creates the same identification for the target volume as for the source volume the user cannot distinguish one from the other, so the user may not be able to access the original data.

Note: For some operating systems, such as Novell NetWare, the user is unable to access either the source or target volume. Although both data sets are intact, they are invisible to the user.

The target volume and the source volume can be on the same host system for a PPRC or FlashCopy operation only under the following conditions:

- For AIX: when the host system is using a Logical Volume Manager (LVM) with **recreatevg** command support
- For AIX, SUN, and HP: when the host system is **not** using an LVM
- For any host system: when the host system can distinguish between a source and a target volume that have the same identification

UNIX, Windows NT, and Windows 2000 availability features

This section describes UNIX, Windows NT, and Windows 2000 availability features, which include:

- Data sharing
- IBM Subsystem Device Driver

Data sharing

You can use the ESS to share data among multiple UNIX-based homogeneous host systems and host systems with Windows NT and Windows 2000. Use the correct application code or database manager to regulate concurrent read or write access.

For example:

- You could assign an 8-GB disk partition (logical volume) to multiple separate UNIX-based host systems.

If host systems are using software that can regulate access to data, then one host system could write data while a second host system initiates a query.

- Two IBM RS/6000 host systems with the Oracle Parallel Edition could also share a single copy of data.

Oracle also runs with other UNIX operating systems.

Application software or database manager software is responsible for the integrity of the database. This includes access management and access locking. The ESS provides the physical access to the data. Sharing of data is now possible without transferring files, creating second copies of data, or other methods that you may have used previously.

IBM Subsystem Device Driver

You can install the IBM Subsystem Device Driver in your open host system to improve data availability and performance. The IBM Subsystem Device Driver uses redundant connections between the host server and disk storage in an ESS. These connections comprise many different components through which data flows during input and output processes.

Redundancy and the ability to switch between these components provides many different paths on which the data travels. See *IBM Subsystem Device Driver, Version 1 Release 1* for more information.

System/390 availability features

This section describes the following availability features and other System/390 functions:

- Extended remote copy
- Using Extended Remote Copy for outages
- Concurrent Copy
- Multiple allegiance
- Parallel Access Volumes

For more detailed descriptions of extended remote copy and concurrent copy and procedures about how to use them, see *IBM Advanced Copy Services*.

Extended Remote Copy

The ESS supports the Extended Remote Copy (XRC) feature on System/390 hosts. XRC mirrors data on the ESS to a remote location for disaster recovery. It ensures data consistency across all volumes that you have defined for mirroring. The volumes can reside on several different ESSs. XRC can mirror the volumes over several thousand kilometers from the primary site to the recovery site.

Using Extended Remote Copy for outages

With ESS XRC you can suspend or resume service during an outage. You do not have to terminate your current data-copy session. You can suspend it and restart it.

Only data that has changed during the outage needs to be resynchronized between the copies, a simple operation that greatly reduces resynchronization time.

Note: The ESS supports this function on System/390 MVS operating systems only.

If you need to change the default setting for an outage, you can do so through the ESS Copy Services Web interface. The Copy Services servers must be identified and set up by IBM service personnel prior to your using the ESS Copy Services Web interface.

See the *IBM Enterprise Storage Server Web Interface User's Guide* for the procedures for changing the XRC time-out from the ESS Copy Services Web interface.

Concurrent Copy

The ESS supports the Concurrent Copy feature on System/390 hosts. Concurrent Copy, like FlashCopy, creates point-in-time copies of volumes. However, Concurrent Copy can also copy data sets from a source volume. It can copy the data to tape, an optical library or to another DASD device. Data systems like the IBM DB2[®] product, can also initiate Concurrent Copy.

Multiple allegiance

The Multiple Allegiance feature allows the ESS to accept an input/output (I/O) request from each channel path group for a unit address. The request can be concurrent with other I/O requests. The ESS queues requests and then initiates them. This allows you to have multiple access to a shared volume (logical device) without affecting performance.

Using the Multiple Allegiance feature can improve ESS throughput and performance.

Parallel Access Volume

The Parallel Access Volume (PAV) feature allows you to access a CKD volume on an ESS in parallel. With PAV, you assign a base address to a CKD logical device. You can use any of the 256 available addresses as the base device address. You then configure alias addresses for the CKD logical device.

You can then dynamically reassign any configured alias address from one CKD logical device to another CKD logical device. Address types are:

- Base address

The base address is the unique unit address of a volume. The ESS associates storage space with this address.

- Alias address

You can assign several alias addresses to the base address. The ESS runs I/O operations to the alias address against the base address.

With PAV, a single System/390 can simultaneously process multiple I/O operations to the same logical volume. This can reduce volume contention.

See the *IBM Enterprise Storage Server User's Guide* for more information on using PAV.

Descriptions and comparisons of the IBM Enterprise Storage Server models

This section describes the ESS models and features.

Power differences between models

Table 1 shows the power differences between the ESS models.

Table 1. Power differences between ESS models

Attribute	Models E10 and F10	Models E20 and F20
Dual power cords	Yes	Yes
Power	Single phase (50/60 A)	Three phase (50/60 A)
DDM support	16 - 64	16 - 128

Features

Table 2 compares the ESS features that are available for hosts that have small computer system interface (SCSI) interfaces with hosts that have Enterprise Systems Connection (ESCON) interfaces.

Table 2. IBM Enterprise Storage Server feature comparison

Feature	Host Systems with SCSI or Fibre-Channel Interfaces	Host Systems with ESCON Interfaces
Attachment	Parallel attachment, SCSI <ul style="list-style-type: none"> • 1 - 15 targets per bus • 1 - 64 logical units per target 128 fibre-channel attached hosts per fibre port (see "Fibre-channel host adapters" on page 30 for information on loop topology)	ESCON attachment <ul style="list-style-type: none"> • 1 - 16 controller images • 1 - 256 devices per control unit image
Host systems supported	<ul style="list-style-type: none"> • IBM AS/400 • IBM RS/6000 and RS/6000 SP • HP 9000 • Sun • Compaq AlphaServer • Data General • IBM Netfinity and Intel-based PCs • IBM NUMA-Q 	<ul style="list-style-type: none"> • IBM ES/9000 • IBM 3090 • IBM S/390 Models 7060, 9672, and 2003
Control unit emulation	No	<ul style="list-style-type: none"> • 3990 Model 3, Model 3 transaction processing facility (TPF), and Model 6 • Models E10, F10, E20, and F20
Host adapters, 2 - 16 (See Note 1.)	<ul style="list-style-type: none"> • Ultra-SCSI, dual port (for attaching host systems with SCSI-2 or SCSI-3 adapters) • Fibre channel, single port (for attaching host systems with fibre-channel adapters) 	ESCON
Software device drivers	<ul style="list-style-type: none"> • AS/400 hosts <ul style="list-style-type: none"> – 9337 Models 580, 590 • UNIX , Window NT and Windows 2000 hosts <ul style="list-style-type: none"> – Models E10, E20, F10, and F20 	MVS, VM, VSE, TPF

Table 2. IBM Enterprise Storage Server feature comparison (continued)

Feature	Host Systems with SCSI or Fibre-Channel Interfaces	Host Systems with ESCON Interfaces
Disk drive module (DDM) format	Fixed block address (FBA)	Count key data (CKD)
Peer-to-Peer remote copy (PPRC) (See Notes 2 and 3.)	Yes	Yes
Concurrent Copy	No	Yes
Extended Remote Copy (XRC)	No	Yes
XRC planned outage	No	Yes (MVS operating systems)
FlashCopy (See Note 3.)	Yes	Yes
IBM Subsystem Device Driver (see Note 1 below)	Yes	No
Multi-path locking facility (MPLF)	No	Yes
Multiple allegiance	No	Yes
Parallel-access volume	No	Yes
Notes:		
<ol style="list-style-type: none"> 1. See the ESS web site at www.ibm.com/storage/hardsoft/products/ess/refinfo.htm for details about host-system adapters supported with the ESS. See the following web site for details 2. This feature requires that you install an ESCON adapter on both the primary ESS and the secondary ESS. 3. The ESS does not support PPRC or FlashCopy on the AS/400. 		

Table 3 lists the physical features for the ESS.

Table 3. IBM Enterprise Storage Server physical features

Feature	Description
Continuous availability, designed to virtually eliminate single points of failure or repair (See Note 1.)	<ul style="list-style-type: none"> • Cluster-processor complex failover • Device adapter failover • Concurrent maintenance • Failover/failback
Dual-cluster configuration	<ul style="list-style-type: none"> • Eight cluster processors • Cache: 6 GB for Models E10 and E20, 8 GB standard and optional 16 GB for Models F10 and F20 • NVS: 384 MB
SSA device adapters	Eight serial storage adapter loops (maximum)
Spare DDM (See Note 2.)	<ul style="list-style-type: none"> • RAID 5 (6+P+S, 7+P) • RAID reconstruction with spare DDM
Read/write functions	<ul style="list-style-type: none"> • Read/write cache • Fast-write NVS in storage server • Maximum sequential bandwidth <ul style="list-style-type: none"> – 180 MB/second read – 140 MB/second write

Table 3. IBM Enterprise Storage Server physical features (continued)

Feature	Description
Service	<ul style="list-style-type: none"> • Mobile solutions terminal or equivalent • Remote service • Call home • Concurrent maintenance • Simple Network Management Protocol (SNMP)
Customer interface	<ul style="list-style-type: none"> • Storage server Ethernet attachment (10Base-T) • Customer workstation • Web interface
DDMs (See Note 2.)	<ul style="list-style-type: none"> • 16 - 384 in increments of 8 (8-pack) • Capacity <ul style="list-style-type: none"> – 105 GB to 2.8 TB (9.1 GB DDMs) – 210 GB to 5.6 TB (18.2 GB DDMs) – 420 GB to 11.2 TB (36.4 GB DDMs)
Support of 8-packs	<ul style="list-style-type: none"> • 36.4 GB (40 MBps) • 18.2 GB (40 MBps) • 9.1 GB (40 MBps)
Expansion enclosure	Supported by Models E20 and F20
Notes: <ol style="list-style-type: none"> 1. The ESS requires two spares per SSA loop with RAID. For enhanced availability, IBM recommends that you install the IBM Subsystem Device Driver on your open host system. 2. DDM configuration: <ol style="list-style-type: none"> a. DDMs are either all 9.1 GB, all 18.2 GB, or all 36.4 GB. b. DDM capacity assumes a RAID-5 configuration. 	

Logical subsystems

IBM configures the ESS as logical containers that are known as logical subsystems (LSSs). The limit is 16 LSSs each for count-key-data (CKD) and fixed block (FB) format.

Note: If you reduce the CKD LSS limit to zero, then no Peer-to-peer copy functions will execute. CKD LSS limit must be no lower than eight to support peer-to-peer copy functions for Open only machines.

IBM advises that you consider reducing the maximum LSSs limit (to eight or zero) if you do not intend to create more than eight LSSs. Also reduce the maximum LSS limit if you plan to create only CKD or FB data on your ESS. Reducing the maximum LSS limit reduces the cache space that the ESS uses to maintain the LSS structures (performance tuning).

Note: If you increase or decrease the LSS at a future date, you will need to reinitialize the ESS in order for the change to take effect.

Chapter 2. Planning the physical configuration

This chapter lists the feature codes for the required and optional features for the ESS, and gives planning information for the features. Use the feature codes to order the following software components and hardware components:

- United States-government orders
- Power
- Adapter cards
- Memory capacity
- Physical configuration feature codes and options
- Connection hardware
- Language for the operator panel
- Requirements for attaching 7133 drawers
- ESS Network (ESSNet) installation requirements
- Physical configuration changes
- Licensed internal code and optional software

See “Physical configuration options” on page 32 for a list of the physical configuration options you may select.

United States-government orders

For United States-government orders, select feature code 0983. This feature code ensures that IBM manufactures the ESS in the United States of America.

Power features

This section includes information on requirements and feature codes for:

- Power outlets
- Power supply input voltage
- Power cables
- Remote power-control logic card
- Remote support (modem and modem switch)
- Extension cords

Power outlets

You need to supply the following power outlets for the ESS installation:

- High-voltage outlets:
 - Two power outlets for the two ESS power cables
IBM recommends separate power sources for these outlets. This maximizes availability by eliminating a single point of failure.
 - Two power outlets for the two power cables for the expansion enclosure
- Regular-voltage outlets:
 - Three power outlets for the ESSNet power cables (one for the workstation, one for the display, and one for the hub). IBM provides the power cables for the ESSNet
 - One power outlet for the service terminal
This outlet needs to be within 2 m (6 ft.) of the ESS.

- Two power outlets for remote support (one for the modem and one for the switch)

IBM cannot install the ESS if your site does not meet these power requirements.

Uninterruptible power system

If you have an uninterruptible power supply (UPS) that prevents power interruptions, have IBM connect the UPS to each ESS enclosure. Connect the UPS to the ESS enclosures through mainline power cable 1. The ESS maintains the charge of the main batteries through this mainline power cable.

Power supply input voltage

You need to specify one of the following feature codes for input voltage when you order your ESS:

9870	Voltage, 200 - 240 V, 50 - 60 Hz (USA)
9871	Voltage, 380 - 480 V, 50 - 60 Hz

Power cables

The following feature codes determine the type of power cable you receive with the ESS Models. The ESS requires two power cables. The expansion enclosure also requires two power cables. When you order an expansion enclosure, IBM includes the correct power cables. IBM also provides the power cables for the ESSNet.

For Models E10 and F10, order the following feature codes:

9801	Single Phase, 50, 60 Hz, 50 A (United States (U.S.), Canada, Latin America (LA), and Asia Pacific (AP))
9802	Single Phase, 50 Hz, 50 A (Europe, Middle East, Africa (EMEA))
9803	Single Phase, 50, 60 Hz, 60 A (Japan)
9986	Single Phase, 50, 60 Hz, 50 A (Chicago)

For Models E20 and F20, order the following feature codes:

9851	Three phase, 50, 60 Hz, 50 A for the U.S., Canada, LA, and AP
9852	Three phase, 50 Hz for EMEA
9853	Three phase, 60 Hz, 60 A for Japan and U.S.
9854	Three phase, 50, 60 Hz, 60 A for U.S., Canada, LA, and AP
9987	Three phase, 50, 60 Hz, 50 A for Chicago (U.S.)
9988	Three phase, 50, 60 Hz, 60 A for Chicago (U.S.)

Remote support features

This section includes feature codes for remote support. This includes:

- Remote power control
- Remote support function
- Remote support function attachment

Remote power control

This optional feature is for the logic card that supports remote power control within the ESS:

1001 Remote power control

Remote support switch

Each ESS requires a modem for remote service access. When you attach the remote-support switch to a modem, you can interconnect up to seven ESSs. For remote support, you must order either feature code 2715 or feature code 2716:

2715 Remote-support function

This feature provides:

- Remote-support switch and cables
- Modem
- ESSNet workstation (a personal computer)
- Monitor
- Three Ethernet cables, each 17 m (50 ft.) in length
- Ethernet Hub
- Power cables for the PC, hub, and monitor
- Hypertext Markup Language (HTML) file for the ESSNet

2716 Remote-support function - additional attachment

This feature provides a pair of cables for attaching an ESS to the remote-support switch. This feature also includes two ESSNet Ethernet cables, each 17 m (50 ft.) in length.

See “Power cables for the remote-support switch by modem country” for information about power cables.

Power cables for the remote-support switch by modem country

Select the power cable for the remote-support switch for your modem country-group:

9301 Modem country-group M01
Brazil, Canada, Mexico, U.S.

9302 Modem country-group M02
Croatia, Czech Republic, Hungary, Jordan, Kazakhstan, Romania, Russia, Slovakia, Ukraine

9303 Modem country-group M03
Germany

9304 Modem country-group M04
Israel

9305 Modem country-group M05
France, Italy, Portugal

9306 Modem country-group M06
Japan

9307 Modem country-group M07
Belgium, Netherlands

9308 Modem country-group M08
New Zealand

9309	Modem country-group M09 Denmark, Iceland, Norway, Poland, Sweden
9310	Modem country-group M10 Mozambique, Nigeria, South Africa
9311	Modem country-group M11 Cyprus, Great Britain (UK), Oman, United Arab Emirates (UAE)
9312	Modem country-group M12 Colombia, Costa Rica, Ecuador, Peru, Republic of China, Venezuela, Uruguay
9313	Modem country-group M13 Argentina, Chile, Egypt, Greece, India, Indonesia, Korea, Lebanon, Philippines, Saudi Arabia, Spain, Thailand, Turkey
9314	Modem country-group M14 Austria
9315	Modem country-group M15 Switzerland
9316	Modem country-group M16 Finland
9317	Modem country-group M17 Australia
9318	Modem country-group M18 Peoples Republic of China, Hong Kong, Malaysia, Singapore

Extension cords

Each ESS requires an extension cord for use by service personnel. (These cords are also known as convenience cords.) Specify one of the following feature codes to order the type of extension cord you require at your site:

9401	Extension cord country-group C01 Brazil, U.S., Canada
9402	Extension cord country-group C02 Aruba, Bahamas, Barbados, Bermuda, Bolivia, Cayman Islands, Columbia, Costa Rica, Curacao, Dominican Republic, El Salvador, Ecuador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Japan, Liberia, Mexico, Netherlands Antilles, Nicaragua, Panama, Philippines, Peoples Republic of China, Saudi Arabia, Surinam, Trinidad Tobago, Venezuela
9403	Extension cord country-group C03 Peru, Thailand
9404	Extension cord country-group C04 Israel
9405	Extension cord country-group C05

	Chile, Ethiopia, Italy, Libya, Somalia
9406	Extension cord country-group C06 Afghanistan, Algeria, Andorra, Angola, Austria, Belgium, Benin, Bosnia Herzegovina, Bulgaria, Burundi, Cameroon, Central African Republic, Chad, Congo Brazzaville, Croatia, Czech Republic, Egypt, Finland, France, French Guiana, Germany, Greece, Guinea, Hungary, Iceland, Indonesia, Iran, Ivory Coast, Jordan, Kenya, Korea, Lebanon, Luxemburg, Macau, Malagasy, Mali, Martinique, Mauritania, Mauritius, Monaco, Morocco, Mozambique, Netherlands, New Caledonia, Niger, Norway, Poland, Portugal, Romania, Senegal, Slovakia, Slovenia, Spain, Sudan, Sweden, Syria, Togo, Tunisia, Turkey, Upper Volta, Russia, Vietnam, Yugoslavia, Zaire, Zimbabwe
9407	Extension cord country-group C07 Denmark
9408	Extension cord country-group C08 Argentina, Paraguay, Uruguay
9409	Extension cord country-group C09 Liechtenstein, Switzerland
9410	Extension cord country-group C10 Australia, Peoples Republic of China, New Zealand, Papua New Guinea, Western Samoa
9411	Extension cord country-group C11 Bangladesh, Burma, Pakistan, South Africa, Sri Lanka
9412	Extension cord country-group C12 Antigua, Bahrain, Brunei, Channel Islands, Cyprus, Fiji, Ghana, Hong Kong, India, Iraq, Ireland, Kuwait, Malawi, Malaysia, Malta, Nepal, Nigeria, Oman, Polynesia, Qatar, Sierra Leone, Singapore, Tanzania, United Arab Emirates, Uganda, United Kingdom, Yemen, Zambia

Adapter features

This section includes the feature codes and information for:

- Small computer system interface (SCSI) host adapters
- Fibre-channel host adapters and attachment
- Enterprise Systems Connection (ESCON) host adapters
- Device adapters

Also see the ESS Web site for details about the host system adapters that the ESS supports:

www.storage.ibm.com/hardsoft/products/ess/supserver.htm

The ESS has four host adapter bays. Each bay supports up to four host adapters. Each ESS supports 32 SCSI ports, 16 fibre-channel ports, or 32 ESCON channel ports or any combination of SCSI, fibre-channel, and ESCON connections. The ESS supports up to a total of 32 physical ports (16 host system adapters).

SCSI host adapters

The ESS provides an ultra-SCSI interface with SCSI-3 protocol for attachment to host systems with UNIX, Windows NT, Windows 2000, and the OS/400 operating systems. The interface also supports SCSI-2 protocol.

The ESS supports up to 32 ports; two per SCSI host adapter. Each port supports an ultra-SCSI or SCSI-2 fast and wide differential-connection to the host system. A SCSI-2 fast and wide differential connection is a subset of ultra-SCSI.

3002 SCSI host adapter (optional 1 - 16)

Order host cables separately (see "Connection hardware" on page 37).

Fibre-channel host adapters

The ESS supports the point-to-point topology, the switched fabric topology and the fibre channel arbitrated loop topology, private loop profile. When using the loop topology, the ESS has no restrictions on the number of hosts or devices that you can attach on a loop, other than the architectural limit of 127. However, the loop goes through a loop initialization process (LIP) whenever you add or remove a host or device from the loop. LIP disrupts any I/O operations currently in progress. For this reason, IBM recommends that you only have a single host and a single ESS on any loop (point-to-point loop).

To have IBM install short-wave fibre-channel adapters on your ESS, order FC 3022 (IBM P/N 54G3384). This feature code includes a 31 m (93 ft), 50 µm short-wave optics cable. These fibre-channel adapters incorporate short-wave laser transmitters. You can order and have IBM install a maximum of 16 fibre-channel adapters on the ESS. Each adapter has a single host port. See your IBM field office about longer cables or 62.5 µm cable.

3022 Fibre-Channel Short Wave host adapter (optional 2-16)

Complimentary 31m, 50 micron host cable included.

ESCON host-adapters

Each ESCON host adapter provides two ESCON channel interfaces for attachment to up to 32 channels. Each ESCON channel supports 64 logical paths, for a total of 2048 paths.

3011 ESCON host adapter (optional 2, 4, 6, 8, 10, 12, 14, and 16)

Order host cables separately (see "Connection hardware" on page 37).

Device adapters

The standard configuration for the ESS includes eight device (DDM) adapters.

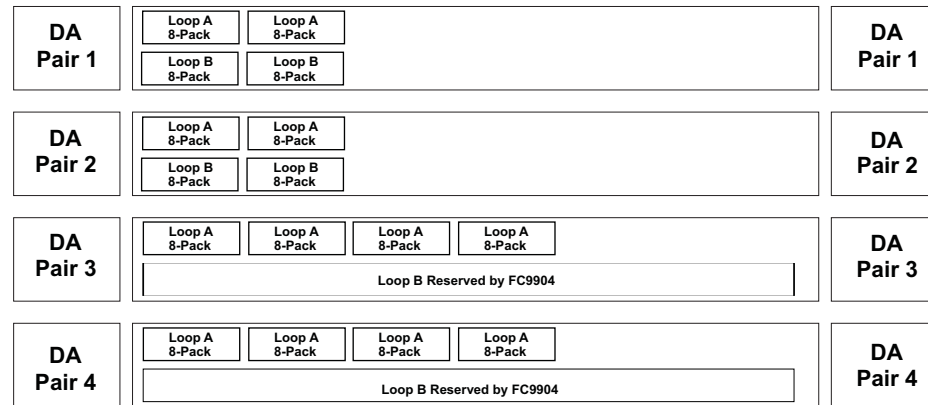
Each device adapter provides two device loops (4 interfaces) that operate at up to 160 MB per second, depending on the DDM type that you attach. Each loop supports up to 48 DDMs.

Because the device loops are between adapter pairs, both clusters 1 and 2 can access all DDMs on a loop. See "Failover protection" on page 15 for the advantages to this configuration.

Reserved loops

IBM supports reuse of 7133 Models 020 and D40 drawers in a 2105 Model 100 expansion enclosure in an IBM Enterprise Storage Server configuration. Support includes 7133 drawers in new 2105 Model 100 expansion enclosures. This support provides investment protection for up to 12 of your existing IBM 7133 serial disk drawers.

IBM service personnel add the Model 100 to the loops you reserved with feature code 9904. FC 9904 reserves two loops; the limit is four reserved loops. A loop refers to the wiring that is needed to address the storage. Figure 8 shows reserved loops.



S008708

Figure 8. Reserved loops

See “Feature codes and requirements for attaching 7133 drawers” on page 36 for the needed requirements in order to attach Model 100 expansion racks.

Memory capacity features

The ESS Models E10 and E20 have the following memory capacity:

- Standard 6 GB of cache, 3 per cluster
- 384 MB (192 MB per cluster) of nonvolatile storage (NVS)

The ESS Models F10 and F20 have the following memory capacity:

- Standard 8 GB of cache, 4 per cluster with FC 4002. IBM delivers FC 4002 on the ESS unless you specify the following option:
 - 16 GB of cache, FC 4004
- 384 MB (192 MB per cluster) of nonvolatile storage (NVS)

Physical configuration features and options

This section includes the feature codes for:

- DDM cages and 8-packs
- physical configuration options
- Storage on demand

DDM cages and 8 packs

The Models E10 and F10 support one DDM cage. Models E20 and F20 support two DDM cages.

Each DDM cage supports eight 8-packs (64 DDMs), four in the front, and four in the rear. IBM will ship the appropriate number of cages, based on the number of 8-packs you order.

The feature numbers for ordering 8-packs in different DDM sizes for the ESS cages are:

2121 DDM 8-pack (9.1 GB)

2122 DDM 8-pack (18.2 GB)

2123 DDM 8-pack (36.4 GB)

IBM includes device cables for the 8-packs that IBM installs in the factory. You must order device cables for the 8-packs that you have service personnel install in the field.

Expansion enclosures

The expansion enclosures (feature code 2100) support one, two, three, or four DDM cages.

Each DDM cage supports eight 8-packs (64 DDMs), four in the front, and four in the rear.

Note: The Model E10 does not support the expansion enclosure.

Populating the IBM Enterprise Storage Server

You can build the maximum configuration for an ESS with the expansion enclosures.

If you order the expansion enclosure from the factory, IBM populates the expansion enclosure with 8-packs in the following order:

- Models E10 and F10
 - Cage 1, 8-packs 4, 3, 2, 1
 - Cage 1, 8-packs 8, 7, 6, 5
- Models E20 and F20
 - Cage 1, 8-packs 4, 3, 2, 1
 - Cage 1, 8-packs 8, 7, 6, 5
 - Cage 2, 8-packs 4, 3, 2, 1
 - Cage 2, 8-packs 8, 7, 6, 5

Physical configuration options

You can order the following physical configurations for your ESS:

- Ultra-high-performance configuration with arrays that include only 9.1-GB DDMs
- High-performance configuration with arrays that include only 18.2-GB DDMs
- Capacity configurations with arrays that include only 36.4-GB DDMs

Standard configuration provides:

- 6 GB of cache for Models E10 and E20

- 8 GB of cache for Models F10 and F20. Also see “Cache” on page 16 for an optional cache increase.
- 384 MB of nonvolatile storage (NVS)
- Eight SSA device adapter cards
- DDMs assigned to optimum serial loops
- Storage that is allocated as RAID or non-RAID

Note: AS/400 storage must be RAID.

- System/390 and zSeries storage defined as either 3380 or 3390 track format
- Emulated LUNs defined for the UNIX, OS/400, Windows NT, and Windows 2000 operating systems

Ultra-high-performance configurations

You can order the ultra-high-performance configuration in two capacities for Models E10, E20, F10, and F20. This configuration supports only arrays with 9.1-GB DDMs.

Table 4. Ultra-high-performance configuration

Feature Code	Capacity	Description	Models
9601	420 GB	8 eight-packs	E10, F10, E20, and F20
9602	840 GB	16 eight-packs	E20 and F20

High-performance configurations

The high-performance configurations in Table 5 support only arrays with 18.2-GB DDMs.

Table 5. High-performance configurations

Feature Code	Capacity	Description	Models
9621	420 GB	4 eight-packs	E10, F10, E20, and F20
9622	630 GB	6 eight-packs	E10, F10, E20, and F20
9623	840 GB	8 eight-packs	E10, F10, E20, and F20
9630	1050 GB	10 eight-packs	E20 and F20
9624	1260 GB	12 eight-packs	E20 and F20
9631	1470 GB	14 eight-packs	E20 and F20
9625	1680 GB	16 eight-packs	E20 and F20
9632	2170 GB	20 eight-packs, and expansion enclosure	E20 and F20
9626	2660 GB	24 eight-packs, and expansion enclosure	E20 and F20
9633	3150 GB	28 eight-packs, and expansion enclosure	E20 and F20
9627	3640 GB	32 eight-packs, and expansion enclosure	E20 and F20
9634	4130 GB	36 eight-packs, and expansion enclosure	E20 and F20
9628	4620 GB	40 eight-packs, and expansion enclosure	E20 and F20
9635	5110 GB	44 eight-packs, and expansion enclosure	E20 and F20

Table 5. High-performance configurations (continued)

Feature Code	Capacity	Description	Models
9629	5600 GB	48 eight-packs, expansion enclosure	E20 and F20

Capacity configuration

The capacity configuration supports only arrays with 36.4-GB DDMs.

Table 6. Capacity configurations

Feature Code	Capacity	Description	Models
9646	840 GB	4 eight-packs	E10, F10, E20, and F20
9647	1260 GB	6 eight-packs	E10, F10, E20, and F20
9641	1680 GB	8 eight-packs	E10, F10, E20, and F20
9650	2100 GB	10 eight-packs	E20 and F20
9642	2520 GB	12 eight-packs	E20 and F20
9651	2940 GB	14 eight-packs	E20 and F20
9643	3360 GB	16 eight-packs	E20 and F20
9652	4340 GB	20 eight-packs, and expansion enclosure	E20 and F20
9648	5320 GB	24 eight-packs, and expansion enclosure	E20 and F20
9653	6300 GB	28 eight-packs, and expansion enclosure	E20 and F20
9644	7280 GB	32 eight-packs, and expansion enclosure	E20 and F20
9654	8260 GB	36 eight-packs, and expansion enclosure	E20 and F20
9649	9240 GB	40 eight-packs, and expansion enclosure	E20 and F20
9655	10 220 GB	44 eight-packs, and expansion enclosure	E20 and F20
9645	11 200 GB	48 eight-packs, and expansion enclosure	E20 and F20

ESS storage on demand

IBM offers a storage-on-demand feature called step-ahead storage. With the step-ahead feature you can purchase an ESS Model F20 with extra storage (18.2 or 36.4 GB drives) and use the extra storage when you need it.

This option is particularly useful when you have dynamic or unpredictable growth, or if you just want the assurance that the storage will be there when you need it. You may activate the stand-by capacity without interruption to your work. IBM requires payment for the on-demand capacity upon your activation of the storage.

To get storage on-demand you must:

- Place a new order of an ESS Model F20. The order includes ESS standard configuration plus step ahead feature codes.

Note: You are billed for the standard configuration that you ordered plus a carrying fee for the step-ahead storage.

- Sign a contract with IBM wherein you agree to purchase the step-ahead storage when you configure it for use. The purchase must be no later than one year after you activate the storage.
- Enable the ESS call-home function, and leave it enabled to allow IBM to monitor your activation of the step-ahead storage.
- The Call Home heartbeat interval must not be set to 0.

Feature codes for step-ahead storage

Use the following feature codes to order the ESS Model F20 with step ahead storage. The step-ahead carrying fee is included in the price of these step-ahead configuration features:

FC 2132

Eight pack with 18.2 GB DDM

FC 2133

Eight pack with 36.4 GBDDM

Table 7. High-performance Configurations with 18.2 GB DDMs

Capacity Increments (GB)	Step ahead Capacity Increments (GB)	Total Capacity (GB)	Expansion Enclosure (FC 2100)	Feature Code	Number of Eight Pack Feature Codes
420	210	630	No	9521	(4) 2122, (2) 2132
630	210	840	No	9522	(6) 2122, (2) 2132
840	210	1050	No	9523	(8) 2122, (2) 2132
1050	210	1260	No	9530	(10) 2122, (2) 2132
1260	210	1470	No	9524	(12) 2122, (2) 2132
1470	210	1680	No	9531	(14) 2122, (2) 2132
1680	490	2170	Yes	9525	(16) 2122, (4) 2132
2170	490	2660	Yes	9532	(20) 2122, (4) 2132
2660	490	3150	Yes	9526	(24) 2122, (4) 2132
3150	490	3640	Yes	9533	(28) 2122, (4) 2132
3640	490	4130	Yes	9527	(32) 2122, (4) 2132
4130	490	4620	Yes	9534	(36) 2122, (4) 2132
4620	490	5110	Yes	9528	(40) 2122, (4) 2132
5110	490	5600	Yes	9535	(44) 2122, (4) 2132

Table 8. Capacity Configurations with 36.4 GB DDMs

Capacity Increments (GB)	Step ahead Capacity Increments (GB)	Total Capacity (GB)	Expansion Enclosure (FC 2100)	Feature Code	Number of Eight Pack Feature Codes
840	420	1260	No	9546	(4) 2123, (2) 2133
1260	420	1680	No	9547	(6) 2123, (2) 2133
1680	420	2100	No	9541	(8) 2123, (2) 2133
2100	420	2520	No	9550	(10) 2123, (2) 2133
2520	420	2940	No	9542	(12) 2123, (2) 2133
2940	420	3360	No	9551	(14) 2123, (2) 2132
3360	980	4340	Yes	9543	(16) 2123, (4) 2133
4340	980	5320	Yes	9552	(20) 2123, (4) 2133
5320	980	6300	Yes	9548	(24) 2123, (4) 2133
6300	980	7280	Yes	9553	(28) 2123, (4) 2133
7280	980	8260	Yes	9544	(32) 2123, (4) 2133
8260	980	9240	Yes	9554	(36) 2123, (4) 2133
9240	980	10,220	Yes	9549	(40) 2123, (4) 2133
10,220	980	11,200	Yes	9555	(44) 2123, (4) 2133

Feature codes and requirements for attaching 7133 drawers

For protection of your assets, IBM supports attachment of your existing 7133 drawers to an ESS in a new 2105 Model 100 expansion enclosure. Use:

- FC 1121 to attach the first new Model 100 expansion enclosure
- FC 1122 to attach a second new Model 100 expansion enclosure, as a follow-on to FC 1121

These feature codes have the following requirements:

- The LIC in the ESS to which you are attaching the 2105 model 100 expansion enclosure must support attachment of 7133 drawers.
- The 2105 Model 100 installation must meet the floor loading and service clearance requirements as specified in “Service clearance and floor-loading requirements for the ESS” on page 55.

- You must fill out custom configuration work sheets, using a modified version of a Define Disk Groups work sheet that closely matches the storage capacity being installed with the Model 100 expansion enclosures and 7133 drawers. The 7133 drawer will be configured as 2 disk groups. The disk groups can be either RAID 5 arrays or non RAID disks. Logical configuration of the 7133 drawers is only supported via ESS Specialist. See the *IBM Enterprise Storage Server Configuration Planner*.
- You cannot attach the Model 100 to an ESS model that already has an ESS expansion enclosure (FC 2100).
- You reserved the necessary device loops in the ESS with FC 9904
With two FC 9904 (four reserve loops), you can attach up to a maximum of twelve 7133 Model 020 or Model D40 drawers. With one FC 9904 (two reserve loops), you can attach up to the maximum of six 7133 Model 020 or Model D40 drawers.
- The 7133 drawers can only be installed in a new Model 100 (FC 1121 and FC 1122). The drawers must meet the following requirements:
 - When attached to an ESS, up to six 7133 drawers can be installed in a Model 100 rack. A maximum of two Model 100s can be attached to an ESS.
 - Only 7133 Model 020 and 7133 Model D40 drawers can be attached to the ESS.
 - You cannot attach drawers that have less than 16 DDMs to the ESS. All the DDMs must be the same capacity. The ESS cannot support mixed DDMs on the same loop.
 - Any 7133 drawers you install must meet the 7133 drawer compatibility requirements above.
 - You need to migrate or remove all data on 7133 drawers and disband the ranks/arrays before installing the 7133 drawers in the model 100.

See “Appendix C. Adding and Removing Drawers and Racks” on page 91 for more information on attaching 7133 drawers and racks to the ESS.

Connection hardware

This section includes the feature codes for:

- SCSI host cables
- Fibre-channel cables
- ESCON host cables
- Remote power-control attachment cables

SCSI host cables

You need to order cables for each host adapter. Each host adapter provides two host connections (ports). Each host connection has a terminator; the connection to the ESS must be at the end of the SCSI bus.

For each SCSI host adapter (FC 3002), order two SCSI host cables:

- | | |
|-------------|---|
| 9701 | Ultra-SCSI cable (10 m for UNIX and Windows NT) |
| 9702 | Ultra-SCSI cable (20 m for UNIX and Windows NT) |
| 9703 | SCSI-2 fast and wide cable (10 m for IBM RS/6000 MCA adapter) |
| 9704 | SCSI-2 fast and wide cable (20 m for IBM RS/6000 MCA adapter) |
| 9705 | SCSI-2 fast and wide cable (10 m for IBM AS/400) |

9706	SCSI-2 fast and wide cable (20 m for IBM AS/400)
9707	SCSI-2 fast and wide cable (10 m for Sun and Hewlett Packard PCI dual port)
9708	SCSI-2 fast and wide cable (20 m for Sun and Hewlett Packard PCI dual port)
9709	SCSI-2 fast and wide cable (10 m for Hewlett Packard PCI single port)
9710	SCSI-2 fast and wide cable (20 m for Hewlett Packard PCI single ports)

All cables support a 2-byte-wide bus with differential drivers. If you require a cable length that is not listed above, see your IBM field office.

Fibre-channel cables

For fibre-channel cable, order FC 3022 (IBM P/N 54G3384) which includes a fibre-channel short wave adapter card and a 31 m (93 ft), 50 µm short-wave optics cable. See your IBM field office if additional cables, longer cables, or 62.5 µm cables are required.

ESCON host cables

Each ESCON host adapter provides two host connections. Order two ESCON cables for each adapter for System/390 hosts. You can have your IBM field office order the cable using the OMCABLE transaction in Advanced Administrative Systems (AAS).

Each feature code 3011 gives you one host adapter card. Each adapter card requires two ESCON attachment cables: either the standard riser-rated cable, cable group number 3797, or the plenum-rated cable, cable group number 8486. The following table gives the connector IDs to order for the cables.

Table 9. ESCON cable connectors

Number of ESCON Host Adapter Feature Code 3011s to Order	Number of ESCON Host Adapters	Number of Cables	Connector ID
2	2	4	151, 153, 251, 253
4	4	8	151, 153, 155, 157, 251, 253, 255, 257
6	6	12	151, 153, 155, 157, 159, 161, 251, 253, 255, 257, 259, 261
8	8	16	151, 153, 155, 157, 159, 161, 163, 165, 251, 253, 255, 257, 259, 261, 263, 265
10	10	20	151, 153, 155, 157, 159, 161, 163, 165, 167, 169, 251, 253, 255, 257, 259, 261, 263, 265, 267, 269

Table 9. ESCON cable connectors (continued)

Number of ESCON Host Adapter Feature Code 3011s to Order	Number of ESCON Host Adapters	Number of Cables	Connector ID
12	12	24	151, 153, 155, 157, 159, 161, 163, 165, 167, 169, 171, 173, 251, 253, 255, 257, 259, 261, 263, 265, 267, 269, 271, 273
14	14	28	151, 153, 155, 157, 159, 161, 163, 165, 167, 169, 171, 173, 175, 177, 251, 253, 255, 257, 259, 261, 263, 265, 267, 269, 271, 273, 275, 277
16	16	32	151, 153, 155, 157, 159, 161, 163, 165, 167, 169, 171, 173, 175, 177, 179, 181, 251, 253, 255, 257, 259, 261, 263, 265, 267, 269, 271, 273, 275, 277, 279, 281

Remote-power-control attachment cables

You can order remote-power-control attachment cables for the ESS in quantities from one through eight. Table 10 gives the connector IDs.

Table 10. Remote-power-control attachment cable connectors

Remote Power Control Feature Code	Cable Group Number	Number of Cables	Connector ID
1001	1178	1 through 8	01, 03, 05, 07, 09, 11, 13, 15

Language for the operator panel

The operator-panel language feature determines the language for operator panel labeling. If you do not specify a language, the default is English.

2924	English
2928	French
2929	German
2930	Japanese
2931	Spanish
2932	Italian
2935	Canadian French
2938	Brazilian Portuguese
2942	Belgian Dutch
2962	Chinese Traditional (ROC)

2969	Korean
2980	UK English

Configuration changes

After IBM performs the initial logical configuration during ESS installation, use the ESS Specialist Web interface to reconfigure or deconfigure the logical configuration.

IBM can only perform capacity upgrades that are within the same DDM size.

Optional one-year warranty

The ESS comes with a three-year warranty. IBM also offers a one-year warranty. See your IBM field office for details.

Licensed internal code and optional software

The ESS includes licensed internal code (LIC) for the following features:

- Multiple allegiance
- I/O priority queues
- Concurrent copy

This section describes the following optional features for the ESS:

- Parallel Access Volumes
- ESS Copy Services

IBM service personnel enable these features for you. Order the feature code for the capacity that is equal to or greater than the capacity of your ESS.

Parallel Access Volumes (PAV)

Order the PAV capacity that you need for your System/390 and zSeries hosts by using the following feature codes:

1800	Up to 0.5 terabyte (TB)
1801	Up to 1 TB
1802	Up to 2 TB
1803	Up to 4 TB
1804	Up to 8 TB
1805	Larger than 8 TB

OS/390 operating systems that support PAV include: V1R3, V2R4, V2R6, V2R7 (with program temporary fixes); and DFSMS/MVS™ 1.3.0, 1.4.0, and 1.5.0.

ESS Copy Services

This section lists the following information:

- Feature codes for FlashCopy
- Feature codes for extended remote copy (XRC)
- Feature codes for peer-to-peer remote copy (PPRC)
- Guidelines for enabling and using ESS Copy Services
- Planning ESS Web Copy Services configuration

See the *IBM Enterprise Storage Server Host Systems Attachment Guide* for information on the ESS command line interface (CLI) for open system hosts. You can use the command-line interface from your host system to invoke PPRC and FlashCopy.

See “FlashCopy and PPRC restrictions for open system hosts” on page 18 for additional information about PPRC and FlashCopy.

Feature codes for FlashCopy

Order the capacity you need for your System/390 hosts, SCSI, and fibre-channel attached host systems by using the following feature codes:

1830	Up to 0.5 TB
1831	Up to 1 TB
1832	Up to 2 TB
1833	Up to 4 TB
1834	Up to 8 TB
1835	Larger than 8 TB

Feature codes for Extended Remote Copy (XRC)

Order the Extended Remote Copy feature for the total capacity you need using the following feature codes:

1810	Up to 0.5 TB
1811	Up to 1 TB
1812	Up to 2 TB
1813	Up to 4 TB
1814	Up to 8 TB
1815	Larger than 8 TB

Feature codes for peer-to-peer remote copy

Order the capacity you need for your System/390 hosts, fibre-channel, and SCSI attached host systems for *both* the primary and secondary ESS. Use the following feature codes:

1820	Up to 0.5 TB
1821	Up to 1 TB
1822	Up to 2 TB
1823	Up to 4 TB
1824	Up to 8 TB
1825	Larger than 8 TB

Guidelines for enabling and using ESS Web Copy Services

This section gives an overview of ESS Copy Services followed by the guidelines for enabling and using ESS Web Copy Services.

OS/390

You can access and control ESS Copy Services functions from OS/390 host systems with OS/390 DFSMS. Alternatively, you can access and control ESS Copy Services functions for OS/390 host systems using the ESS StorWatch Web Copy

Services function. The default setting for ESS is disable ESS Web Copy service Interface for S/390 hosts. If you are interested in using the Web Copy service Interface, you must identify the information in “Appendix B. Communication Resources (ESS Web Copy Services) work sheet” on page 89.

Note: You can invoke Extended Remote Copy (XRC), Concurrent Copy, PPRC, and FlashCopy for IBM System/390 hosts with the IBM/System390 command functions.

Open Systems

ESS Web Copy Services is a Java-based client server application. The application consists of one primary server component, an optional backup server component, and one or more client components. The backup server refers to a server that can be started as a primary server in the event that the first primary server fails.

The implementation of these application components in a collection of ESS clusters forms an ESS Web Copy Services server group. This implementation allows users to define, execute and view the status of Copy Services functions and tasks in, and between the server group clusters. For example, the ESS Web Copy Services application allows a user to:

- Initiate a FlashCopy task for two volumes in one ESS cluster
- Establish PPRC relationships for volumes in two ESS clusters
- Execute predefined PPRC and FlashCopy tasks

Each ESS cluster within a server group runs the ESS Web Copy Services client component. The user designates one of the ESS clusters in a server group to also run the primary server component, and optionally designates another ESS cluster to run the backup server component. If the server group consists of ESS clusters installed at different locations, then the primary and backup servers should be assigned to ESS clusters that are remote from each other.

The ESS clusters that are part of a Copy Services (CS) server group use the TCP/IP network to communicate. You can configure two ESS Copy Services servers to a group. Each ESS Copy Services server group manages four clusters and a maximum of 2048 volumes. You have identified the assignment of the TCP/IP addresses within the Communication work sheet given to the CE during ESS installation. You enter this information on the Copy Services work sheet. See “Chapter 4. Planning for communication” on page 65 for the procedures for filling in this work sheet. (In order for this communication to work well, some type of name resolution has to be running in the users network.) IBM recommends using a domain name server (DNS) for name resolution. DNS resolves the names of the participating ESS clusters and enables ESS Web Copy Services to operate correctly. This includes allowing the open system hosts to run CLI for Copy Services automation. When DNS is not available, the IBM SSR can configure each ESS to provide name resolution.

Users access the ESS Web Copy Services interface from the ESS Specialist Introduction panel using an ESSNet console or a Web browser at a local workstation. Access to the ESS Web Copy Services from a browser window normally connects to the primary server, which has the overall view and control of the server group Copy Services configuration. The backup server provides similar view and control for handling when the primary server is unavailable. A user can access the backup server if the primary server is unavailable. A user must manually reset the Web Copy Services Function to connect to the backup server when the primary server is unavailable as in Disaster Recovery actions.

ESS Copy Services also includes a command-line interface (CLI). The CLI is a Java-based application package that you may optionally install on your open system host. The CLI application provides a set of commands that allow a user to write customized scripts for a host system that will initiate predefined tasks in an ESS Copy Services server application. You use the set of CLI commands to indirectly control ESS PPRC and FlashCopy tasks within an ESS Copy Services server group. The CLI is available for the following operating systems:

- AIX
- Solaris
- HP-UX
- Windows NT 4.0
- Windows 2000

See the following ESS Web site for details about supported operating system levels.

www.storage.ibm.com/hardsoft/products/ess/supserver.htm

Before using either the ESS Web Copy Services interface or the Open host command-line interface, you or IBM must perform the following tasks:

1. Purchase ESS Copy Services features (FlashCopy, PPRC, or XRC).
2. If the ESS machine has already been installed, then the ESS needs to be upgraded to the 2105 LIC code that support Copy Services.
3. IBM installs and configures the ESS. The requirements include:
 - a. Connect the ESS to the ESSNET Network. Install DNS (recommended)
 - b. Install and activate the Copy Services LIC features.

Note: LIC features for F10/F20 is capacity limited. You can use the capacity for Flash Copy and PPRC that you purchase. LIC features should be installed before you configure the machine.

- c. For PPRC, install ESS ESCON host adapters. If you specify the ESCON feature code with your initial order for an ESS, IBM will install the ESCON host adapters. After initial installation, you must order an MES to have IBM install the adapters.

Note: ESS ESCON host adapters are required for PPRC because communication in a peer-to-peer relationship is through the ESCON channels.

- d. For each ESS cluster in a Copy Services Server Group, decide if ESS Copy Services commands should be enabled for S/390 volumes. Enter the information in “Appendix A. Communication Resources work sheet” on page 85.

Note: This information should be filled out for the SSR prior to the installation of the ESS.

- e. Configure the ESS clusters for the use of ESS Web Copy Services. For each ESS in a Copy Services Server Group, enter the IP addresses of the ESS clusters that you have identified as the primary and backup servers in “Appendix B. Communication Resources (ESS Web Copy Services) work sheet” on page 89.

- f. Configure a domain name server (DNS) for ESS Copy Services. Enter the information in “Appendix A. Communication Resources work sheet” on page 85.
- g. Logically configure the ESS, allocate storage, and create logical unit numbers (LUNs).
- h. Attach the ESSs to your host systems; this enables you to identify, create, and copy volumes.
- i. If the HOSTS are already installed, make sure that you are at the correct levels of HOST Install, SDD, and CLI.

Note: There may be additional level requirements between CLI and the ESS License Internal Code. When the SSR updates the ESS with new microcode, there may be a CLI code update.

- j. Install the command line interface (CLI) on your open system hosts. You can use the command-line interface from your host system to invoke PPRC and FlashCopy. CLI must have Java 1.1.8 support on the Open Host system. See the *IBM Enterprise Storage Server Host Systems Attachment Guide* for more information about CLI.
4. Run **cfgmgr** or operating system environment, to have the host system recognize the ESS volumes.
5. Run **rsTestConnection** to ensure that web Copy Services is running.
6. Run **rsPrimeServer** on your open host system.

This script notifies the ESS Copy Services server of the mapping of your host system disks to ESS volume serial numbers. This task allows you to view the Host system assigned volume with the Web Copy Services interface, from the Volume panel.

Notes:

- a. You must first authorize users before they can initiate this script from your host system. CLI commands provide security level protection. See the *IBM Enterprise Storage Server Host Systems Attachment Guide*.
- b. This script must be run whenever there are changes to the volumes accessed on a specific host.
- c. **rsPrimeServer** with -d option should be run when you remove a host from attachment to the ESS machine to remove the mapping from Web Copy Services Interface.
7. Run **rsList2105s** to get host disk to ESS volume association that can be used in defining Copy Services tasks.
8. The PPRC device-physical configurations (source and target devices) must be the same track format. Target volumes may be larger than the source volumes. For example, you can do a FlashCopy from a 9 GB LUN to a 16 GB LUN for data expansion.

See the *IBM Enterprise Storage Server Web Interface User's Guide* for the procedures on using PPRC and information about how to:

- Define disks to the primary host
- Access the secondary disks
- Control volume groups
- Perform disaster recovery
- Migrate data between storage servers

See “Planning ESS Copy Services configuration” for examples of site configurations for PPRC.

Planning ESS Copy Services configuration

This section provides examples of site configurations for Copy Services, and explains why you might select a particular configuration.

Example of a PPRC operational environment

For this example, assume that you have two sites, Site A and Site B. Each Site has a set of ESSs connected to the network. One of the ESS clusters at Site A has been configured as the ESS Web Copy Services primary server. One of the clusters at Site B has been configured as the ESS Web Copy Services backup server. Host systems at both Site A and Site B have installed the CLI for control of ESS Copy Services. ESS Copy Services code keeps data synchronized between the primary and the backup server.

If for some reason, the Copy Services primary server is down, you can change the management of all the ESS clusters to the backup Copy Services server. The secondary Copy Services server then takes over the management of all the remaining ESSs.

A typical PPRC physical configuration might include:

- A single logical storage server that is shadowed to a single secondary logical subsystem
- All devices or a subset of devices in PPRC pairs

This applies to a user who might have:

- All production applications and data located in a primary site
- All secondary data located at a disaster-recovery site

Shadowing all data that is associated with a server to a backup site reduces the operational management complexity. This includes determining what data (on a file-by-file basis) the backup site requires to recover the application in the event of a disaster since all data is replicated at the secondary site.

A single storage server mirrored to a secondary server

IBM recommends mirroring all logical subsystems at the primary site to an identical logical subsystem at the secondary site. This includes:

- All production applications and data located in a primary site
- All secondary data located in a secondary or disaster recovery site. For more information on disaster recovery, see the *IBM Enterprise Storage Server Web Interface User's Guide*.

Generally, the files associated with an application or application set are dynamic in many environments. Consequently, you may choose to mirror all of the application data. This configuration requires minimal application storage-management analysis to guarantee optimal performance.

Bi-directional mirroring

With bi-directional mirroring, half of the devices are mirrored from ESS A to ESS B. The remaining half are mirrored from ESS B to ESS A.

This configuration distributes all inputs/outputs (I/O) across two ESSs instead of directing them to a single primary ESS.

A combination configuration

You can combine any options to be managed as a single logical subsystem to a secondary-site logical subsystem (or bi-directional), such as:

- A volume list
- A logical volume group

This option depends on the amount of ESS storage your operational environment has.

Any combination you select must meet these requirements:

- The PPRC configurations (source and target devices) must be the same track format. Target volumes may be larger than the source volumes. For example, you can do a FlashCopy from a 9 GB LUN to a 16 GB LUN for data expansion.
- PPRC source volumes and target volumes are mirror images of each other from a host point of view. That is, all of the data that you can access from the primary host is exactly the same across the source and target PPRC volume.

Note: The volumes must be in full duplex mode.

- Additional requirements for fibre-channel, SCSI-attached host systems (open systems), and System/390 hosts:
 - Because data on both the primary and secondary PPRC devices is identical, the volume identifications are the same for both the source and the target volumes. Typically operating systems for open systems hosts, and their related file and related data base systems cannot easily manage LUNs with identical device identification.

IBM recommends that, for operational simplicity, you attach and address the PPRC primary devices from the primary production server. IBM recommends that you also attach and address the PPRC secondary devices from the secondary production server or the recovery server.
 - The ESS protects open system PPRC secondary volumes from host access. This protection ensures data integrity and data consistency between the PPRC primary and secondary volumes.

Consequently, you must execute a task at the ESS Copy Services server to terminate the PPRC pair before you can use the backup volumes. This action recovers or returns the PPRC secondary device to simplex mode, allowing host system access to secondary volumes. Another option is to do a FlashCopy of the secondary volume without terminating the PPRC pair. The FlashCopy can be used to read the secondary data at a particular point in time.
- IBM also recommends the following:
 - The Copy Services primary server be accessible from both the primary and secondary sites.
 - The primary and backup copy services servers should be physically located on different sites for disaster recovery purposes.

IBM recommends that you configure ESS Copy Services primary/backup servers to run on cluster 1.

IBM Subsystem Device Driver

The IBM Subsystem Device Driver feature supports multiple or redundant data paths for shared LUNs. Multi-pathing reduces the potential for a single point of failure on an ESS.

See *IBM Subsystem Device Driver* for information about using this ESS option. This book describes how to install and use the IBM Subsystem Device Driver on SCSI and fibre-channel attached host systems to enhance availability for the ESS.

Chapter 3. Installation planning

This chapter includes information for installation planning:

- Host system support
- Software requirements
- Equipment requirements
- Site requirements

Equipment requirements

Your shipment of the IBM Enterprise Storage Server includes:

- Two ESS cover keys. If you open the ESS, please be aware of IBM safety concerns. The tag to the keys has the following caution notice:

CAUTION:

This machine is certified to be serviced by trained personnel only.

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- Licensed internal code (LIC) compact disc.

Note: IBM service enables or disables any LIC features on your ESS.

- Host interface cards for the ESS. See “Adapter features” on page 29 and “Connection hardware” on page 37. Enterprise Systems Connection (ESCON), small computer system interface (SCSI), and fibre-channel host adapters and cables for the ESS.
- Compact disc for the host adapters.
- Compact disc that includes installation scripts for the 2105 (ESS) host attachment for AIX and HP-UX , and installation instructions for the IBM Subsystem Device Driver.
- Modems, modem switches, cables, and power cables for remote support. See “Remote support switch” on page 27.
- The IBM workstation, cables, and power cables for ESSNet.
- The extension cord that the service provider uses to connect the service terminal to a power outlet. See “Extension cords” on page 28.
- Compact disc for the IBM Subsystem Device Driver.
- Customer documents compact disc, SK2T-8770

This compact disc includes a softcopy of the ESS customer publications. See “The ESS product library” on page xvi for a list of the books.

Additional items that are shipped with the ESS for use by authorized service personnel, include:

- State-save diskettes

One set of blank diskettes that are used for extracting state-save information during service.

Note: The ESS diskette drive only reads diskettes with 1.44-MB format that a 1.44-MB drive has formatted.

- Service documents compact disc, SK2T-8771

This compact disc includes softcopies of the ESS service guides, ESS parts catalog, and the ESS customer publications.

- Hardcopies of the service guide.
- Two compact discs for the operating system.
- Compact disc for the operating system for program temporary fixes (PTFs).
- Compact disc for the operating system for service diagnostics.

You also need the following equipment for installing and operating the ESS:

- An analog telephone line near the ESS to enable remote support. The service interface provides an RS232 connection, through a modem switch, to the analog telephone line.
- Power cable connectors. The ESS requires two power cables that are country dependent and location dependent. You need the correct connectors as identified in “Power cable and power connector requirements” on page 60 and “Power cable connectors” on page 61.
- Power outlets that are compatible with the extension cords listed in “Extension cords” on page 28. Outlets must be within 3 m (9 ft) of the ESS. See “Power features” on page 25 for details on power requirements.

Engineering changes

IBM might periodically release engineering changes (ECs) to the materials in the ship group to correct problems or provide additional support. IBM might ship ECs as either mandatory or optional field bills. You should install the mandatory field bills as directed by IBM.

Notes:

1. The compact disc label indicates the EC level of the LIC.
2. The ESS stores three EC levels of LIC code for the ESS and for any DDMs that IBM has installed on the ESS. The ESS stores a new EC level prior to activating it as the current level.

Site requirements for the ESS

See Table 11 on page 51 for the physical characteristics of the IBM Enterprise Storage Server.

IBM ships all models in an Arbo Crate. The Arbo Crate weighs 228 kg (504 lbs). The local carrier is responsible for delivering the ESS as close to its final location as possible. The carrier is also responsible for unloading the ESS and removing the crate and returning it to IBM.

To compensate for the weight of the ESS models, IBM recommends that the loading dock ramp at your site does not exceed an angle of 12°.

CAUTION:

A fully configured unit in the crate can weigh up to 1500 kilograms (3305 pounds). Use of less than three persons to move it can result in injury.

1060.

Table 11 on page 51 gives the dimensions and weights of the ESS models.

Table 11. ESS dimensions and weights

Model	Dimensions, Meters (Inches) (See Note 1.)		Dimensions with Arbo Crate, Meters (Inches)		Maximum Weight (Fully Configured)	Maximum Weight with Arbo Crate
E10 or F10	Height	1.796 (70.7) (See Note 2.)	Height	2.075 (81.69) (See Note 2.)	1000 kg (2200 lbs)	1228 kg (2704 lbs)
	Width	1.383 (54.4)	Width	1.573 (62.00)		
	Depth	0.91 (35.8)	Depth	1.067 (42.00)		
E20 or F20	Height	1.796 (70.7) (See Note 2.)	Height	2.075 (81.69) (See Note 2.)	1204 kg (2650 lbs)	1432 kg (3154 lbs)
	Width	1.383 (54.4)	Width	1.573 (62.00)		
	Depth	0.91 (35.8)	Depth	1.067 (42.00)		
Model E20 or F20 with the expansion enclosure (See Notes 3 and 5.)	Height	1.796 (70.7)	Height	2.075 (81.69)	2545 kg (5600 lbs)	(See Note 4.)
	Width	2.938 (115.7)	Width	3.128 (123.30)		
	Depth	0.91 (35.8)	Depth	1.067 (42.00)		
Model 100 (See Note 6)	Height	1.780 (70)	Height	2.045 (80.5)	770 kg (1696 lbs)	928 kg (2046 lbs)
	Width	Width 0.840 (33)	Width	Width 1.016 (40)		
	Depth	Depth 1.305 (51)	Depth	Depth 1.499 (59)		

Table 11. ESS dimensions and weights (continued)

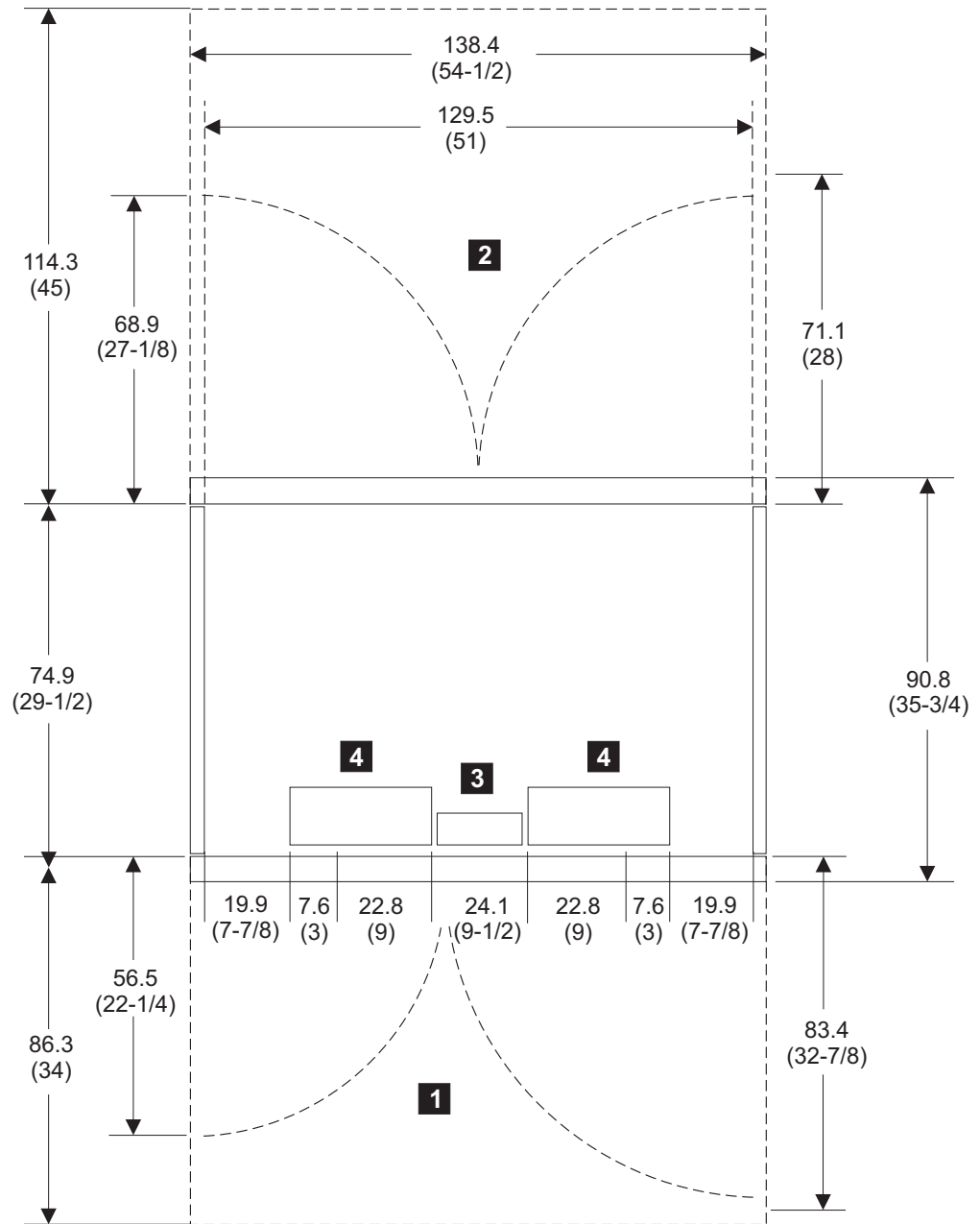
Model	Dimensions, Meters (Inches) (See Note 1.)	Dimensions with Arbo Crate, Meters (Inches)	Maximum Weight (Fully Configured)	Maximum Weight with Arbo Crate
Notes:				
1. These dimensions include casters and covers. (The casters are recessed and do not require extra clearance.)				
2. These dimensions exclude the top cover. With the top cover, the height is 1.915 m (75.3 in.).				
3. Models E10 and F10 do not support the expansion enclosure.				
4. Models E20 and F20 and the expansion enclosure are shipped in separate crates. With the Arbo Crate, the expansion enclosure weighs 1500 kg (3305 lbs).				
5. Install the expansion enclosure to the right (as you face its front) of Models E20 and F20.				
6. Install the Model 100 to the right (as you face its front) of Models E10/E20 and E10/F20.				

IBM recommends that you install the ESS on a raised floor. When you install the ESS, you can cut out tiles for cable entry at the front. IBM recommends that you place two fully perforated tiles in front of the ESS for cooling.

Center all openings and cutouts at the front of the enclosures. See Table 12 for the dimensions for the cutouts. See Figure 9 on page 53 for the cutout locations, and the clearances that are required for the doors. The ESS has recessed casters that do not require extra clearance.

Table 12. Cable cutout dimensions (maximum size)

Model	Floor Cutouts, Meters (Inches)
E10, F10, E20, and F20	0.10 x 0.91 (4 x 36)
Expansion enclosure	0.10 x 0.25 (4 x 10)
100	Front: 0.15 x 0.15 (6 x 6) Rear: 0.15 x 0.15 (6 x 6)



S008303R

Figure 9. Cable cutout and door clearance for Models E10, F10, E20, and F20

The reference keys in Figure 9 identify the following locations:

- 1** is the front of the enclosure.
- 2** is the rear of the enclosure.
- 3** is the cutout for the power cables. Expansion enclosure only.
- 4** is the cutout for the Enterprise Systems Connection (ESCON), fibre channel, small computer system interface (SCSI) cables, and power cables. (Models E10, F10, E20, F20)

Dimensions shown are centimeters (inches).

The dimensions and cutouts for the expansion enclosure are the same as for Models E10, F10, E20, and F20. However, the expansion enclosure does not require **4**, the cutout for the ESCON, fibre channel, or SCSI cables.

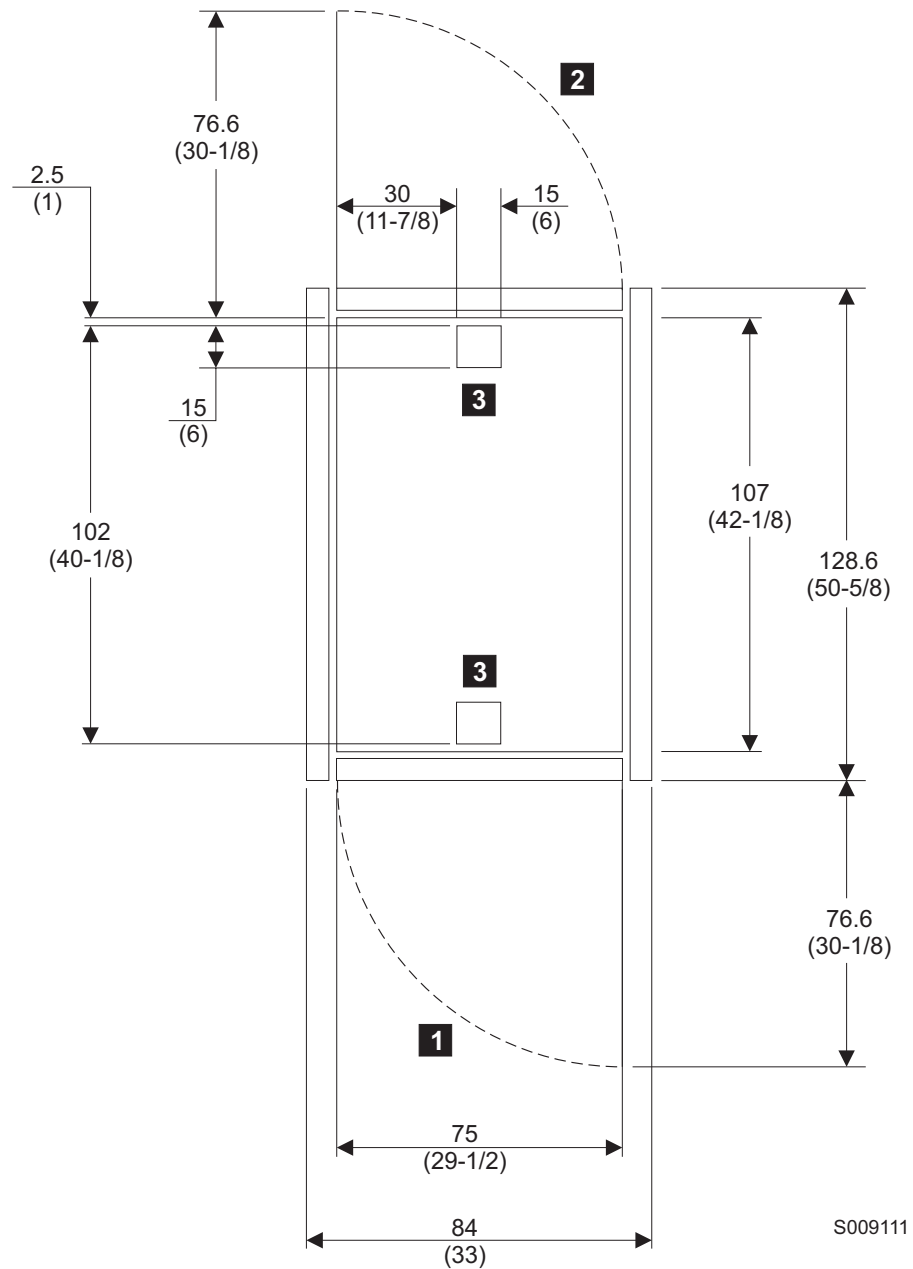


Figure 10. Cable cutout and door clearance for Model 100

The reference keys in Figure 10 identify the following locations:

- 1** is the front of the enclosure.
- 2** is the rear of the enclosure.
- 3** is the cutout for power cables

Dimensions shown are centimeters (inches).

Service clearance and floor-loading requirements for the ESS

Table 13 shows the clearances that the ESS requires for service and for the floor-loading requirements.

Table 13. Clearance and floor-loading requirements

Configuration and Weight	Service Clearance		Floor Loading, lbs/ft ² (See Notes 1 and 3.)	Dedicated Weight Distribution Areas mm (in.) (See Notes 3, 4, 6, and 7.)		
	Front	Rear		Sides	Front	Rear
2105 Model E10 and F10, Weight 998 kg (2200 lbs) Note 2	864mm (34 in.)	1145 mm (45 in.)	610 kg/m ² (125 lb/ft ²)	0 mm (0 in.)	356 mm (14 in.)	356 mm (14 in.)
			488 kg/m ² (100 lb/ft ²)	76 mm (3 in.)	432 mm (17 in.)	572 mm (22.5 in.)
			439 kg/m ² (90 lb/ft ²)	184 mm (7.25 in.)	432 mm (17 in.)	572 mm (22.5 in.)
			361 kg/m ² (70 lb/ft ²)	559 mm (22 in.)	432 mm (17 in.)	572 mm (22.5 in.)
2105 Model E20 and F20, Weight 1202 kg (2650 lbs) Note 2	864 mm (34 in.)	1145 mm (45 in.)	610 kg/m ² (125 lb/ft ²)	15 mm (.6 in.)	432 mm (17 in.)	572 mm (22.5 in.)
			488 kg/m ² (100 lb/ft ²)	229 mm (9 in.)	432 mm (17 in.)	572 mm (22.5 in.)
			439 kg/m ² (90 lb/ft ²)	368 mm (14.5 in.)	432 mm (17 in.)	572 mm (22.5 in.)
			342 kg/m ² (70 lb/ft ²)	762 mm (30 in.)	483 mm (19 in.)	610 mm (24 in.)
2105 Model E20 and F20 with Expansion Enclosure, Weight 2540 kg (5600 lbs) Note 2, 4, 5	864 mm (34 in.)	1145 mm (45 in.)	610 kg/m ² (125 lb/ft ²)	0 mm (0 in.)	381 mm (15 in.)	572 mm (22.5 in.)
			488 kg/m ² (100 lb/ft ²)	413 mm (16.25 in.)	432 mm (17 in.)	572 mm (22.5 in.)
			439 kg/m ² (90 lb/ft ²)	711 mm (28 in.)	432 mm (17 in.)	572 mm (22.5 in.)
			342 kg/m ² (70 lb/ft ²)	762 mm (30 in.)	762 mm (30 in.)	762 mm (30 in.)

Table 13. Clearance and floor-loading requirements (continued)

Configuration and Weight	Service Clearance		Floor Loading, lbs/ft ² (See Notes 1 and 3.)	Dedicated Weight Distribution Areas mm (in.) (See Notes 3, 4, 6, and 7.)		
	Front	Rear		Sides	Front	Rear
2105 Model 100, Weight 771 kg (1700 lbs) Note 2, 6, 8.	1145 mm (45 in.)	813 mm (32in.)	610 kg/m ² (125 lb/ft ²)	0 mm (0 in.)	318 mm (12.5 in.)	559 mm (22 in.)
			488 kg/m ² (100 lb/ft ²)	102 mm (4 in.)	572 mm (22.5 in.)	406 mm (16 in.)
			439 kg/m ² (90 lb/ft ²)	178 mm (7 in.)	572 mm (22.5 in.)	406 mm (16 in.)
			342 kg/m ² (70 lb/ft ²)	425 mm (16.75 in.)	572 mm (22.5 in.)	406 mm (16 in.)
2105 Model 100s, Weight 1542 kg (3400 lbs) Note 2, 7, 8	1145 mm (45 in.)	813 mm (32in.)	610 kg/m ² (125 lb/ft ²)	0 mm (0 in.)	419 mm (16.25 in.)	419 mm (16.25 in.)
			488 kg/m ² (100 lb/ft ²)	178 mm (7 in.)	572 mm (22.5 in.)	406 mm (16 in.)
			439 kg/m ² (90 lb/ft ²)	330 mm (13 in.)	572 mm (22.5 in.)	406 mm (16 in.)
			342 kg/m ² (70 lb/ft ²)	762 mm (30 in.)	635 mm (25 in.)	406 mm (16 in.)

Table 13. Clearance and floor-loading requirements (continued)

Configuration and Weight	Service Clearance		Floor Loading, lbs/ft ² (See Notes 1 and 3.)	Dedicated Weight Distribution Areas mm (in.) (See Notes 3, 4, 6, and 7.)		
	Front	Rear		Sides	Front	Rear
Notes:						
<ol style="list-style-type: none"> 1. IBM recommends that you install the ESS on a floor with a minimum of 342 kg/m² (70 lbs/ft²) strength. 2. Floor loads are calculated for maximum weight of the storage server. 3. Side clearances are for both sides of an ESS expansion enclosure. Clearances on both sides are dedicated to the ESS. Adjacent expansion enclosures must have their own floor-loading clearance. 4. If you install a Model E20 or F20 with an expansion enclosure, the floor strength must be 440 kg/m² (90 lbs/ft²). At 342 kg/m² (70 lbs/ft²), the side clearance exceeds the 762-mm (30-in.) maximum allowed. Consult a structural engineer if you are unsure about the correct placement and clearances of these machines for floor-loading distribution. 5. Multiple expansion enclosures are bolted together with 280-mm (11-in.) spacers. Move the side cover from the Model E20 or F20 to the side of the expansion enclosure. 6. The Model 100 is recommended to be placed to the right side of the E20 and F20. Distance between the frames is dictated by the floor loading of each machine. 7. When having two Model 100s, the Model 100 frames are bolted together with a 40 mm (1.6 in) spacer between them, and physically positioned to the right of the Model E20 or F20. 8. There can be a maximum of six drawers in a Model 100. 9. A clearance of 102 mm (4 in.) on each side of the ESS is required to open the covers to 90 degrees. 10. If you place an ESS Model E10, E20, F10, or F20 next to each other, a clearance of 102 mm (4 in.) is required between the sides of the models. This clearance allows you to open the doors. 						

When you attach the IBM 2105 Model 100 expansion enclosure to the ESS, follow the floor loading requirements in Table 13 on page 55. This table also gives the side clearances that are required for both sides of the installation. For more information on the IBM 2105 Model 100, please see the *Introduction and Planning Guide 2105 Model B09*, which can be accessed at the following web site:

www.storage.ibm.com/hardsoft/products/vss/books/vssrefinfo.htm

Planning for installation of the ESSNet

IBM installs the IBM Enterprise Storage Server Network (ESSNet) when they install your ESS.

IBM provides the power cables for the ESSNet. You provide:

- A location for the ESSNet hub that is within 15 m (50 ft) of the ESS.
- A location for the ESSNet console (workstation and monitor) that is within 15 m (50 ft) of the hub.
- Three outlets (for the workstation, monitor, and hub).

If you are attaching your network to the ESSNet hub, you also need to provide an Ethernet cable and TCP/IP information to IBM. IBM will connect your LAN cable to the ESSNet hub after the ESS and the ESSNet are installed and in operation.

You are responsible for firewall protection for the ESSNet.

You also need to provide a table or a stand for the ESSNet workstation at your site. The workstation is a personal computer (PC) and a monitor. The weight and dimensions for the PC are:

PC weight	11 kg (25 lbs)
PC height	128 mm (5 in.)
PC width	440 mm (17.7 in.)
PC depth	440 mm (17.7 in.)

The approximate weight and dimensions for the monitor are:

Monitor weight	18 kg (38 lbs)
Monitor height	432 mm (17 in.)
Monitor width	406 mm (16 in.)
Monitor depth	432 mm (17 in.)

The monitor has a 75 mm (15 in.) screen. The combined weight of the monitor and the PC does not exceed 30 kg (65 lbs).

Power requirements

This section provides power and cooling requirements and environmental information for the ESS.

Input voltages and frequencies

See Table 14 for the input voltages and frequencies that the ESS supports. The values apply to both primary power cables on any expansion enclosure or any model. Inputs are either single phase or balanced three phase depending on the connector type as described in "Power cable connectors" on page 61. Also see "Power features" on page 25 for information about power features.

Table 14. ESS input voltages and frequencies

Characteristic	Value
Nominal input voltages	200, 208, 220, 240, 380, 400, 415, or 480 RMS V ac
Minimum input voltage	180 RMS V ac
Maximum input voltage	512 RMS V ac
Steady-state input frequencies	50 ± 0.5 or 60 ± 0.5 Hz
PLD input frequencies (<10 seconds)	50 ± 2.0 or 60 ± 2.0 Hz

Power consumption and environmental information

Table 15 on page 59 gives power consumption and environmental information on the ESS.

Table 15. Power consumption and environmental information for the ESS

Measurement	Units	Models E10 or F10	Models E20 or F20	Models E20 or F20 with Expansion Enclosure
Electric power	kVA	3.5	5	12
Thermal load	BTU/hour	11 000	16 000	40 000
Capacity of exhaust (See Note.)	Cubic meters per min (cubic ft per min)	44.2 (1500)	51.8 (1800)	102.7 (3600)
Single-phase and three-phase leakage current	Milliamps	17	17	17
Startup current	Amps	≤ 100	≤ 100	≤ 100
Startup current duration	microseconds	< 200	< 200	< 200
Idle and operating-sound power (LwAd)	bels	7.5	7.5	Not applicable
Idle and operating-sound pressure (LpA)	decibels	59	59	Not applicable

Note: The ESS takes air in through the front cover and exhausts air from the rear and top.

Cooling requirements

For cooling, install two fully perforated tiles in front of each ESS. Also install one fully perforated tile in front of an expansion enclosure and one fully perforated tile at the back of an expansion enclosure.

Operating environment

The following sections list the environmental operating points and ranges that IBM recommends for the ESS.

Power on environment

Table 16 gives the operating extremes for an ESS with the power on.

Table 16. Operating extremes with the power on

Altitude	0 - 2133 m (7000 ft)
Dry Bulb Temperature	16 - 32°C (60 - 90°F)
Relative humidity	20 - 80%
Wet Bulb Temperature	23°C (73°F)

Table 17 gives the operating points that IBM recommends for an ESS with the power on.

Table 17. Recommended operating points with the power on

Temperature (See Attention)	22°C (72°F)
Relative humidity (See Attention)	45%

Table 17. Recommended operating points with the power on (continued)

Attention:
If you deviate substantially in either direction from these recommended operating points for extended, consecutive hours, you expose the ESS to malfunction from extreme causes.

Table 18 gives the operating ranges that IBM recommends for an ESS with the power on.

Table 18. Recommended operating ranges with the power on

Temperature	20 - 25°C (68 - 77°F)
Relative humidity	40 - 50%

Power off and storage environments

Table 19 gives the temperatures and humidity that IBM recommends for an ESS with the power off.

Table 19. Recommended temperatures and humidity with the power off

Temperature	10 - 43°C (50 - 110°F)
Relative humidity	8 - 80%
Wet Bulb Temperature	27°C (80°F)

Table 20 gives the temperatures and humidity that IBM recommends for storing an ESS.

Table 20. Recommended temperatures and humidity while in storage

Temperature	29°C (84°F)
Relative humidity	5 - 80%
Wet Bulb Temperature	29°C (84°F)

Recommended storage points or ranges

The recommended storage points or ranges are:

Wet bulb	29°C (84°F)
Temperature	1 - 60°C (34 - 140°F)
Relative humidity	5 - 80%

Energy saving law

The energy savings for all ESS models is:

0.001 Watts/MB for MB > 160, Category G.

Power consumption in energy savings mode is not applicable.

Power cable and power connector requirements

This section describes ESS power cable requirements and power connector requirements. See "Power cables" on page 26 for the power-cable feature codes.

Power cable connectors

Table 21 on page 62 shows the power cables, in-line connectors, and receptacles. Select the feature code that is appropriate for your site. Phase rotation on three-phase power-cable connectors is counterclockwise as you look at the plug. Phase rotation is clockwise as you look at the face of the power receptacle.

Table 21. ESS power cable connectors

Power cable Feature Code	Power cable Description (See Notes 1 and 3.)	In-line Connector (See Note 2.)	Receptacle (See Note 2.)
9801, 9986	1-phase, 50/60 Hz 50 A (See Notes 4 and 10.)	9C53U0 (See Note 8.)	9R53U0W (See Note 9, 10, and 12.)
9802	1-phase, 50 Hz (See Notes 4 and 10.)	No connector	Hard wire (See note 10 and 12.)
9803	1-phase, 50/60 Hz, 60 A (See Note 4.)	Not used	360R6W (See Note 6, 10, and 12.)
9851, 9987	3-phase, 50/60 Hz, 50 A (See Notes 5 and 10.)	9C54U0 (See Note 8.)	9R54U0W (See Note 9, 11, and 13.)
9988, 9854	3-phase, 50/60 Hz, 60 A (See Notes 5 and 10.)	7428-78 (See Note 7.)	7324-78 (See note 11 and 13.)
9852	3-phase, 50 Hz, (See Notes 5 and 11.)	No connector	Hard wire (See note 11 and 13.)
9853	3-phase, 50/60 Hz, 60 A (See Note 5.)	Not used	460R9W (See Note 6, 11, and 13.)

Notes:

1. All power cables are rated at 600 V ac except power cables for Japan, which are 250 V ac. Single-phase power cables have 2 poles and 3 wires. Three-phase power cables have 3 poles and 4 wires.
2. Connector and receptacle types indicated are Russell Stoll except types for Japan, which can use any manufacturer.
3. All power cables are 4.7 m (14 ft) long except Chicago, which is 2 m (6 ft) long.
4. Not available on the Model E20 or F20 or the expansion enclosure.
5. Not available on the Model E10 or F10.
6. Install IEC309 receptacle 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.
7. The 7428-78 in-line connector must have the appropriate JPA adapter included in the assembly to ensure continuity between the connector housing and the metallic shielding of the liquid-tight conduit.
8. IBM recommends that you attach these in-line connectors to a liquid-tight, metallic-shielded conduit, using adapter C75 for 1.89 cm (3/4-in.) conduit, or using C10 for 2.54 cm (1-in.) conduit.
9. These receptacles require back box 3711A.
10. For low-voltage, single phase installations (200 V to 240 V), IBM recommends a minimum rated circuit breaker of 40 amperes, and not to exceed the wire rating of the facility.
11. For low-voltage, three phase installation (200 V to 240 V), IBM recommends a minimum rated circuit breaker of 25 amperes, and not to exceed the wire rating of the facility.
12. For high-voltage, single phase installations (380 V to 415 V), IBM recommends a minimum rated circuit breaker of 20 amperes, and not to exceed the wire rating of the facility.
13. For high-voltage, three phase installations (380 V to 415 V), IBM recommends a minimum rated circuit breaker of 15 amperes, and not to exceed the wire rating of the facility.

Outlet power for the extension cord

Each ESS model E10, F10, E20, or F20 includes a 4.7-m (14-ft), multiple-outlet extension cord. Service personnel use the outlets within the ESS to power service tools.

You must supply an appropriate receptacle for the extension cord at your site for each ESS model. The ESS supports various power cable plugs to accommodate your site. The outlet circuit should support at least 1200 W.

Remote service connection

You need to connect each ESS to a modem and a remote support switch. With the remote support switch, you can attach up to seven ESSs. The modem connection and the switch connection allow service personnel to perform service remotely. See “Remote support features” on page 26 for information on remote support feature codes.

Locate and provide power to the remote support switch and modem externally from the ESS. The cable from the ESS to the remote support switch is 16 m (50 ft) long. The cable from the remote support switch to the modem is 3.33 m (10 ft) long. You supply the cable to connect the modem to a telephone jack.

Select the appropriate power cables for the modem and for the remote support switch. Make your selection based on the feature code for the remote support-switch power cable.

The modems that IBM offers are for worldwide use, and they meet all required standards.

Connect the remote support switch to the serial port of each cluster in the ESS.

Remote service outlet power

You supply an appropriate receptacle for each modem and each remote support switch. The ESS supports various power cable plugs to accommodate different geographies. The country code determines which plug IBM supplies with the product.

Remote power control

The ESS supports up to eight S/360 remote power-control interfaces to allow remote power control.

Remote service telephone lines

You need one or more analog telephone lines to support remote service. Determine the number of telephone lines you need by the number of ESSs you are installing. You also provide the telephone cable that connects the modem to the telephone-line jack. An expander supports one telephone line.

Chapter 4. Planning for communication

This chapter provides guidelines for completing the Communication Resources work sheet (see “Guidelines for completing the Communication Resources work sheet”) and the ESS Copy Services work sheet (see “Communications for ESS Web Copy Services” on page 73).

Communication overview

During installation IBM establishes communication links between the ESS and your storage management personnel, and between the ESS and service personnel.

IBM installation personnel use the information from the work sheet to establish communications between your host system and the ESS.

After IBM has installed the ESS, you can change the communication settings from the Web interface. See the *IBM Enterprise Storage Server Web Interface User's Guide* for guidelines on using the IBM StorWatch Enterprise Storage Server Specialist to change the settings.

The Communication Resources work sheet allows you to define how the various communications functions within the ESS should be configured. It also lets you authorize or deny access to your ESS by service personnel. The following communications functions are available:

- Enable outgoing modem calls
You control this remote service. IBM recommends that you enable this service by checking **Yes**. When you enable outgoing-modem calls, the ESS places the call-back password in the header of each call home record. The call-back password allows your service provider to login to the ESS in response to the service call.
- Enable remote login
You control this remote access. IBM recommends that you enable this service by checking **Yes**. Service personnel can login to the ESS with the call-back password.
- Optional remote access password
This password adds further security to the support login ID. This password should be set in agreement between you and IBM service personnel.

With access to the ESS, service personnel can perform service tasks, such as viewing error logs and problem logs and initiating trace or dump retrievals.

Guidelines for completing the Communication Resources work sheet

Use the following guidelines when completing the work sheet that is shown in “Appendix A. Communication Resources work sheet” on page 85:

1. Time zone configuration and date configuration

a. Time zone

Fill in the time zone that applies to this machine. Select one of the following items. The number in parentheses shows the time adjustment from Coordinated Universal (CUT) time, in hours. Enter this number (with the plus or minus) in the field:

- Coordinated Universal
- United Kingdom (0)

- Azores; Cape Verde (-1)
- Falkland Islands (-2)
- Greenland; East Brazil (-3)
- Central Brazil (-4)
- Eastern U.S.; Columbia (-5)
- Central U.S.; Honduras (-6)
- Mountain U.S. (-7)
- Pacific U.S.; Yukon (-8)
- Alaska (-9)
- Hawaii; Aleutians (-10)
- Bering Straits (-11)
- New Zealand (+12)
- Solomon Islands (+11)
- Eastern Australia (+10)
- Japan (+9)
- Korea (+9)
- Western Australia (+8)
- Taiwan (+8)
- Thailand (+7)
- Tashkent; Central Asia (+6)
- Pakistan (+5)
- Gorki; Central Asia; Oman (+4)
- Turkey (+3)
- Saudi Arabia (+3)
- Finland (+2)
- South Africa (+2)
- Norway; France (+1)

b. Daylight savings

Check **Yes** if this location goes on daylight savings time; check **No** if it does not.

2. **TCP/IP configuration**

The following guidelines are for basic TCP/IP configuration. For advanced TCP/IP configuration, see the *AIX System Management Guide: Communications and Networks, Version 4, SC23-2526*. Work with the IBM service personnel at your ESS site to set up advanced TCP/IP configuration on the ESS.

If you want to attach your LAN to the ESSNet hub, you need to provide the following TCP/IP information to IBM. IBM will connect your LAN cable to the ESSNet hub and enter the TCP/IP information.

Note: IBM will attach your LAN *after* the ESS and ESSNet are installed and in operation.

a. Network interface

Select one of the following network interfaces:

en0 Standard Ethernet

et0 Institute of Electrical and Electronics Engineers (IEEE) 802.3 Ethernet

The difference between these two choices is the header format. On the same local network, all stations must use the same header format.

b. Cluster 1 hostname

Enter the hostname that you are assigning to cluster 1 for access over the network. For example, Storage00.

Note: The hostname you define here is also the Web site address for access to ESS Specialist in cluster 1 or cluster 2.

The ESS has two independent clusters (cluster 1 and cluster 2). The clusters provide management functions for the ESS. The clusters also manage the interfaces to host devices and to external local area networks (LANs). Each cluster manages approximately half of the attached storage.

c. Cluster 1 Internet address

Enter the dotted decimal address you are assigning to cluster 1 of this machine. For example, 9.113.152.148.

d. Cluster 2 hostname

Enter the hostname that you are assigning to cluster 2 for access over the network. For example, Storage01.

e. Cluster 2 Internet address

Enter the dotted decimal address you are assigning to cluster 2 of this machine. For example, 9.113.152.149 .

f. ESSNet workstation hostname

Enter the hostname that you are assigning to ESSNet for access over the network. For example, ESSNet1.

g. ESSNet workstation Internet address

Enter the Internet address that you are assigning to ESSNet for access over the network. For example, 555.555.555.0.

h. Network mask

Enter the dotted decimal network mask that you are applying to TCP/IP on this machine. For example, 255.255.255.0.

i. Nameserver Internet address

Enter the dotted decimal address of the nameserver that this machine is to access. For example, 9.113.42.250.

j. Nameserver domain name

Enter the domain name of the nameserver. For example, tucson.ibm.com.

k. Default gateway address

Enter a dotted decimal or symbolic name as the address of the default gateway for this machine. For example, 9.113.155.254 or sanjosegate.

l. Ethernet adapter mode

Select half-duplex mode for the Ethernet adapter. The mode must match the mode of the external switch or router to which you are connecting the adapter.

3. **Customer information**

Enter information that you feel might be useful to your service provider, such as:

a. Business name or company name

IBM support uses this information; this information should be consistent for all machines within an account.

b. Location

Enter the location of the ESS (city, street address, and building).

c. Telephone number

This is the telephone number where service personnel can contact you.

d. Name of contacts

These are the names of individuals at your site that service personnel can contact about ESS service matters.

- e. Electronic mail (e-mail) address

Note: IBM strongly recommends that you list at least one e-mail address. This address will receive information when product engineers or service support personnel connect to your machine.

4. **Enable ESS Specialist**

Check either **Yes** or **No**. IBM service will enable or disable ESS Specialist during installation of your ESS. ESS Specialist is the Web interface that you and IBM use to configure the ESS. When you enable ESS Specialist, you can use it to change the configuration.

5. **Call home and remote services**

Complete all of this information except the **Remote telephone numbers** field and the **Support catcher telephone number** field. IBM service personnel or your service provider completes these fields.

- a. Enable the incoming calls

The ESS can accept the incoming calls. Check **Yes** to enable these calls. Check **No** to disallow or deny these calls.

- b. Enable outgoing modem calls

The ESS can place a call to IBM service or to your service provider when it requires service. Check **Yes** to enable these calls. Check **No** to disallow or deny these calls.

- c. Call home heartbeat interval

Enter 0 - 15 days to set the length of time between heartbeat call homes from the ESS clusters to IBM. IBM uses this record to monitor the health of the call home process for each cluster. If you enter 0, the ESS does not send a call home heartbeat. The default interval is 5 days.

- d. Enable e-mail across the LAN

The ESS can send e-mail to your LAN when it requires service. It sends e-mail through the ESSNet if you have attached your LAN to the ESSNet external hub. Check **Yes** to enable e-mail. Check **No** to disable e-mail.

- e. Enable pager messages

The ESS can send problem information to your pager if you have attached your LAN to the ESSNet external hub. Check **Yes** to enable pager messages. Check **No** to disable pager messages. See step 9 on page 71 for details about pagers.

- f. Remote telephone numbers

IBM service personnel or your service provider completes this information. The telephone numbers should include area codes and country codes, when appropriate.

- g. Support catcher telephone number

IBM service personnel or your service provider completes this information. The telephone numbers should include area codes and country codes, when appropriate. The SSR personnel who do not know this number should call the next level of support for this information.

Service personnel use this telephone number to send heartbeat call home records that are non-problem related, directly to the support catcher server rather than to the catcher server for remote technical-assistance

information network (RETAIN). These records might include such information as a trace, dump package, and the activation of Step Ahead Storage usage.

h. Call-back (local modem) telephone number

Enter the external telephone number of the line to the modem that is connected to this machine. Include all area codes and all country codes, when appropriate.

Note: Multiple ESSs can share a telephone modem if you install a modem switch.

i. Customer-contact telephone numbers

Enter the primary and off-shift telephone numbers that service personnel can use to contact someone at your ESS site to discuss service matters. Include all area codes. An off-shift number could be the backup number. These telephone numbers should be for the individuals you name for contacts in step 3 on page 67.

j. Call-back password

Enter 1 to 8 characters for the password. This is a mandatory entry. The ESS sends this public password with each call-home record. IBM suggests that you set support as the password.

k. Outside line prefix

This is the number you dial to access an outside line. Enter up to three numbers in this field.

l. Enable remote IBM PE login across a LAN

Check **Yes** to enable IBM product engineering (PE) personnel to login to the ESS. The PE personnel have service experience and development experience for this product. Check **No** to disallow this access.

6. **Modem configuration**

IBM service personnel or your service provider completes this information. A list of the fields follows for your information.

a. Name of modem set

Note: DeskPorte Fast should be entered if a MultiTech MultiModem was shipped

b. Dialer telephone system

Select tone or pulse.

c. Modem data rate

Select one of the following:

Fastest possible speed

14400 16800 19200 21600

24000 26400 28800

Note: IBM recommends that you select **Fastest possible speed**.

d. Cancel the call if it does not connect within 30 - 180 seconds. IBM recommends 45 seconds.

e. Number of consecutive retries for connection

f. Name of the expander set

g. Expander port for the modem

h. Expander port for cluster 1

- i. Expander port for cluster 2

7. E-mail configuration

Attention: If you plan to connect your network to the ESSNet, IBM recommends that you defer having IBM configure e-mail during initial installation and configuration. You can configure e-mail by using ESS Specialist after you connect your network to the ESSNet.

- a. Maximum error notification count per problem

The ESS sends error notifications (0 to 9) to e-mail addresses and call home. Enter the total number of notifications you want sent to each recipient for each problem. A number greater than 1 increases opportunities for delivery.

Note: If you enter a value of 0, the ESS does not send an error notification.

- b. Add e-mail destinations

The ESS sends error notifications and information to the destinations you enter here if you have attached your LAN to the ESSNet external hub.

Note: IBM strongly recommends that you list at least one e-mail address. This address will receive information when product engineers or service support personnel connect to your machine.

- Enter the full e-mail address for each destination, for example, maria@host.com.
- For each recipient, check one box: **Errors, information, all, or none.** This specifies which notification the recipient receives.

- c. Enable smart relay host

Note: You cannot enable smart relay host if you have enabled local e-mail as the two configurations are mutually exclusive.

Select **Yes** to enable a smart relay host when you have met either of the following conditions:

- Your e-mail is sent from a UNIX-based system on which you have specified a mail relay or mail gateway
- You have installed a message transfer agent (MTA) on your mail server

If you selected **Yes** (one of the above conditions applies), enter a host name or network address.

If the above conditions do not apply, select **No**.

Note: If the address you entered in step 7b does not receive e-mail, configuring the smart relay host may correct the problem.

- d. Enable local e-mail

Note: You cannot enable local e-mail if you have enabled smart relay host as the two configurations are mutually exclusive.

Select **Yes** when:

- You have connected your ESS to a host-system network that does not have a domain name server (DNS)

8. SNMP configuration

The ESS generates Simple Network Management Protocol (SNMP) traps and supports a read-only management information base (MIB) to allow monitoring by your network.

Note: SNMP is required for PPRC status reporting for ESS Copy Services for Open Systems.

Attention: If you plan to connect your network to the ESSNet, IBM recommends that you defer having IBM configure SNMP during initial installation and configuration. You can configure SNMP by using ESS Specialist after you connect your network to the ESSNet.

a. Allow MIB access

The ESS provides access to a management information base (MIB). To allow read access to this information, check **Read Only**. To disallow or deny read access to this information, check **None**.

b. Allow generic traps

The ESS can generate generic SNMP traps. To allow the ESS to send these traps, check **Yes**; to not allow it to send these traps, check **No**.

c. Allow product-specific traps

The ESS can generate product-specific SNMP traps. To allow it to send these traps, check **Yes**. To not allow it to send these traps, check **No**.

d. Maximum trap notifications per problem

Enter the total number of trap notifications you want sent for each trap condition. To ensure that traps are not lost, you may want to send each trap notification more than once.

e. SNMP community name

Enter the SNMP community name (up to 31 characters) to use for authenticating requests. If you do not enter a name, this entry defaults to public access.

f. SNMP SysContact

This is an optional entry. If you like, enter the name of the person responsible for your machine who your service provider should contact.

g. SNMP SysLocation

This is an optional entry. If you like, enter the location of the machine.

h. Add SNMP trap destinations

Enter host names or dotted decimal addresses of the destinations that are to receive SNMP traps. For example: host.com, or 9.113.152.254.

9. **Customer pager information**

This information is optional. The ESS can send problem record information to your pager through the call-home modem. Enter the following information:

a. Pager user name

Enter your pager user name in alphanumeric characters. This must be a unique name.

b. Modem telephone number

Enter the modem telephone number of the pager company. The pager must use TAP/IPO protocol. If the pager company recommends a slow speed or non-error correcting protocol, add an uppercase "z" (Z) to the end of the telephone number.

c. Pager PIN or ID number

This is the pager PIN number or ID number required by the pager company. It is usually not null.

d. Carrier password

This is a security password. Check with your pager company; this may be null.

e. Pager type

Select alphanumeric or numeric.

The numeric pager test message is: 01234-56789

The normal pager message is: 111-aaaaaa-222-bbbbbbb-333-c-444-ddd, where:

aaaaaa is the numeric characters from the product-serial number

bbbbbbb is the customer voice-telephone number

c is the cluster number (1 or 2)

ddd is the Problem ID

Note: The information the ESS can send to a numeric pager is limited.

f. Pager state

Check **Yes** to enable, or **No** to disable.

g. Number of repeats

This is the number of times the ESS sends problem record information (0 - 10). The ESS sends information once automatically.

10. **Service information messages (SIMs) for S/390**

The ESS sends SIMs to System/390 host consoles for the following three types of SIMs:

- Direct access storage device (DASD) SIM

This SIM tracks disk drive module (DDM) failures and problems.

- Media SIM

This SIM tracks data check problems on the media.

- Storage facility SIM

This SIM tracks control unit, power control, and other hardware problems.

You select the number of times that the ESS sends a SIM to your console. The ESS can send a SIM 1 - 9 times, or not at all (0). You also select the severity level of the SIMs. The ESS does not send any SIMs that are below the severity level that you select. Severity levels are:

- | | |
|-------------------|--|
| 1 acute | An irrecoverable error with possible loss of data. This severity level only applies to DASD SIMs. |
| 2 serious | An irrecoverable error or a data check with loss of access to data. |
| 3 moderate | A system path or paths are not operational, and performance may be degraded. This severity level does not apply to media SIMs. |
| 4 service | A recoverable error, equipment checks, or data checks. You can defer repair. |

Enter the severity levels for the SIMs and enter the number of times the ESS should send a SIM:

- a. Enter the SIM-severity reporting level for DASD SIMs.

- 1 to 4
- b. Enter the number of times the ESS is to send a DASD SIM.
0 to 9
- c. Enter the SIM-severity reporting level for media (data check) SIMs.
2 or 4
- d. Enter the number of times the ESS is to send a media SIM.
0 to 9
- e. Enter the SIM-severity reporting level for a storage server SIM.
2, 3, or 4
- f. Enter the number of times the ESS is to send the storage-server SIM.
0 to 9

11. **Fibre-channel LUN-access control**

A switch on the ESS determines whether hosts have access to all LUNs over fibre channel, or whether access is restricted.

- a. Switch setting:

Check **Restricted** if you want to limit access to LUNs to hosts that you define in the ESS Specialist interface. Restricted is the default setting.

Check **Permit All** if all hosts are to have access to all LUNs.

Communications for ESS Web Copy Services

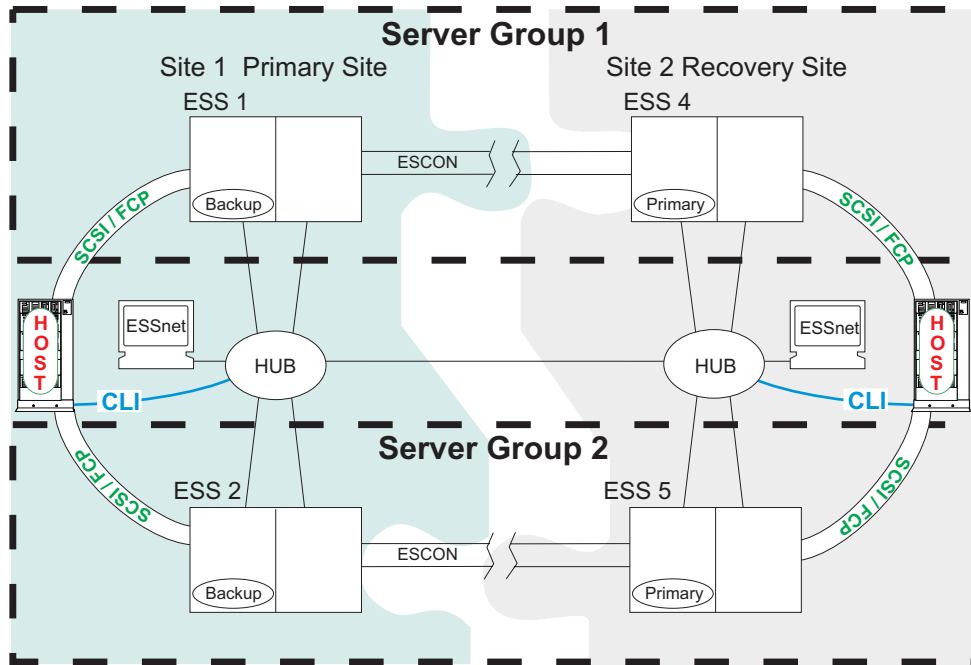
This section gives guidelines for filling out the Copy Services work sheet.

The ESS clusters that are part of a Copy Services Server Group use the TCP/IP network to communicate. Each ESS cluster needs to have an IP address assigned to it. You enter this information on the Communication Resources (Copy Services) work sheet.

IBM recommends that you use a Domain Name Server (DNS) for name resolution. DNS provides the following advantages:

- It resolves the names of the participating ESS clusters
- It allows the Copy Services code to communicate with remote sites
- A domain name provides a unique, stable address for communication; the dotted decimal address can be changed

Figure 11 on page 74 shows ESS Copy Services server group in a DNS configuration.



CS000005

Figure 11. ESS Web Copy Services configuration with DNS

If you decide not to use a DNS in your configuration, you need to provide your IBM SSR with information in addition to the information in the Communication Resources (Copy Services) work sheet. The SSR uses the ESS Service interface to update the host table with this information:

- The TCP/IP address and host name for each ESS cluster in the copy services server group.
- The TCP/IP address and hostname for each host using the CLI.
- The TCP/IP address and hostname of the ESSNet Workstation.

Use the following instructions when completing the Communication Resources (ESS Web Copy Services) work sheet in “Appendix B. Communication Resources (ESS Web Copy Services) work sheet” on page 89. Refer to the “Guidelines for enabling and using ESS Web Copy Services” on page 41 for additional information:

Attention: This work sheet must be copied and provided for each ESS Web copy services server group defined

1. Server Group : Identify the server group () that is being defined by this work sheet.
2. Primary Copy Services Server IP Address. For example, 9.113.152.148.
3. Backup Copy Services Server IP Address. For example, 9.113.152.147.
4. Is a Domain Name Server (DNS) configured on ESS.

Note: If you do not have a DNS specified and you are using the CLI, collect the hostnames and IP addresses for all of the Open System servers that are using the CLI.

5. Enable ESS Web Copy Services commands for System/390 volumes

Select **Enable** or **Disable**. (Disable is the default) ESS Copy Services supports FlashCopy and PPRC for System/390 volumes in addition to volumes on open system hosts.

Note: It is not necessary to enable ESS Web Copy Services if you are going to use TSO and IDCAMS

6. ESS Machine Serial Number for Primary Server Site.

Enter the serial number of this machine. For example, 013-FCA15.

You can configure two ESS within a Copy Services Server group. Each ESS Copy Services server group manages four clusters and a maximum of 2048 volumes. Provide this information to your IBM SSR for each Copy Services server group that you want to configure.

Note: A Copy Services server group is a collection of ESS clusters that participate in Copy Services functions that include the volumes within the clusters.

a. Cluster 1 Hostname

Enter the hostname that you are assigning to cluster 1 for access over the network. For example, Storage03.company.com.

Note: The hostname you define here is the Web site address for access to ESS Copy Services.

b. Cluster 1 IP Address

Enter the dotted decimal address you are assigning to cluster 1 of this machine. For example, 9.113.152.149.

c. Cluster 2 Hostname

Enter the hostname that you are assigning to cluster 2 for access over the network. For example, Storage04.company.com.

d. Cluster 2 IP Address

Enter the dotted decimal address you are assigning to cluster 2 of this machine. For example, 9.113.152.151 .

7. ESS Machine Serial Number for Backup Server Site.

Enter the serial number of this machine. For example, 013-FCA15.

a. Cluster 1 Hostname

Enter the hostname that you are assigning to cluster 1 for access over the network. For example, Storage03.company.com.

Note: The hostname you define here is the Web site address for access to ESS Copy Services.

b. Cluster 1 IP Address

Enter the dotted decimal address you are assigning to cluster 1 of this machine. For example, 9.113.152.149.

c. Cluster 2 Hostname

Enter the hostname that you are assigning to cluster 2 for access over the network. For example, Storage04.company.com.

d. Cluster 2 IP Address

Enter the dotted decimal address you are assigning to cluster 2 of this machine. For example, 9.113.152.151 .

Use the following instructions when completing the work sheet that is shown in Table 24 on page 89:

1. Server Group : Identify the server group () that is being defined by this work sheet.
2. Command Line Interface Host 1 IP Address
Enter the dotted decimal address you are assigning to Command Line Interface Host 1. For example, 9.113.152.151 .
Command Line Interface Host 1 Hostname
Enter the hostname that you are assigning to Command Line Interface 1 for access over the network. For example, Storage04.company.com.
3. Command Line Interface Host 2 IP Address
Enter the dotted decimal address you are assigning to Command Line Interface Host 1. For example, 9.113.152.153 .
Command Line Interface Host 2 Hostname
Enter the hostname that you are assigning to Command Line Interface 2 for access over the network. For example, Storage01.company.com.
4. Command Line Interface Host 3 IP Address
Enter the dotted decimal address you are assigning to Command Line Interface Host 1. For example, 9.113.152.154 .
Command Line Interface Host 3 Hostname
Enter the hostname that you are assigning to Command Line Interface 3 for access over the network. For example, Storage02.company.com.
5. Command Line Interface Host 4 IP Address
Enter the dotted decimal address you are assigning to Command Line Interface Host 1. For example, 9.113.152.155 .
Command Line Interface Host 4 Hostname
Enter the hostname that you are assigning to Command Line Interface 4 for access over the network. For example, Storage03.company.com.
6. ESSNet workstation Internet address
Enter the Internet address that you are assigning to ESSNet for access over the network. For example, 555.555.555.0.ESSNet workstation hostname
Enter the hostname that you are assigning to ESSNet for access over the network. For example, ESSNet1.

Disaster Recovery Considerations for Copy Services

If a disaster or emergency situation at your primary production site causes you to lose connections to the Copy Services primary server, you must manually switch control to your recovery site. ESS Web Copy Services code copies tasks synchronously between the primary and backup servers, but there are some steps you should consider in planning for disaster recovery, and in implementing procedures following a disaster.

Preparing for a disaster

Planning for a disaster requires some additional steps for PPRC. First, decide where to place your primary and backup ESS Web Copy Services servers. There are two options:

1. **Primary Copy Services server is at your recovery site**

Choosing this configuration can gain you some efficiency in terms of recovering from a disaster. Because the primary server is at the recovery site, you do not have to perform manual recovery steps to switch to a different Web Copy

Services server. If you have planned in advance and have created tasks for disaster recovery then you can run those tasks and bring your production systems back up.

Note: In Open Systems environments this setup might have performance implications because the communications with Open Systems command line interface (CLI) and the ESS Web Copy Services server is done over TCP/IP links. If you have enabled ESS Web Copy Services for the OS/390 environment, you will have the same results.

2. **Primary Copy Services server is at your production site**

This configuration might be the desirable setup in Open Systems environments. The reason for this is the Open Systems CLI uses TCP/IP links to communicate with the host systems and the Web Copy Services Server, which may introduce network delays. If you have enabled ESS Web Copy Services for the OS/390 environment, you will have the same results.

However, with this configuration, if your primary site fails, there can be delays in bringing up applications at the recovery site. Because the primary server is at the production site, you will need to perform manual procedures to enable the backup server as the active server at the recovery site before you can execute tasks to begin using the volumes.

Creating tasks for PPRC and FlashCopy

We recommend you create all tasks during setup, and that you name the tasks in such a way that will be meaningful to you. The Web User Interface will enforce rules so the names you choose will be compatible with command line invocation.

As the following steps show, each time you create a task, you also need to create the corresponding tasks to terminate relationships. Why is that a good idea? Because after a disaster you need to terminate existing relationships to get your production systems up and running at your recovery site. For further information, see *IBM Enterprise Storage Server Web Interface User's Guide*.

1. **Establish Paths tasks**

Step 1a	<ul style="list-style-type: none"> a. Create tasks for establish groups b. For Consistency Grouping, select CG c. Name, and save each task
Step 1b	<p>Copy and edit each establish paths task created in step 1a, to create</p> <ul style="list-style-type: none"> a. An associated remove paths task b. Name, and save each task

2. **Establish Pairs tasks**

Step 2a	<ul style="list-style-type: none"> a. Create tasks for establish pairs b. Name, and save each task
Step 2b	<p>For each establish pairs task created in 2a, copy and edit to create an associated</p> <ul style="list-style-type: none"> a. Suspend pair task b. Terminate pair on primary task c. Terminate pair on secondary task d. Establish pair with re-sync task e. Name, and save each task as you create it

3. Freeze/Consistency Groups Created tasks

Step 3a	a. Create tasks name for freeze b. Name, and save each task
Step 3b	For each freeze task created in step 3a, a. Copy and edit to create an associated consistency group created task b. Name, and save the task

4. FlashCopy tasks

Note: These tasks are not required for disaster recovery because FlashCopy operates only in the same LSS. We show them here for planning purposes only.

Step 4a	a. Create tasks for establish pairs b. Select background copy or no background copy c. Name, and save each task
Step 4b	For each establish pairs task created in step 4a, a. Copy and edit to create an associated withdrawal task b. Name, and save the task

5. Finally, after creating all relevant tasks, group tasks that are alike so they can run together.

Chapter 5. Planning data migration

This chapter provides planning guidelines for migrating data to the ESS. It includes information to help you plan for the migration of data for the following hosts:

- UNIX, Windows NT, Windows 2000 and OS/400
- Host system views of the ESS
- System/390 hosts

UNIX, Windows NT, Windows 2000 and OS/400 host systems

For UNIX, Windows NT, Windows 2000, and OS/400 hosts systems, you can use a variety of methods for copying or moving data from one disk drive to another. These include, but are not limited to:

- Volume management software

Volume management software provides specific tools for wholesale movement of data.

AIX, Solaris, and HP-UX all have volume management software that directly controls the disks and storage devices attached to the system. It provides the system administrator with tools for configuring and managing disk drives, file systems, paging, and to exchange spaces. The software also provides the operating system interface to the data.

- Direct copy with **cpio -p**

The **cpio** command is a standard UNIX command for archiving and copying data. The **-p** (pass) option allows the operating system to copy data between file systems without the creation of an intermediate archive.

The **cpio** command reads a list of files to copy from its standard input. You typically use it with the UNIX **find** command to copy complete directory structures.

- AIX **backup** and **restore** commands

You commonly use these commands on AIX systems to archive and restore data. However, they do not support a direct disk-to-disk copy. They require an intermediate device such as a tape drive or spare disk drive to store the archive that is created by the **backup** command.

- The **dump** and **restore** commands

These commands are similar in function to the AIX **backup** command and **restore** command; you mostly find them on other forms of UNIX. They, too, require an intermediate device.

- Other commands

Other UNIX commands provide archival functions, such as the **tar** command, that you can use to transport data. Again, these commands require that you create an intermediate archive, usually on a tape drive or spare disk drive.

Your system administrator should select the method that is the best compromise between efficiency and least impact on the users of the system:

- Management software provides simple robust methods that you can generally use during production without disturbing users.
- The AIX logical volume manager (LVM) provides methods that you can use at any time without disrupting access to the data by users. You may notice a small performance degradation, but this is better than having to shut down databases or require users to log off the system.

- Methods that use backup and restore procedures will generally have the most impact on the system usage. They require that databases and file systems be in quiescent states to ensure a valid snapshot of the data.

Replacing existing storage

To provide investment protection for IBM 7133 disk drives, the ESS supports reuse of 7133 Model 020 and D40 drawers in 2105 Model 100 expansion enclosures.

Reformatting existing disk drive modules

To provide integrity-checking of data and to allow different operating systems to use the ESS, IBM formats ESS disks to a 524-byte sector. The 524-byte sector replaces the traditional 512-byte sector of fixed-block architecture disk drive modules (DDMs). The 524-byte sector format requires that you reformat all disks that you are migrating to the ESS. Because reformatting will erase any data that is already contained on the drives, you must back up the data to some form of temporary storage.

You can use the DDM for either direct migration of data or as temporary storage while the existing drives are moved. If this is not possible, use a removable media device such as a tape drive to temporarily store the data while you reformat the drives.

The AIX Logical Volume Manager (LVM) uses a fixed-byte sector of 512 bytes. When used in an ESS, the format is a fixed-byte sector of 524 bytes. The data portion of the sector remains at 512 bytes. AS/400 headers use eight additional bytes. A 2-byte sequence number and a 2-byte longitudinal redundancy check (LRC) complete the extra bytes. The ESS LIC uses the sequence number and LRC. The ESS does not transfer them to the host system. For a description of the new format, see “524-byte sector format”.

524-byte sector format

Most fixed-block disk architectures use a fixed-byte sector of 512 bytes. This includes most UNIX systems, including AIX. When used in an ESS subsystem, the format of a DDM has a fixed-byte sector of 524 bytes. The 524-byte sector format enables the ESS subsystem to connect to a wide range of host systems and share data between them.

The IBM AS/400 host systems use eight bytes at the start of the sector. UNIX host systems do not use these eight bytes when you attach them to the ESS. The data portion of the sector remains at 512 bytes for all host systems. A 2-byte sequence number and a 2-byte LRC increase the size of the sector to 524 bytes.

The sequence number is a modulo 64K value of the logical block address (LBA) of this sector. It is an extra method of ensuring that you are accessing the correct block.

The LRC, generated by the host adapter, is calculated on the 520 data bytes and header bytes. The ESS uses the LRC as an error checking mechanism. The LRC checks the data as it progresses from the host, through the ESS controller, into the SSA adapter, to the array. See “UNIX systems” on page 81 for a detailed description on data flow through the subsystem. The ESS also uses LRC as an error checking mechanism as the ESS reads data from the array and passes it to the host adapter. The ESS never transfers the sequence number and the LRC to the host system.

Open system host views of the IBM Enterprise Storage Server

ESS supports connection to host systems through an ultra-SCSI adapter or a fibre-channel adapter. A variety of UNIX-based systems and AS/400 systems support the ESS as peripheral devices. The following sections discuss how the host systems view the ESS.

OS/400 operating systems

When attached to an IBM AS/400 with an OS/400 operating system, the ESS can emulate a 9337. The ESS as an emulated 9337 reports differently to the AS/400 than does a real 9337. The major differences are in the AS/400 Hardware Resource Manager, some AS/400 service screens, and the AS/400 performance monitors. LUN reporting is also different:

- A real 9337 reports each of its LUN serial numbers to the AS/400 as a one-digit physical slot number. It adds the last five digits of the 9337 physical subsystem's serial number to the total.

The AS/400 uses the last six digits as the controller serial number. This causes a real 9337 to show on the AS/400 as one controller with up to eight LUNs under it.

- The ESS generates its LUN serial numbers by using a three-digit volume ID plus four digits from the ESS physical serial number for the subsystem.

The AS/400 interprets the last two digits of the ESS volume ID as part of the six-digit controller serial number. This results in the AS/400 generating a unique controller resource for each ESS LUN.

This resource shows on the AS/400 as multiple controllers with anywhere from zero to eight LUNs under each controller for each 9337 emulated subsystem. Most of the extra controllers will have a status of "not connected", and may still show that "operational" disk units are attached.

Although these differences may be confusing to the user, they do not cause functional problems with the ESS.

UNIX systems

For UNIX-based systems, the ESS emulates multiple SCSI DDMs. The host system accesses the virtual drives of the ESS as if they were generic SCSI DDMs. The AIX operating system contains entries in its object-distribution manager database to identify the ESS. However, the AIX operating system accesses the ESS through its generic SCSI DDM. The ESS appears to be a standard physical volume or *hdisk* to AIX. The ESS appears similarly to Solaris and HP-UX systems.

When you use ultra- or wide-small computer system interface (SCSI) adapters in your host systems, a total of 16 SCSI IDs per interface is available on the ESS. The host system SCSI IDs are known as initiators; the ESS SCSI IDs are the targets.

If you connect only one host system to an ESS SCSI port, the ESS can assign up to 15 unique target IDs. If you connect the maximum of four host systems to the ESS, the ESS can only assign up to 12 unique SCSI target IDs.

You can configure an ESS to appear as 64 LUN's per SCSI interface. Define any LUN size you want from 0 to the maximum array size of 245.5 GB, in 100 MB GB increments.

When you use fibre-channel adapters to attach to ESS, the ESS can support connection to a maximum of 128 hosts per fibre-channel port, and a maximum of

512 hosts across all fibre-channel and SCSI ports configured on one machine. The ESS can support up to 4096 LUNs across all of its fibre-channel and SCSI ports. If the software in the fibre-channel host supports the SCSI command "Report LUNs", then that host will support 4096 LUNs per fibre-channel port on the ESS. If the software in the fibre-channel host does not support the SCSI command "Report LUNs", then the host will only support 256 LUNs per fibre-channel port on the ESS.

System/390 hosts

This section includes information about planning data migration for System/390 host systems. It also includes information about IBM services for data migration.

Data migration planning

This section provides information about:

- Planning data migration for Multiple Virtual Storage (MVS) environments
- Planning data migration for virtual machine (VM) environments

Planning data migration for MVS environments

The following guidelines and resources can help you plan data migration for MVS environments:

1. Consider the major environments:
 - System-managed storage (SMS)
The SMS environment greatly simplifies introduction of new DDMs in comparison to non-SMS environments. If your environment is SMS, you can use *3390 Installation and Migration for DFSMS* (GG66-3155) to help you plan your migration.
 - Non-SMS
If your environment is non-SMS, you can coordinate a migration to SMS with a migration to the new storage server. You can also consider SMS and non-SMS migrations as separate projects.
2. Use *IBM 3390 Direct Access Storage Migration Guide* (GG24-3373) as a reference for overall migration for both SMS and non-SMS environments.
3. Identify the most critical data and determine in advance some methods to verify that the data has been moved correctly.

Planning data migration for VM environments

You can simplify data migration for a VM environment by using DFSMS/VM[®], which is a no-charge feature of VM/ESA. This lets you manage and control the use of VM disk space. It will also move minidisks from one media to another.

Use of DIRMAINT also provides tools that will manage the movement of CMS minidisks from one media to another.

IBM data migration and other services

IBM "Product Support Services, Storage Services and Support" provides storage-related services for a fee. For information about installation planning or migration planning, including the migration services described below, call **1-800-IBM-4YOU** and request information about storage services offerings.

IBM Product Support Services provides migration services for your Enterprise Storage Server as part of a new migration service for storage area networks. These migration services offer you a fast, easy, reliable method of migrating your data to

an Enterprise Storage Server. These services provide minimal application disruption without significantly impacting the performance of your system. Services include:

- Project planning
- Data migration to larger capacity DDMs
- Consolidation of data from the differing systems to one central location
- Consolidation of your data center
- Post-migration services

An IBM services specialist performs the service at your site by using an IBM-supplied software tool installed on your systems. This tool mirrors source data and target data and allows continued systems operation during the process. To ensure a smooth migration, the tool only updates your files when there is minimal impact to system operations.

Appendix A. Communication Resources work sheet

Table 22. Communication Resources work sheet

1. Time zone and date configuration	
a. Time zone Enter a selection from the list in 1a on page 65.	
b. Do you go on daylight savings time? (check one)	<input type="checkbox"/> Yes <input type="checkbox"/> No
2. TCP/IP Configuration	
a. Network interface (check one)	<input type="checkbox"/> en0 Standard Ethernet network interface <input type="checkbox"/> et0 IEEE 802.3 Ethernet network interface
b. Cluster 1 Hostname (100 characters maximum)	
c. Cluster 1 Internet address (dotted decimal)	
d. Cluster 2 Hostname (100 characters maximum)	
e. Cluster 2 Internet address (dotted decimal)	
f. ESSNet workstation hostname	
g. ESSNet workstation Internet address	
h. Network mask (dotted decimal)	
i. Nameserver Internet address (dotted decimal)	
j Nameserver domain name	
k. Default gateway address (dotted decimal or symbolic name)	
l. Ethernet adapter mode	<input type="checkbox"/> half-duplex
3. Customer information	
a. Business name or company name	a. _____
b. Location	b. _____
c. Telephone number	c. _____
d. Name of contacts	d. _____
e. E-mail address	e. _____
4. Enable ESS Specialist	
a. Enable (check one)	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. Call home and remote services	
a. Enable incoming calls? (check one)	<input type="checkbox"/> Yes <input type="checkbox"/> No
b. Enable outgoing modem calls? (check one)	<input type="checkbox"/> Yes <input type="checkbox"/> No
c. Call home heartbeat interval	_____ (0 - 15)
d. Enable e-mail across LAN? (check one)	<input type="checkbox"/> Yes <input type="checkbox"/> No
e. Enable pager messages? (check one)	<input type="checkbox"/> Yes <input type="checkbox"/> No
f. Remote telephone numbers IBM service personnel fill in this information.	1. _____ 2. _____
g. Support Catcher telephone number IBM service personnel fill in this information.	1. _____
h. Call-back (local modem) telephone number	_____

Table 22. Communication Resources work sheet (continued)

i. Customer-contact telephone number	Primary: _____ Off shift: _____
j. Call-back password	_____
k. Outside line prefix	_____
l. Enable remote IBM PE login across a LAN	<input type="checkbox"/> Yes <input type="checkbox"/> No
6. Modem configuration (IBM service personnel fill in this section)	
a. Name of modem set:	_____
b. Dialer phone system (check one)	<input type="checkbox"/> tone <input type="checkbox"/> pulse
c. Modem data rate (check one)	<input type="checkbox"/> Fastest speed available <input type="checkbox"/> 14400 <input type="checkbox"/> 16800 <input type="checkbox"/> 19200 <input type="checkbox"/> 21600 <input type="checkbox"/> 24000 <input type="checkbox"/> 26400 <input type="checkbox"/> 28800
d. Cancel the call if it does not connect within:	_____ seconds
e. Number of consecutive retries for connection	_____
f. Name of the expander set	_____
g. Expander port for the modem	_____ (1 - 16)
h. Expander port for cluster 1	_____ (1 - 16)
i. Expander port for cluster 2	_____ (1 - 16)
7. e-mail configuration	
a. Maximum error notification count per problem	_____
b. Add e-mail destinations _____ _____	Enable for: (check one) 1. <input type="checkbox"/> errors <input type="checkbox"/> information <input type="checkbox"/> all <input type="checkbox"/> none 2. <input type="checkbox"/> errors <input type="checkbox"/> information <input type="checkbox"/> all <input type="checkbox"/> none
c. Enable smart relay host? (check one) If yes, enter host name or network address	<input type="checkbox"/> Yes <input type="checkbox"/> No _____
d. Enable local e-mail? (check one)	<input type="checkbox"/> Yes <input type="checkbox"/> No
8. SNMP configuration	
a. Allow MIB access? (check one)	<input type="checkbox"/> None <input type="checkbox"/> Read Only
b. Allow generic traps? (check one)	<input type="checkbox"/> Yes <input type="checkbox"/> No
c. Allow product-specific traps? (check one)	<input type="checkbox"/> Yes <input type="checkbox"/> No
d. Maximum trap notifications per problem	
e. SNMP community name	
f. SNMP SysContact (optional)	
g. SNMP SysLocation (optional)	
h. Add SNMP trap destinations _____ _____	
9. Customer pager information (optional)	

Table 22. Communication Resources work sheet (continued)

<p>a. Pager username b. Modem telephone number c. Pager PIN or ID number d. Carrier password e. Pager type (check one) f. Pager state g. Number of repeats (0 - 10)</p>	<p>a. _____ b. _____ c. _____ d. _____ e. <input type="checkbox"/> Alphanumeric <input type="checkbox"/> Numeric f. Enabled? <input type="checkbox"/> Yes <input type="checkbox"/> No g. _____</p>
<p>10. Service information messages (SIMs) for S/390</p>	
<p>a. Enter the SIM severity reporting level for DASD SIMs (check one) b. Enter the number of times a DASD SIM is to be sent. (0 - 9) c. Enter the SIM severity reporting level to media SIMs (check one) d. Enter the number of times a media SIM is to be sent (0 - 9) e. Enter the SIM severity reporting level for a storage server SIM (check one) f. Enter the number of times the storage server SIM is to be sent (0 - 9)</p>	<p>a. 1 ____, 2 ____, 3 ____, 4 ____ b. ____ c. 2 ____, 4 ____ d. ____ e. 2 ____, 3 ____, 4 ____ f. ____</p>
<p>11. Fibre-channel LUN access control</p>	
<p>a. Switch setting (check one)</p>	<p><input type="checkbox"/>Restricted <input type="checkbox"/>Permit all</p>

Appendix B. Communication Resources (ESS Web Copy Services) work sheet

Attention: The following work sheets (when completed) should be copied and made available at both the Primary Server Site and the Backup Server Site.

Table 23. Enable ESS Web Copy Services work sheet

1. Server Group (_____)	
2. Primary Copy Services Server IP Address	
3. Backup Copy Services Server IP Address	
4. Is a Domain Name Server (DNS) Configured on ESS	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. Enable Web Copy Services Commands for S/390 Volumes	<input type="checkbox"/> Enable <input type="checkbox"/> Disable
6. ESS Machine Serial Number (Primary Server Site)	
a. Cluster 1 Hostname (100 characters maximum)	
b. Cluster 1 IP address (dotted decimal)	
c. Cluster 2 Hostname (100 characters maximum)	
d. Cluster 2 IP address (dotted decimal)	
7. ESS Machine Serial Number (Backup Server Site)	
a. Cluster 1 Hostname (100 characters maximum)	
b. Cluster 1 IP address (dotted decimal)	
c. Cluster 2 Hostname (100 characters maximum)	
d. Cluster 2 IP address (dotted decimal)	

Attention: When Copy Services is being used without a Domain Name Server (for example, when the ESS's in this Server Group are attached to the ESSNet on a private network), additional information must be entered into the Host Tables in both the ESS and the Host. In addition to the information in the Enable Copy Services table, the following information must be entered.

Table 24. Enable ESS Web Copy Services without DNS work sheet

1. Server Group (_____)	
2. Command Line Interface Host 1 IP Address	
Command Line Interface Host 1 Hostname	
3. Command Line Interface Host 2 IP Address	
Command Line Interface Host 2 Hostname	
4. Command Line Interface Host 3 IP Address	
Command Line Interface Host 3 Hostname	
5. Command Line Interface Host 4 IP Address	
Command Line Interface Host 4 Hostname	
6. ESSNet workstation IP Address	
ESSNet workstation Hostname	

Note: Copy this table if more than four (4) hosts are using CLI to this ESS Web Copy Services server group.

Appendix C. Adding and Removing Drawers and Racks

If you have existing 7133 model 20 or D40 drawers and would like to attach to an ESS, specify feature code 1121 for the first 2105 model 100 and 1122 for the second 2105 model 100. Each of the 2105 with feature code 1121 or 1122 will have appropriate hardware and cables to allow attachment of six 7133 drawers model 20 or D40 to an ESS.

7133 Drawers must not have:

- 48 volt power supply input
- DDM locks
- Front cover

Ensure that the drawers meet minimum hardware requirements:

- Three power supplies for 7133 model 20 and two power supplies for 7133 model D40.
- 4.5, 9.1, 18.2, or 36.4 GB DDMs
- 16 DDMs in each drawer that are all the same capacity and same RPM.
- SSA cables are provided in the FC 1121 and 1122 ship group

Also see 7133 Model 20, and D40 Requirements for 2105 Installation.

Drawer Placement

The ESS supports up to twelve 7133 drawers, with up to six 7133 drawers in each of the two Model 100 racks.

Existing drawers must be placed in a factory new Model 100 rack. This ensures the power systems will be fully compatible. Feature code 1000, battery back-up, is required. The Model 100 racks will be populated from the bottom to the top, so that the center of gravity remains low ensuring better stability. See 7133 Model 20, and D40 .

Note: Prior to relocating a drawer to an ESS rack, you must backup critical data. You lose all existing data during ESS installation configuration and reformatting.

IBM will charge you for these services against 7133 relocation. All parts that the service representative removes are your property.

After you have met the compatibility requirements, the 7133 drawers are installed and configured by a customer engineer. The customer engineer follows the instructions in the "Physically Installing a 7133 Device Drawer" in the 2105 Model 100 Attachment to ESS Service Guide.

7133 Model 20 Requirements

Your Model 20 drawer must meet the following requirements before a service representative can install it in a ESS.

- The Model 20 drawer must have 16 DDMs that are all the same capacity and RPM, either 4.5 or 9.1 GB DDM . 18.2GB and 36.4GB DDM's are not supported in the 7133 Model 20.
- If 48-Volt power supplies are in the drawer:

- Order three 220-volt power supplies, 7132-REP, FC 3090. Also order the following Engineering Changes:
 - F20795A, for the power supply
 - F23443A, for the power-supply package
- Verify that engineering change ECA 005 is installed. Check the bar code on the drawer mounting bracket for 1WCxxxxx. The code 1WC indicates that ECA 005 is installed.
- If ECA 005 is not installed, order it. This ECA provides SSA loop bypass cards
 - PN 25L5890 (bottom left)
 - PN 25L5888 (top left)
 - PN 25L5891 (bottom right)
 - PN 25L5889 (top right)
- The service representative ensures that the drawer bypass-card jumpers are correctly positioned. This information is in the 2105 model 100 attachment to ESS Service Guide.
- Drawer Label Requirements
 - The service representative needs the machine type, model and serial number from the label on the front bezel of the Model 20 drawer. This is the "old label". The blank S/N labels are included in the 2105 Model 100 Feature Code 1121 and 1122 ship group
 - The service representative records the information from the old label onto the new blank label (PN 05J7400) that IBM provides in the VSS Ship group. The service representative attaches the new label to the lower right-hand corner of the 7133 drawer so that it is visible.

Note: This visual label provides essential information that you and the service representative need when preparing the configuration work sheets.

Model D40 Requirements

Your Model D40 drawer must meet the following requirements before a service representative can install it in a ESS:

- It must be a 7133 Model D40
- **Note:** You cannot install a 7133 Model T40 in a 2105 .
- You need to remove the front cover from the Model D40
- Disk Drive Modules (DDM):
 - The Model D40 drawer must have 16 DDMs that are all the same capacity and speed, either 4.5, 9.1, 18.2 or 36.4 GB DDM.
- The service representative ensures that the drawer bypass-card jumpers are correctly positioned. This information is in the 2105 model 100 attachment to ESS Service Guide.
- Drawer Label Requirements
 - The service representative needs the machine type, model and serial number from the label on the front bezel of the Model D40 cover. The blank S/N labels are included in the 2105 Model 100 Feature Code 1121 and 1122 ship group. The service representative records the information from the old label onto the new blank label (PN 05J7400) that IBM provides in the 2105 Model 100 ship group. The service representative attaches the new label to the lower right-hand corner of the 7133 drawer so that it is visible.

Note: This visual label provides essential information that you and the service representative need when preparing the configuration work sheets.

7133 Model 020 and D40 Requirements for 2105 Installations

To upgrade a 7133 Model 20 or Model D40 drawer from a not fully-populated drawer to a fully-populated drawer, order enough 7133 DDMs to fill slots not currently containing DDMs. All DDMs in a drawer must be the same size and RPM.

Order a 7133 MES; Order the DDMs against the serial number of the 7133 drawer you are upgrading.

For Model 20:

Order FC 3401 for each 4.5 GB DDM. Order FC 3901 for each 9.1 GB DDM.

For Model D40:

Order FC 8204 for each 4.5 GB DDM. Order FC 8509 for each 9.1 GB DDM. Order FC 8518 for each 18.2 GB DDM. Order FC 8536 for each 36.4GB DDM.

When you receive the 7133 DDMs, call your service provider to request the upgrade service.

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If you purchased an IBM Personal Computer Machine in Albania, Armenia, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Georgia, Hungary, Kazakhstan, Kirghizia, Federal Republic of Yugoslavia, Former Yugoslav Republic of Macedonia (FYROM), Moldova, Poland, Romania, Russia, Slovak Republic,

Slovenia, or Ukraine, you may obtain warranty service for that Machine in any of those countries from either (1) an IBM reseller approved to perform warranty service or (2) from IBM.

The applicable laws, Country-unique terms and competent court for this Statement are those of the country in which the warranty service is being provided. However, the laws of Austria govern this Statement if the warranty service is provided in Albania, Armenia, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Federal Republic of Yugoslavia, Georgia, Hungary, Kazakhstan, Kirghizia, Former Yugoslav Republic of Macedonia (FYROM), Moldova, Poland, Romania, Russia, Slovak Republic, Slovenia, and Ukraine.

The following terms apply to the country specified:

EGYPT: Limitation of Liability:The following replaces item 2 in this Section: 2. as to any other actual direct damages, IBM's liability will be limited to the total amount you paid for the Machine that is the subject of the claim.

Applicability of suppliers and resellers (unchanged).

FRANCE: Limitation of Liability:The following replaces the second sentence of the first paragraph of this Section:

In such instances, regardless of the basis on which you are entitled to claim damages from IBM, IBM is liable for no more than: (items 1 and 2 unchanged).

GERMANY: The IBM Warranty for Machines: The following replaces the first sentence of the first paragraph of this Section:

The warranty for an IBM Machine covers the functionality of the Machine for its normal use and the Machine's conformity to its Specifications.

The following paragraphs are added to this Section:

The minimum warranty period for Machines is six months.

In case IBM or your reseller are unable to repair an IBM Machine, you can alternatively ask for a partial refund as far as justified by the reduced value of the unrepaired Machine or ask for a cancellation of the respective agreement for such Machine and get your money refunded.

Extent of Warranty: The second paragraph does not apply.

Warranty Service:The following is added to this Section: During the warranty period, transportation for delivery of the failing Machine to IBM will be at IBM's expense.

Production Status: The following paragraph replaces this Section: Each Machine is newly manufactured. It may incorporate in addition to new parts, reused parts as well.

Limitation of Liability: The following is added to this Section:

The limitations and exclusions specified in the Statement of Limited Warranty will not apply to damages caused by IBM with fraud or gross negligence and for express warranty.

In item 2, replace "U.S. \$100,000" with "1,000,000 DM."

The following sentence is added to the end of the first paragraph of item 2:

IBM's liability under this item is limited to the violation of essential contractual terms in cases of ordinary negligence.

IRELAND: Extent of Warranty:The following is added to this Section:

Except as expressly provided in these terms and conditions, all statutory conditions, including all warranties implied, but without prejudice to the generality of the foregoing all warranties implied by the Sale of Goods Act 1893 or the Sale of Goods and Supply of Services Act 1980 are hereby excluded.

Limitation of Liability: The following replaces items one and two of the first paragraph of this Section:

1. death or personal injury or physical damage to your real property solely caused by IBM's negligence; and 2. the amount of any other actual direct damages, up to the greater of Irish Pounds 75,000 or 125 percent of the charges (if recurring, the 12 months' charges apply) for the Machine that is the subject of the claim or which otherwise gives rise to the claim.

Applicability of suppliers and resellers (unchanged).

The following paragraph is added at the end of this Section:

IBM's entire liability and your sole remedy, whether in contract or in tort, in respect of any default shall be limited to damages.

ITALY: Limitation of Liability: The following replaces the second sentence in the first paragraph:

In each such instance unless otherwise provided by mandatory law, IBM is liable for no more than: (item 1 unchanged) 2) as to any other actual damage arising in all situations involving nonperformance by IBM pursuant to, or in any way related to the subject matter of this Statement of Warranty, IBM's liability, will be limited to the total amount you paid for the Machine that is the subject of the claim.

Applicability of suppliers and resellers (unchanged).

The following replaces the second paragraph of this Section:

Unless otherwise provided by mandatory law, IBM and your reseller are not liable for any of the following: (items 1 and 2 unchanged) 3) indirect damages, even if IBM or your reseller is informed of their possibility.

SOUTH AFRICA, NAMIBIA, BOTSWANA, LESOTHO AND SWAZILAND:

Limitation of Liability:The following is added to this Section:

IBM's entire liability to you for actual damages arising in all situations involving nonperformance by IBM in respect of the subject matter of this Statement of Warranty will be limited to the charge paid by you for the individual Machine that is the subject of your claim from IBM.

TURKIYE: Production Status: The following replaces this Section:

IBM fulfills customer orders for IBM Machines as newly manufactured in accordance with IBM's production standards.

UNITED KINGDOM: Limitation of Liability: The following replaces items 1 and 2 of the first paragraph of this Section:

1. death or personal injury or physical damage to your real property solely caused by IBM's negligence;
2. the amount of any other actual direct damages or loss, up to the greater of Pounds Sterling 150,000 or 125 percent of the charges (if recurring, the 12 months' charges apply) for the Machine that is the subject of the claim or which otherwise gives rise to the claim;

The following item is added to this paragraph:

3. breach of IBM's obligations implied by Section 12 of the Sale of Goods Act 1979 or Section 2 of the Supply of Goods and Services Act 1982.

Applicability of suppliers and resellers (unchanged).

The following is added to the end of this Section:

IBM's entire liability and your sole remedy, whether in contract or in tort, in respect of any default will be limited to damages.

Glossary

This glossary includes terms for the IBM Enterprise Storage Server(ESS) and other Seascope solution 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). Copies may be purchased from the American National Standards Institute, 11 West 42nd Street, New York, New York 10036. Definitions are identified by the symbol (A) 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 (SIO/IEC JTC1/SC1). Definitions of published parts of this vocabulary are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers being developed by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not been reached among the participating National Bodies of SCI.

The following cross-reference is used in this glossary:

See This refers the reader to (a) a related term, (b) a term that is the expanded form of an abbreviation or acronym, or (c) a synonym or more preferred term.

A

AAS. See *Advanced Administrative Systems*.

access. (1) To obtain the use of a computer resource. (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.

Advanced Administrative Systems (AAS). A system used by IBM for order entry for machines and external cables either by a regular order or by an MES.

alert. (1) A message or log that a storage facility generates as the result of error event collection and analysis. An alert indicates that you need to perform some service action. (2)

allegiance. In the ESA/390 architecture, a relationship that is created between a device and one or more channel paths during the processing of certain conditions. Refer to implicit allegiance, contingent allegiance, and reserved allegiance.

allocated storage. On an IBM storage server, the space allocated to volumes, but not yet assigned. See *assigned storage*.

American National Standard Code for Information Interchange (ASCII). 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)

American National Standards Institute (ANSI). An organization consisting 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)

ANSI. See *American National Standards Institute*.

APAR. See *authorized program analysis report*.

arbitrated loop. For fibre-channel connection, arbitrated loop is a topology that allows you to interconnect a set of nodes.

array. An ordered collection, or group, of physical devices (disk drive modules) that are used to define logical volumes or devices.

ASCII. See *American National Standard Code for Information Interchange (ASCII)*.

assigned storage. On an IBM storage server, the space allocated to a volume and assigned to a port.

authorized program analysis report (APAR). A report of a problem caused by a suspected defect in a current, unaltered release of a program.

availability. The degree to which a system or resource is capable of performing its normal function. Also see *data availability*.

B

bay. Physical space on an IBM Enterprise Storage server. A bay contains SCSI and ESCON host adapter cards. See *service boundary*.

bit. Either of the digits 0 or 1 when used in the binary numeration system. (T)

block. A group of consecutive bytes.

byte. A group of eight adjacent binary digits that represent one EBCDIC character.

C

cache. A buffer storage that contains frequently accessed instructions and data; it is used to reduce access time.

cache fast write. A form of the fast-write operation in which the subsystem writes the data directly to cache where it is available for later destaging.

cache memory. Typically refers to volatile memory that a subsystem uses to improve access times to instructions or data. The cache memory is typically smaller and faster than the primary memory or storage medium. A storage subsystem uses the cache memory to improve the performance of accesses to data that ultimately resides on the storage devices in the storage facility.

cascading. The connecting of network controllers to each other in a succession of levels, to concentrate many more lines than a single level permits. 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 but relinquishes the resource to the primary node upon reintegration of the primary node into the cluster

CCR. See *channel-command retries*.

CCW. See *channel command word*.

CEC. See *computer-electronic complex*.

channel. In the ESA/390 architecture, the part of a channel subsystem that manages a single I/O interface between a channel subsystem and a set of controllers.

channel-command retries (CCR). In the ESA/390 architecture, the protocol used between a channel and a controller that allows the controller to request that the channel reissue the current command.

channel command word (CCW). In the ESA/390 architecture, a data structure that is used to specify an I/O operation to the channel subsystem.

channel path. In the ESA/390 architecture, the interconnection between a channel and its associated controllers.

channel subsystem. In the ESA/390 architecture, the part of a host computer that manages I/O communication between the program and any attached controllers.

channel-subsystem image. In the ESA/390 architecture, the logical functions that a system requires to perform the function of a channel subsystem. With EMIF, one channel subsystem image exists in the channel subsystem for each LPAR. Each image appears to be an independent channel subsystem program, but all images share a common set of hardware facilities.

CKD. See *count key data*.

CLI. See *command-line interface*.

cluster. (1) A partition in a storage server that is capable of performing all function of a storage server. When there are multiple clusters in a storage server, any remaining clusters in the configuration can take over the processing of any failing clusters. (2) On an AIX platform, a cluster is a group of nodes within a complex.

cluster processor complex (CPC). The unit within a cluster that provides the management function for the storage server. It consists of cluster processors, cluster memory, and related logic.

command-line interface. The command-line interface on the open-systems hosts that initiates and manages PPRC and FlashCopy on the ESS.

compact disc, read-only memory. High-capacity read-only memory in the form of an optically read compact disc.

compression. (1) The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks. (2) Any encoding to reduce the number of bits used to represent a given message or record.

computer-electronic complex (CEC). The set of hardware facilities associated with a host computer.

concurrent copy. Concurrent Copy allows a program such as DFDSS to make a backup of a data set while maintaining continuous read and write access to the data. The data is frozen at the point in time that the commands were issued to the controller.

concurrent download of licensed internal code. Capability to download and install licensed internal code on an ESS 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. To define the logical and physical configuration of the input/output (I/O) subsystem through the user interface provided for this function on the storage facility.

consistent copy. A copy of a data entity (for example a logical volume) that contains the contents of the entire data entity at a single instant in time.

console. A user interface to a server, such as a personal computer.

contingent allegiance. In the ESA/390 architecture, a relationship that is created in a controller between a device and a channel path when unit-check status is accepted by the channel. The allegiance causes the controller to guarantee access; the controller does not present the busy status to the device. This enables the controller to retrieve sense data that is associated with the unit-check status on the channel path with which the allegiance is associated.

controller. In the ESA/390 architecture, a storage controller with ESCON or OEMI interfaces. See *cluster*.

controller image. In the ESA/390 architecture, a logical subsystem that you access with an ESCON I/O interface. One or more control-unit images exist in each controller. Each image appears to be an independent controller, but all images share a common set of hardware facilities.

control unit (CU). In System/390 architecture, a storage control unit with ESCON or OEMI interfaces. Also referred to as a controller.

Copy Services server group. A collection of ESS clusters that participate in Copy Services functions that include the volumes within the clusters.

count field. The first field of a 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 the ESA/390 architecture, a logical device that specifies the format of and access mechanisms for the logical data units on the device. The logical data unit is a track that can contain one or more records, each consisting of a count field, a key field (optional), and a data field (optional).

CPC. See *cluster processor complex*.

CRC. See *cyclic redundancy check*.

CU. See *control unit*.

customer console. See *console*.

CUT. See *Universaile Tempes du Coordonaire*.

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. A cylinder has a fixed number of tracks.

D

DA. See *device adapter* and *SSA adapter*.

daisy chain. A method of device interconnection for determining interrupt priority by connecting the interrupt sources serially.

DASD. See *direct access storage device* and *disk drive module*.

DASD-fast write. A function of a storage controller that allows caching of active write data without exposure of data loss by journaling of the active write data in nonvolatile storage.

data availability. The degree to which data is available when needed. For better data availability when you attach multiple hosts that share the same data storage, configure the data paths so that data transfer rates are balanced among the hosts.

data compression. A technique or algorithm that you use to encode data such that you can store the encoded result in less space than the original data. This algorithm allows you to recover the original data from the encoded result through a reverse technique or reverse algorithm. See *compression*.

Data Facility Storage Management Subsystem. An operating environment that helps automate and centralize the management of storage. To manage storage, SMS provides the storage administrator with control over data class, storage class, management class, storage group, and automatic class selection routine definitions.

data field. The third (optional) field of a CKD record. You determine the field length by the data length that is specified in the count field. The data field contains data that the program writes.

data record. A subsystem stores data records on a track by following the track-description record. The subsystem numbers the data records consecutively, starting with 1. A track can store a maximum of 255 data records. Each data record consists of a count field, a key field (optional), and a data field (optional).

data sharing. The ability of homogenous or divergent host systems to concurrently utilize information that they store on one or more storage devices. The storage

facility allows configured storage to be accessible to any, or all, attached host systems. To use this capability, you need to design the host program to support data that it is sharing.

DDM. See *disk drive module*.

DDM group. See *disk drive module group*.

dedicated storage. Storage within a storage facility that is configured such that a single host system has exclusive access to the storage.

demote. The action of removing a logical data unit from cache memory. A subsystem demotes a data unit in order to make room for other logical data units in the cache. It could also demote a data unit because the logical data unit is not valid. A subsystem must destage logical data units with active write units before they are demoted.

destaging. The moving of data from an online or higher priority device to an offline or low priority device.

device. In the ESA/390 architecture, a disk drive.

device adapter (DA). A physical subunit of a storage controller that provides the ability to attach to one or more interfaces used to communicate with the associated storage devices.

device address. In the ESA/390 architecture, the field of an ESCON device-level frame that selects a specific device on a control-unit image.

device interface card. A physical subunit of a storage cluster that provides the communication with the attached DDMs.

device number. (1) In the ESA/390 architecture, a four-hexadecimal-character identifier, for example 13A0, that you associate with a device to facilitate communication between the program and the host operator. (2) The device number that you associate with a subchannel.

device sparing. A subsystem function that automatically copies data from a failing DDM to a spare DDM. The subsystem maintains data access during the process.

direct access storage device (DASD). A mass storage medium on which a computer stores data.

disk drive module (DDM). The primary nonvolatile storage medium that you use for any host data that is stored within a subsystem. The number and type of storage devices within a storage facility may vary.

disk drive module group. A group of eight disk drive modules (DDMs). Each DDM group is a RAID array.

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.

drawer. A unit that contains multiple DDMs and provides power, cooling, and related interconnection logic to make the DDMs accessible to attached host systems.

drive. (1) A peripheral device, especially one that has addressed storage media. (2) The mechanism used to seek, read, and write information on a storage medium.

duplex. 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

EBCDIC. See *extended binary-coded decimal interchange code*.

EC. See *engineering change*.

ECKD. See *extended count key data*.

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 controller, 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 CKD 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 this architecture include the ES/9000[®] family.

Enterprise Systems Connection (ESCON). (1) An ESA/390 computer peripheral interface. The I/O interface uses ESA/390 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*.

ERP. See *error recovery procedure*.

error recovery procedure (ERP). 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 Systems Connection*.

ESCON director (ESCD). An I/O interface switch that allows the interconnection of multiple ESCON interfaces in a distributed-star topology.

ESCON multiple image facility (EMIF). In the ESA/390 architecture, a function that allows LPARs to share an ESCON channel path by providing each LPAR with its own channel-subsystem image.

ESD. See *electrostatic discharge*.

ESS Specialist. See *StorWatch Enterprise Storage Server Specialist*.

extended binary-coded decimal interchange code (EBCDIC). A coded character set of 256 8-bit codes.

extended count key data (ECKD). An extension of the CKD architecture.

Extended Remote Copy (XRC). A function of a storage controller that assists a control program to maintain a consistent copy of a logical volume on another storage facility. 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.

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*.

failover. The routing of all transactions to a second controller when the first controller fails. See *cluster*.

fast write. A write operation at cache speed that does not require immediate transfer of data to a DDM. 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.

FBA. See *fixed-block address*.

FC-AL. See *Fibre Channel - Arbitrated Loop*.

FCP. See *fibre-channel protocol*.

FCS. See *fibre-channel standard*.

Fibre Channel - Arbitrated Loop (FC-AL). An implementation of the fibre-channel technology that uses a ring topology for communication. In this topology two or more fibre-channel end points are interconnected through a looped interface. The ESS supports this topology.

fibre-channel protocol (FCP). For fibre-channel communication the protocol has five layers. The layers 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. Refer to ANSI X3.230-199x.

FICON. Fibre-channel connection for mainframe computers and peripherals that use ESCON architecture, such as the IBM ES/9000 family.

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 may contain other field replaceable units.

FIFO. See *first-in-first-out*.

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 that 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 address (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.

FlashCopy. An optional feature for the ESS. With FlashCopy you can make an instant copy of data, that is, a point-in-time copy of a volume.

FRU. See *field replaceable unit*.

full duplex. See *duplex*.

G

GB. See *gigabyte*.

gigabyte (GB). A gigabyte of storage is 10^9 bytes. A gigabyte of memory is 2^{30} bytes.

group. See *DDM group*.

H

HA. See *host adapter*.

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.

HDA. See *head and disk assembly*.

HDD. See *hard disk drive*.

hdisk. An AIX term for storage space.

head and disk assembly (HDA). The portion of an HDD associated with the medium and the read/write head.

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.

host adapter (HA). A physical subunit of a storage controller that provides the ability to attach to one or more host I/O interfaces.

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 *host system*.

host system. (1) A data processing system used to prepare programs and operating environments for use on another computer or controller. (2) The data processing system to which a network is connected and with which the system can communicate. (3) The controlling or highest level system in a data communication configuration.

hot plug. Pertaining to the ability to add or remove a hardware facility or resource to a unit while power is on.

I

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.

ID. See *identifier*.

identifier (ID). A unique name or address that identifies things such as programs, devices, or systems.

implicit allegiance. In the ESA/390 architecture, a relationship that a controller creates between a device and a channel path when the device accepts a read or write operation. The controller guarantees access to the channel program over the set of channel paths that it associates with the allegiance.

initial program load (IPL). The initialization procedure that causes an operating system to commence operation.

initiator. A SCSI term for the part of a host computer that communicates with its attached targets.

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.

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.

invalidate. The action of removing a logical data unit from cache memory because it cannot support continued access to the logical data unit on the device. This removal may be the result of a failure within the storage controller or a storage device that is associated with the device.

I/O. See *input/output*.

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 you define to allow a host to perform read and write operations with its associated peripheral devices.

IP. See *Internet Protocol*.

IPL. See *initial program load*.

K

KB. See *kilobyte*.

key field. The second (optional) field of a CKD 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. The subsystem uses this data to identify or locate a given record.

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.

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)

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.

LCU. See *logical control unit*.

LED. See *light-emitting diode*.

LIC. See *licensed internal code*.

licensed internal code (LIC). Microcode that IBM does not sell as part of a machine, but licenses to the customer. LIC 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 controller-link-level functions that are attached to the switch port.

link-level facility. The ESCON hardware and logical functions of a controller 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 server (DNS).

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 control unit (LCU). See *controller image*.

logical data unit. A unit of storage that is accessible on a given device.

logical device. A file for conducting input or output with a physical device, or a file for mapping user I/O between virtual and real devices.

logical partition (LPAR). A set of functions that create the programming environment that is defined by the ESA/390 architecture. ESA/390 architecture uses this term when more than one 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.

logical subsystem (LSS). The logical functions of a storage controller that allow one or more host I/O interfaces to access a set of devices. The controller aggregates the devices according to the addressing mechanisms of the associated I/O interfaces. One or more logical subsystems exist on a storage controller. In general, the controller associates a given set of devices with only one logical subsystem.

logical unit. The open-systems term for a logical disk drive.

logical unit number (LUN). The SCSI term for the field in an identifying message that is used to select a logical unit on a given target.

logical volume. The storage medium associated with a logical disk drive. A logical volume typically resides on one or more storage devices. A logical volume is referred to on an AIX platform as an hdisk, an AIX term for storage space. A host system logical volume can be a physical volume.

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 (DDM).

LPAR. See *logical partition*.

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.

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 information base (MIB). The physical and logical characteristics of a system make up a collection of information called a management information base (MIB). The individual pieces of information that comprise an MIB are called MIB objects and they reside in the SNMP Agent. See *simple network management protocol*.

MAP. See *maintenance analysis procedure*.

MB. See *megabyte*.

MCA. See *Micro Channel architecture*.

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 facility, 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.

MES. See *miscellaneous equipment system*.

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.

mirrored pair. Two units that contain the same data. The system refers to them as one entity.

mirroring. In the AS/400 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.

MLC. See *machine level control*.

mobile service terminal (MoST). The mobile terminal used by IBM service personnel.

MoST. See *mobile service terminal*.

MTBF. See *mean time between failures*.

multiple virtual storage (MVS). Consisting of MVS/System Product Version 1 and MVS/370 Data Facility Product operating on an IBM System/370 processor.

MVS. See *multiple virtual storage*.

N

node. The unit that is connected in a fibre-channel network. An ESS is a node in a fibre-channel network.

non-RAID. A collection of disk drives in a non-RAID group or array.

non-removable medium. A recording media that you cannot add to or remove from a storage device.

non-retentive data. Data that the control program can easily recreate in the event it is lost. The control program may cache non-retentive write data in volatile memory.

nonvolatile storage (NVS). (1) Typically refers to nonvolatile memory on a processor rather than a nonvolatile storage device. On a storage facility, nonvolatile storage is used to store active write data to avoid data loss in the event of a power loss. (2) A storage device whose contents are not lost when power is cut off.

NVS. See *nonvolatile storage*.

O

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.

organizationally unique identifier (OUI). An identifier that identifies an organization according to IEEE standards.

original equipment manufacturer's information (OEMI). A reference to an IBM guideline for a computer peripheral interface. More specifically, refer to *IBM System/360 and System/370 I/O Interface Channel to Control Unit Original Equipment Manufactures' Information*. The interface uses ESA/390 logical protocols over an I/O interface that configures attached units in a multi-drop bus topology.

OUI. See *organizationally unique identifier*.

P

parallel access volume (PAV). Created by associating multiple devices of a single control-unit image with a single logical device. Up to 8 device addresses can be assigned to a parallel access volume.

parity. A data checking scheme used in a computer system to ensure the integrity of the data. The RAID implementation uses parity to recreate data if a disk drive fails.

path group. The ESA/390 term for a set of channel paths that are defined to a controller as being associated with a single LPAR. The channel paths are in a group state and are online to the host.

path-group identifier. The ESA/390 term for the identifier that uniquely identifies a given 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.

PAV. See *parallel access volume*.

PCI. See *program-controlled interruption*.

PE. See *IBM product engineering*.

Peer-to-Peer Remote Copy (PPRC). A function of a storage controller that maintains a consistent copy of a logical volume on the same controller or on another controller. You access the controllers over an ESCON I/O interface. All modifications that any attached host performs on the primary logical volume are also performed on the secondary logical volume.

peripheral component interconnection. see *program-controlled interruption*.

point-to-point connection. A fibre-channel topology that allows you to interconnect ports directly.

POST. See *power-on self test*.

power-on self test (POST). A diagnostic test run by servers or computers when they are turned on.

PPRC. See *Peer-to-Peer Remote Copy*.

predictable write. A write operation that can cache without knowledge of the existing format on the medium. All writes on FBA DASD devices are predictable. On CKD DASD devices, a write is predictable if it does a format write for the first data record on the track.

product engineering. See *IBM product engineering*.

program. A generic term for the software that controls the operation of a host computer. Typically, the program is an operating system that allows sharing of the host resources between multiple tasks.

program-controlled interruption (PCI). An interruption that occurs when an I/O channel fetches a channel command word with the program-controlled interruption flag on. PCI is also called peripheral component interconnection.

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

promote. The action of adding a logical data unit to cache memory.

PTF. See *program temporary fix*.

R

R0. See *track-descriptor record*.

rack. See *enclosure*.

RAID. See *redundant array of independent disks and array*.

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. See *array*.

redundant array of independent disks (RAID). A collection of disk drives that operate independently. The IBM Enterprise Storage Server protects all storage with redundant arrays of independent disks (RAID). The ESS attaches serial storage architecture (SSA) disk drive modules (DDMs) in RAID-5 configurations. The implementation of RAID-5 configurations distributes (stripes) parity across all DDMs in the array. Also see *array*.

remote technical assistance information network (RETAIN). Initial Service Tracking for IBM service support.

reserved allegiance. In the ESA/390 architecture, a relationship that is created in a controller between a device and a channel path when a Sense Reserve command is completed by the device. The allegiance causes the control-unit to guarantee access (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

SAM. See *sequential access method*.

SBCON. See *Single-Byte Command Code Sets Connection*.

SCSI. See *small computer system interface*.

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. A SCSI device is either an initiator or a target.

Seascope architecture. A storage system architecture developed by IBM for open-systems servers and S/390 host systems. It provides storage solutions that integrate software, storage management, and technology for disk, tape, and optical storage.

sequential access method (SAM). A sequential access method to find information.

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.

server group. See *Copy Services server group*.

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.

serial storage architecture (SSA). An IBM standard for a computer peripheral interface. The interface uses a SCSI logical protocol over a serial interface that configures attached targets and initiators in a ring topology.

server. (1) A type of host that provides certain services to other hosts that are referred to as clients. (2) A functional unit that provides services to one or more clients over a network.

service boundary. Physical space on an ESS rack. It consists of a bay that contains SCSI and ESCON host adapter cards and the attached devices (DDMs). If a single component in a service boundary is being serviced, none of its components are available to the ESS.

service-information message (SIM). A message sent by a storage server to service personnel.

service processor. A dedicated processing unit used to service a storage facility.

service support representative (SSR). Individuals or a company that you have authorized to service your ESS. This term also refers to a service provider, a service representative, or an IBM service support representative (SSR). An IBM SSR installs your ESS.

shared storage. Storage within a storage facility that is configured such that multiple homogenous or divergent 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. You need to design the programs to handle the effects of concurrent access.

short wave. A technology that allows you to connect a variety of communication protocols.

SIM. See *service-information message*.

simple network management protocol (SNMP). (1) An SNMP Manager is part of a network administration software product, such as Tivoli TME 10 Netview. (2) SNMP permits you to define management information base (MIB) extensions, or enterprise-specific MIBs. By loading a MIB file on a manager station, you can monitor the MIB objects. The SNMP Agent accesses MIB objects when a request is received from an SNMP Manager. (3) 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).

Single-Byte Command Code Sets Connection (SBCON). The ANSI standard for the ESCON I/O interface.

small computer system interface (SCSI). (1) An ANSI standard for a logical interface to computer peripherals and for a computer peripheral interface. The interface uses a SCSI logical protocol over an I/O interface that configures attached targets and initiators in a multi-drop bus topology. (2) A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

SMIT. See *System Management Interface Tool*.

SMP. See *System Modification Program*.

SNMP. See *simple network management protocol*.

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.

spare. A disk drive that is used to receive data from a device that has experienced a failure that requires disruptive service. A spare can be pre-designated to allow automatic dynamic sparing. Any data on a disk drive that you use as a spare is destroyed by the dynamic sparing copy process.

SSA. See *serial storage architecture*.

SSA adapter. The adapter that connects stored data on devices, such as disk drive modules for access and control by the storage server. See *serial storage architecture*.

SSID. See *subsystem identifier*.

SSR. See *service support representative*.

stacked status. In the ESA/390 architecture, the condition when the control-unit is holding status for the channel and the channel responded with the stack-status control the last time the control-unit attempted to present the status.

staging. The action of moving 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.

STI. See *self-timed interface*.

storage complex. Multiple storage facilities.

storage controller. A physical unit that provides an interface between one or more storage devices and a host computer by providing the function of one or more logical subsystems. The storage controller may provide functions that are not provided by the storage device. The storage controller has one or more clusters.

storage device. A physical unit that provides a mechanism to store data on a given medium such that it can be subsequently retrieved. See *disk drive module*.

storage facility. (1) A physical unit that consists of a storage controller integrated with one or more storage devices to provide storage capability to a host computer. (2) A storage server and its attached storage devices.

storage server. A unit that manages attached storage devices and provides access to the storage or storage-related functions for one or more attached hosts.

StorWatch Enterprise Storage Server Specialist.

The Web-based management interface to the IBM Enterprise Storage Server.

stripping. A technique that distributes data in bit, byte, multibyte, record, or block increments across multiple disk drives.

subchannel. A logical function of a channel subsystem associated with the management of a single device.

subsystem identifier (SSID). A number that uniquely identifies a logical subsystem within a computer installation.

support catcher telephone number. The telephone number that service personnel use to send heartbeat call-home records that are non-problem related, directly to the support catcher server rather than to the RETAIN catcher server. These records might include such information as a trace or a dump package.

synchronous write. A write operation that stores data in cache and in nonvolatile storage (NVS). Later the data is stored on a device, using normal destage algorithms.

System Management Interface Tool (SMIT). An interface tool of the AIX operating system for installing, maintaining, configuring, and diagnosing tasks.

System Modification Program (SMP). A program used to install software and software changes on MVS systems.

T

target. A storage device to which information is written.

TB. See *terabyte*.

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

terabyte (TB). (1) For processor storage, real and virtual storage, and channel volume, 2^{40} or 1 099 511 627 776 bytes. (2) For disk storage capacity and communications volume, 1 000 000 000 000 bytes.

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, the option provides interactive time sharing from remote terminals.

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 *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 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 update 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/Internet Protocol (TCP/IP). (1) The Transmission Control Protocol and the Internet Protocol, which together provide reliable end-to-end connections between applications over interconnected networks of different types. (2) The suite of transport and application protocols that run over the Internet Protocol.

transparency. See *software transparency*.

TSO. See *time sharing option*.

U

UFS. UNIX filing system.

Ultra-SCSI. An enhanced small computer system interface.

unit address. The ESA/390 term for the address associated with a device on a given controller. On ESCON interfaces, the unit address is the same as the device address. On OEMI interfaces, the unit address specifies a controller and device pair on the interface.

Universaile Tempes du Coordonnaire (UTC). The basis for coordinated world wide time. This system, formerly known as Greenwich Mean Time (GMT), was officially renamed to UTC, for 'Universaile Tempes du Coordonnaire' because the world clock is now in Paris, France. It is also known as coordinated universal time (CUT).

UTC. See *Universaile Tempes du Coordonnaire*.

utility device. The ESA/390 term for the device used with the Extended Remote Copy facility to access information that describes the modifications performed on the primary copy.

V

virtual machine (VM). A virtual data processing machine that appears to be for the exclusive use of a particular user, but whose functions are accomplished by sharing the resources of a real data processing system.

vital product data (VPD). Information that uniquely defines the system, hardware, software, and microcode elements of a processing system.

VM. See *virtual machine*.

volume. In the ESA/390 architecture, 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 terms may also refer, indirectly, to the storage device that you associate with the volume. When you store multiple volumes on a single storage medium transparently to the program, you may refer to the volumes as logical volumes.

VPD. See *vital product data*.

W

world-wide port name (WWPN). A unique 64-bit identifier for a fibre-channel port that is assigned in an implementation and protocol-independent manner.

write hit. A write operation in which the data that you requested is in the cache.

write penalty. The performance impact of a classical RAID write operation.

WWPN. See *world-wide port name*.

X

XRC. See *Extended Remote Copy*.

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