

IBM TotalStorage™ Enterprise Storage Server™



# Subsystem Device Driver User's Guide



IBM TotalStorage™ Enterprise Storage Server™



# Subsystem Device Driver User's Guide

**Note**

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

**Tenth Edition (November 2001)**

This edition includes information that specifically applies to IBM ESS Subsystem Device Driver (SDD):

- | • Version 1 Release 3 Modification 1 Level 3 for AIX 4.2.1, AIX 4.3.2, AIX 4.3.3, AIX 5.1.0
- | • Version 1 Release 3 Modification 0 Level 1 for HP-UX 11.00, HP-UX 11i
- | • Version 1 Release 3 Modification 0 Level 1 for Solaris 2.6, Solaris 7, Solaris 8
- | • Version 1 Release 3 Modification 1 Level 1 for Windows 2000 Service Pack 2 or higher
- | • Version 1 Release 3 Modification 1 Level 0 for Windows NT 4.0 Service Pack 3 or higher

| This edition also applies to all subsequent releases and modifications until otherwise indicated in new editions.

© **Copyright International Business Machines Corporation 1999, 2001. All rights reserved.**

US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

---

# Contents

<b>Figures</b> . . . . .	vii
<b>Tables</b> . . . . .	ix
<b>About this book</b> . . . . .	xi
Who should use this book . . . . .	xi
Summary of changes . . . . .	xi
New information . . . . .	xi
Modified information . . . . .	xii
Organizational Changes. . . . .	xii
Publications . . . . .	xii
The IBM TotalStorage ESS library . . . . .	xii
Other IBM publications . . . . .	xiv
Other non-IBM publications . . . . .	xvii
Web sites . . . . .	xviii
How to send your comments . . . . .	xviii
<b>Chapter 1. Overview of the Subsystem Device Driver</b> . . . . .	1
Subsystem Device Driver . . . . .	1
Enhanced data availability . . . . .	3
Dynamic I/O load-balancing. . . . .	3
Automatic path-failover protection . . . . .	3
Concurrent download of licensed internal code . . . . .	4
Path-selection policies for the host system . . . . .	4
<b>Chapter 2. SDD for an AIX host system</b> . . . . .	7
Hardware and software requirements . . . . .	7
Host system requirements . . . . .	7
Support for 32-bit and 64-bit applications on AIX 4.3.2, AIX 4.3.3, and AIX 5.1.0 . . . . .	9
Preparing for SDD installation . . . . .	10
Configuring the ESS . . . . .	10
Installing fibre-channel device drivers and configuring fibre-channel attached devices . . . . .	10
Installing the AIX fibre-channel device drivers. . . . .	11
Configuring fibre-channel attached devices. . . . .	11
Determining the Emulex adapter firmware level . . . . .	12
Installing the Subsystem Device Driver . . . . .	13
Using the System Management Interface Tool (SMIT) for installing SDD . . . . .	15
Verifying your currently installed version of SDD. . . . .	16
Preparing to configure the Subsystem Device Driver . . . . .	17
Configuring the Subsystem Device Driver . . . . .	17
Unconfiguring Subsystem Device Drivers . . . . .	18
Verifying the SDD configuration . . . . .	18
Changing the path-selection policy. . . . .	19
Adding paths to SDD devices of a volume group . . . . .	20
Upgrading SDD for AIX 4.2.1, AIX 4.3.2, AIX 4.3.3, and AIX 5.1.0 . . . . .	23
Understanding the SDD support for nondisruptive installation . . . . .	23
Verifying your previously installed version of SDD . . . . .	24
Upgrading to SDD 1.3.1.3 using a nondisruptive installation . . . . .	25
Upgrading manually to SDD 1.3.1.3 . . . . .	25
Removing SDD from an AIX host system . . . . .	26
Using concurrent download of licensed internal code . . . . .	27

Understanding the SDD support for High Availability Cluster Multi-Processing (HACMP/6000) . . . . .	27
SDD fileset attributes . . . . .	31
Providing load-balancing and failover protection . . . . .	35
Displaying the ESS vpath device configuration . . . . .	35
Configuring a volume group for failover protection . . . . .	36
Importing a volume group with SDD . . . . .	37
Exporting a volume group with SDD . . . . .	39
Losing failover protection . . . . .	40
Using ESS devices directly . . . . .	52
Using ESS devices through AIX LVM. . . . .	53
Migrating a non-SDD volume group to an ESS SDD multipath volume group in concurrent mode . . . . .	54
Using the trace function . . . . .	58
Error log messages . . . . .	58
<b>Chapter 3. SDD for a Windows NT host system . . . . .</b>	<b>61</b>
Verifying the hardware and software requirements . . . . .	61
Hardware . . . . .	61
Software . . . . .	61
Non-support environments. . . . .	61
ESS requirements. . . . .	61
Host system requirements. . . . .	61
Preparing for SDD installation . . . . .	62
Configuring the ESS . . . . .	62
Configuring fibre-channel adapters. . . . .	62
Configuring SCSI adapters . . . . .	63
Installing the Subsystem Device Driver . . . . .	63
Configuring the Subsystem Device Driver . . . . .	64
Adding paths to SDD devices . . . . .	64
Upgrading the Subsystem Device Driver . . . . .	68
Adding or modifying a multipath storage configuration to the ESS . . . . .	68
Removing the Subsystem Device Driver . . . . .	72
Displaying the current version of the Subsystem Device Driver . . . . .	72
Support for Windows NT clustering . . . . .	73
Special considerations in the Windows NT clustering environment . . . . .	73
Configuring a Windows NT cluster with SDD . . . . .	73
<b>Chapter 4. SDD for a Windows 2000 host system . . . . .</b>	<b>77</b>
Verifying the hardware and software requirements . . . . .	77
Non-supported environments. . . . .	77
ESS requirements. . . . .	77
Host system requirements. . . . .	77
Preparing for SDD installation . . . . .	78
Configuring the ESS . . . . .	78
Configuring fibre-channel adapters. . . . .	78
Configuring SCSI adapters . . . . .	79
Installing the Subsystem Device Driver . . . . .	79
Configuring the Subsystem Device Driver . . . . .	80
Adding paths to SDD devices . . . . .	80
Upgrading the Subsystem Device Driver . . . . .	82
Removing the Subsystem Device Driver . . . . .	83
Displaying the current version of the Subsystem Device Driver . . . . .	83
Support for Windows 2000 clustering. . . . .	83
Special considerations in the Windows 2000 clustering environment . . . . .	84
Preparing to Configure a Windows 2000 cluster with SDD . . . . .	84

Configuring a Windows 2000 cluster with SDD . . . . .	84
<b>Chapter 5. SDD for a Hewlett-Packard host system . . . . .</b>	<b>87</b>
Verifying the hardware and software requirements . . . . .	87
Support for 32-bit and 64-bit applications on HP-UX 11.0 and HP-UX 11i . . . . .	87
Understanding how SDD works for an HP host system . . . . .	87
Preparing for SDD installation . . . . .	88
Configuring the ESS . . . . .	88
Planning for installation . . . . .	88
Installing the Subsystem Device Driver . . . . .	89
Post-installation. . . . .	91
Upgrading the Subsystem Device Driver . . . . .	92
Changing an SDD hardware configuration . . . . .	93
Using applications with SDD . . . . .	94
Standard UNIX applications . . . . .	94
Installing SDD on a Network File System file server . . . . .	99
Oracle . . . . .	100
<b>Chapter 6. SDD for a Sun host system . . . . .</b>	<b>105</b>
Verifying the hardware and software requirements . . . . .	105
Understanding how SDD works on a Sun host. . . . .	105
Preparing for SDD installation . . . . .	106
Configuring the ESS . . . . .	106
Planning for installation . . . . .	106
Installing the Subsystem Device Driver . . . . .	108
Post-installation . . . . .	110
Upgrading the Subsystem Device Driver . . . . .	111
Changing an SDD hardware configuration . . . . .	112
Using applications with SDD . . . . .	113
Standard UNIX applications. . . . .	113
Installing SDD on a Network File System file server . . . . .	113
Oracle. . . . .	114
Veritas Volume Manager . . . . .	118
Solstice DiskSuite . . . . .	121
<b>Chapter 7. Using the datapath commands . . . . .</b>	<b>125</b>
datapath query adapter command . . . . .	126
datapath query adaptstats command . . . . .	127
datapath query device command. . . . .	128
datapath query devstats command . . . . .	130
datapath set adapter command . . . . .	132
datapath set device command. . . . .	133
<b>Statement of Limited Warranty . . . . .</b>	<b>135</b>
Part 1 – General Terms . . . . .	135
The IBM Warranty for Machines . . . . .	135
Extent of Warranty . . . . .	135
Items Not Covered by Warranty . . . . .	136
Warranty Service. . . . .	136
Production Status . . . . .	137
Limitation of Liability . . . . .	137
Part 2 - Country or region-unique Terms . . . . .	138
ASIA PACIFIC. . . . .	138
EUROPE, MIDDLE EAST, AFRICA (EMEA). . . . .	138
<b>Notices . . . . .</b>	<b>143</b>

Trademarks . . . . .	143
Electronic emission notices . . . . .	144
Federal Communications Commission (FCC) statement . . . . .	144
Industry Canada compliance statement . . . . .	145
European community compliance statement. . . . .	145
Japanese Voluntary Control Council for Interference (VCCI) class A statement . . . . .	146
Korean government Ministry of Communication (MOC) statement. . . . .	146
Taiwan class A compliance statement . . . . .	146
IBM agreement for licensed internal code. . . . .	146
Actions you must not take . . . . .	147
<b>Glossary . . . . .</b>	<b>149</b>
<b>Index . . . . .</b>	<b>167</b>



---

## Figures

1.	Multipath connections between a host system and the disk storage in an ESS . . . . .	3
2.	Output from the Display Data Path Device Configuration SMIT panel. . . . .	35
3.	IBMdpo Driver 32-bit . . . . .	90
4.	IBMdpo Driver 64-bit . . . . .	90



## Tables

1.	Publications in the ESS library . . . . .	xii
2.	Other IBM publications related to the ESS. . . . .	xiv
3.	Other IBM publications without order numbers. . . . .	xvii
4.	ESS Web sites and descriptions. . . . .	xviii
5.	SDD in the protocol stack . . . . .	1
6.	Required number of successful I/O operations before SDD places a path in the open state . . . . .	4
7.	AIX PTF required fixes . . . . .	7
8.	Support for 32-bit and 64-bit applications . . . . .	9
9.	SDD package file names . . . . .	13
10.	Major files included in the SDD installation package . . . . .	14
11.	List of previously installed filesets that are supported with nondisruptive installation . . . . .	24
12.	Software support for HACMP/6000 in concurrent mode. . . . .	28
13.	Software support for HAMCP/6000 in nonconcurrent mode . . . . .	30
14.	Software support for HACMP/6000 in concurrent mode on AIX 5.1.0 (32-bit kernel only) . . . . .	30
15.	Software support for HACMP/6000 in nonconcurrent mode on AIX 5.1.0 (32-bit kernel only) . . . . .	31
16.	HACMP/6000 and supported SDD features . . . . .	31
17.	SDD-specific SMIT panels and how to proceed. . . . .	45
18.	SDD installation scenarios . . . . .	88
19.	HP patches necessary for proper operation of SDD . . . . .	89
20.	SDD components installed for HP host systems . . . . .	91
21.	System files updated for HP host systems . . . . .	91
22.	SDD commands and their descriptions for HP host systems . . . . .	91
23.	SDD installation scenarios . . . . .	107
24.	SDD package file names . . . . .	107
25.	Solaris patches necessary for proper operation of SDD . . . . .	107
26.	SDD components installed for Sun host systems. . . . .	110
27.	System files updated for Sun host systems . . . . .	111
28.	SDD commands and their descriptions for Sun host systems . . . . .	111
29.	Commands . . . . .	125



---

## About this book

This book provides step-by-step procedures for you to install, configure, and use the IBM<sup>®</sup> TotalStorage<sup>™</sup> Enterprise Storage Server<sup>™</sup> (ESS) Subsystem Device Driver (SDD) on IBM AIX<sup>®</sup>, HP, Sun, Microsoft<sup>®</sup> Windows NT<sup>®</sup>, and Microsoft Windows 2000 host systems.

---

## Who should use this book

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

---

## Summary of changes

This book contains both information previously presented in the *IBM TotalStorage Enterprise Storage Server Subsystem Device Driver User's Guide* Version 1 Release 3.0 (September 2001) and major technical changes to that information. Technical changes are indicated by revision bars (|) in the left margin of the book. The following sections summarize those technical changes.

**Note:** For the last-minute changes that are not included in this book, see the README file on the SDD compact disc or visit the SDD Web site at:

[www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates](http://www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates)

## New information

This edition includes the following new technical information:

### What's new in Chapter 2. SDD for an AIX host system:

- A reference to the Web Site address for information about the latest information on fibre-channel device driver APARs, maintenance level fixes, and microcode updates in "Host system requirements" on page 7 and other appropriate sections.
- A reference to the Web Site address for information about the fibre-channel adapters in "Fibre requirements" on page 8.
- A reference to devices.pci.df1000f9 fileset in "Installing the AIX fibre-channel device drivers" on page 11.
- A reference to Emulex LP9002 adapter in appropriate sections.
- A reference to sf382A0 firmware for Emulex LP9002 adapter in "Determining the Emulex adapter firmware level" on page 12.
- A section about "Understanding the SDD support for nondisruptive installation" on page 23.
- A tip about using a nonconcurrent version of SDD in "Understanding the SDD support for High Availability Cluster Multi-Processing (HACMP/6000)" on page 27.

### What's new in Chapter 5. SDD for a Hewlett-Packard host system:

- A reference to the SDD "Support for 32-bit and 64-bit applications on HP-UX 11.0 and HP-UX 11i" on page 87.

## Modified information

This edition includes the following technical modified information:

### What's modified in Chapter 2. SDD for an AIX host system:

- The SDD version release level for AIX is updated as follows:
  - SDD 1.3.0.x to SDD 1.3.1.3

## Organizational Changes

This edition also includes the following organizational changes:

- The "Installing and configuring SDD on an AIX host system" and "Using SDD on an AIX host system" chapters are consolidated into "Chapter 2. SDD for an AIX host system" on page 7.
- Other organizational changes made within the other chapters. These changes are intended to help you find information easier and faster.

---

## Publications

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

- The publications that compose the IBM TotalStorage ESS library.
- Other IBM publications that relate to the ESS.
- non-IBM publications that relate to the ESS.

See "Ordering ESS publications" on page xiii for information about how to order publications in the IBM TotalStorage ESS publication library. See "How to send your comments" on page xviii for information about how to send comments about the publications.

## The IBM TotalStorage ESS library

Table 1 shows the customer publications that comprise the ESS library. See "The IBM publications center" on page xiv for information about ordering these and other IBM publications.

Table 1. Publications in the ESS library

Long title (short title)	Description	Order number
<i>IBM TotalStorage Enterprise Storage Server Copy Services Command-Line Interface User's Guide</i> (ESS CLI User's Guide)	This user's guide describes the commands you can use from the ESS Copy Services command-line interface (CLI). The CLI application provides a set of commands you can use to write customized scripts for a host system. The scripts initiate pre-defined tasks in an ESS Copy Services server application. You can use the CLI commands to indirectly control ESS Peer-to-Peer Remote Copy and FlashCopy configuration tasks within an ESS Copy Services server group.  This book is not available in hardcopy. It is available in PDF format on the following Web site: <a href="http://www.storage.ibm.com/hardsoft/products/ess/refinfo.htm">www.storage.ibm.com/hardsoft/products/ess/refinfo.htm</a>	SC26-7434
<i>IBM TotalStorage Enterprise Storage Server Configuration Planner</i> (ESS Configuration Planner)	This guide provides work sheets for planning the logical configuration of the ESS. This book is not available in hardcopy. This guide is available on the following Web site: <a href="http://www.storage.ibm.com/hardsoft/products/ess/refinfo.htm">www.storage.ibm.com/hardsoft/products/ess/refinfo.htm</a>	SC26-7353

Table 1. Publications in the ESS library (continued)

Long title (short title)	Description	Order number
<i>IBM TotalStorage Enterprise Storage Server Host System Attachment Guide</i> (ESS Attachment Guide)	This book provides guidelines for attaching the ESS to your host system and for migrating from Small Computer System Interface (SCSI) to fibre-channel attachment.	SC26-7296
<i>IBM TotalStorage Enterprise Storage Server DFSMS Software Support Reference</i> (ESS DFSMS Software Support)	This book gives an overview of the ESS and highlights its unique capabilities. It also describes Data Facility Storage Management Subsystems (DFSMS) software support for the ESS, including support for large volumes.	SC26-7440
<i>IBM TotalStorage Enterprise Storage Server Introduction and Planning Guide</i> (ESS Introduction and Planning Guide)	This guide introduces the ESS product and lists the features you can order. It also provides guidelines for planning the installation and configuration of the ESS.	GC26-7294
<i>IBM TotalStorage Enterprise Storage Server Quick Configuration Guide</i> (ESS Quick Configuration Guide)	This booklet provides flow charts for using the TotalStorage Enterprise Storage Server Specialist (ESS 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 when you are modifying the logical configuration. The hardcopy of this booklet is a 9-inch × 4-inch fanfold.	SC26-7354
<i>IBM Enterprise Storage Server System/390 Command Reference</i> (ESS S/390 Command Reference)	This book describes the functions of the ESS and provides reference information for S/390® and @server zSeries hosts, such as channel commands, sense bytes, and error recovery procedures.	SC26-7298
<i>IBM TotalStorage Safety Notices</i> (Safety Notices)	This book provides translations of the danger notices and caution notices that IBM uses in ESS publications.	GC26-7229
<i>IBM TotalStorage Enterprise Storage Server SCSI Command Reference</i> (ESS SCSI Command Reference)	This book describes the functions of the ESS. It provides reference information for UNIX®, Application System/400® (AS/400®), and @server iSeries 400 hosts, such as channel commands, sense bytes, and error recovery procedures.	SC26-7297
<i>IBM TotalStorage Enterprise Storage Server User's Guide</i> (ESS Users Guide)	This guide provides instructions for setting up and operating the ESS and for analyzing problems.	SC26-7295
<i>IBM TotalStorage Enterprise Storage Server Web Interface User's Guide</i> (ESS Web Interface Users Guide)	This guide provides instructions for using the two ESS Web interfaces, ESS Specialist and ESS Copy Services.	SC26-7346

### Ordering ESS publications

All the customer publications that are listed in “The IBM TotalStorage ESS library” on page xii are available on a compact disc that comes with the ESS, unless otherwise noted.

The customer documents are also available on the following ESS Web site in PDF format:

[www.storage.ibm.com/hardsoft/products/ess/refinfo.htm](http://www.storage.ibm.com/hardsoft/products/ess/refinfo.htm)

## The IBM publications center

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

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

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

## Publications notification system

The IBM publications center Web site offers you a notification system about IBM publications. Register and you can create your own profile of publications that interest you. The publications notification system sends you daily electronic mail (e-mail) notes that contain information about new or revised publications that are based on your profile.

If you want to subscribe, you can access the publications notification system from the IBM publications center at the following Web site:

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

## Other IBM publications

Table 2 lists and describes other IBM publications that have information.

Table 2. Other IBM publications related to the ESS.

Title	Description	Order number
<i>DFSMS/MVS<sup>®</sup> Version 1 Advanced Copy Services</i>	This publication helps you to understand and use IBM Advanced Copy Services functions on an S/390 or zSeries. It describes two dynamic-copy functions and several point-in-time copy functions. These functions provide backup and recovery of data if a disaster occurs to your data center. The dynamic-copy functions are Peer-to-Peer Remote Copy and Extended Remote Copy. Collectively, these functions are known as remote copy. FlashCopy™ and Concurrent Copy are the point-in-time copy functions.	SC35-0355
<i>DFSMS/MVS Version 1 Remote Copy Guide and Reference</i>	This publication provides guidelines for using remote copy functions with S/390 and zSeries hosts.	SC35-0169
<i>Enterprise Storage Solutions Handbook</i>	This book helps you understand what comprises enterprise storage management. The concepts include the key technologies that you need to know and the IBM subsystems, software, and solutions that are available today. It also provides guidelines for implementing various enterprise storage administration tasks, so that you can establish your own enterprise storage management environment.	SG24-5250
<i>ESS Fibre-Channel Migration Scenarios</i>	This white paper describes how to change your host system attachment to the ESS from SCSI and SAN Data Gateway to native fibre-channel attachment.  To get the white paper, go to the following Web site:  <a href="http://www.storage.ibm.com/hardsoft/products/ess/refinfo.htm">www.storage.ibm.com/hardsoft/products/ess/refinfo.htm</a>	No order number
<i>Enterprise Systems Architecture/390 ESCON I/O Interface</i>	This publication provides a description of the physical and logical ESA/390 I/O interface and the protocols which govern information transfer over that interface. It is intended for designers of programs and equipment associated with the ESCON I/O interface and for service personnel maintaining that equipment. However, anyone concerned with the functional details of the ESCON I/O interface will find it useful.	SA22-7202



Table 2. Other IBM publications related to the ESS. (continued)

Title	Description	Order number
<i>ESS Solutions for Open Systems Storage Compaq AlphaServer, HP, and Sun</i>	This book helps you to install, tailor, and configure the ESS when you attach Compaq AlphaServer (running Tru64 UNIX), HP, and Sun hosts. This book does not cover Compaq AlphaServer running the Open VMS operating system. This book also focuses on the settings required to give optimal performance and on device driver levels. This book is for the experienced UNIX professional who has a broad understanding of storage concepts.	SG24-6119
<i>Fibre Channel Connection (FICON) I/O Interface, Physical Layer</i>	This publication provides information to the Fiber Channel I/O Interface. This book is also available in PDF format by accessing the following Web site:  <a href="http://www.ibm.com/servers/resourceink/">www.ibm.com/servers/resourceink/</a>	SA24-7172
<i>Fibre-channel Subsystem Installation Guide</i>	This publication tells you how to attach the xSeries 430 and NUMA-Q host system with fibre-channel adapters.	See note.
<i>Fibre Transport Services (FTS) Direct Attach, Physical and Configuration Planning Guide</i>	This publication provides information about fibre-optic and ESCON-trunking systems.	GA22-7234
<i>IBM Enterprise Storage Server</i>	This book, from the IBM International Technical Support Organization, introduces the ESS and provides an understanding of its benefits. It also describes in detail the architecture, hardware, and functions of the ESS.	SG24-5465
<i>IBM Enterprise Storage Server Performance Monitoring and Tuning Guide</i>	This book provides guidance on the best way to configure, monitor, and manage your ESS to ensure optimum performance.	SG24-5656
<i>IBM OS/390 Hardware Configuration Definition User's Guide</i>	This publication provides detailed information about the IODF. It also provides details about configuring parallel access volumes (PAVs). OS/390 uses the IODF.	SC28-1848
<i>IBM SAN Fibre Channel Managed Hub 3534 Service Guide</i>	The IBM SAN Fibre Channel Managed Hub can now be upgraded to switched fabric capabilities with this Entry Switch Activation Feature. As your fibre channel SAN requirements grow, and you need to migrate from the operational characteristics of the Fibre Channel arbitrated loop (FC-AL) configuration provided by the IBM Fibre Channel Managed Hub, 35341RU, to a fabric capable switched environment, the Entry Switch Activation feature is designed to provide this upgrade capability. This upgrade is designed to allow a cost-effective, and scalable approach to developing fabric based Storage Area Networks (SANs). The Entry Switch Activation feature (P/N 19P3126) supplies the activation key necessary to convert the FC-AL based Managed Hub to fabric capability with eight fabric F_ports, one of which can be an interswitch link-capable port, an E_port, for attachment to the IBM SAN Fibre Channel Switch, or other supported switches.	GC26-7391
<i>IBM SAN Fibre Channel Managed Hub 3534 Users Guide</i>	The IBM SAN Fibre Channel Switch 3534 is an eight-port Fibre Channel Gigabit Hub that consists of a motherboard with connectors for supporting up to eight ports, including seven fixed shortwave optic ports and one GBIC port, and an operating system for building and managing a switched loop architecture.	SY27-7616

Table 2. Other IBM publications related to the ESS. (continued)

Title	Description	Order number
<p><i>IBM SAN Fibre Channel Switch, 2109 Model S08 Users Guide</i></p>	<p>The IBM Fibre Channel Switch 2109 Model S08 Users Guide manual describes the switch and the IBM StorWatch Specialist. It provides information on the commands and how to manage the switch with Telnet and Simple Network Management Protocol (SNMP).</p> <p>To get a copy of this manual, see the Web site at:  <a href="http://www.ibm.com/storage/fcswitch">www.ibm.com/storage/fcswitch</a></p>	<p>SC26-7349</p>
<p><i>IBM SAN Fibre Channel Switch 2109 Model S16 Installation and Service Guide</i></p>	<p>This publication describes how to install and maintain the IBM SAN Fibre Channel Switch 2109 Model S16. It is intended for trained service representatives and service providers who act as the primary level of field hardware service support to help solve and diagnose hardware problems.</p> <p>To get a copy of this manual, see the Web site at:  <a href="http://www.ibm.com/storage/fcswitch">www.ibm.com/storage/fcswitch</a></p>	<p>SC26-7352</p>
<p><i>IBM StorWatch Expert Hands-On Usage Guide</i></p>	<p>This guide helps you to install, tailor, and configure ESS Expert, and it shows you how to use Expert.</p>	<p>SG24-6102</p>
<p><i>IBM TotalStorage Enterprise Storage Server Subsystem Device Driver Installation and Users Guide</i></p>	<p>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.</p> <p>For information about the Subsystem Device Driver, see the following Web site:  <a href="http://www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates/">www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates/</a></p>	<p>GC26-7442</p>
<p><i>Implementing ESS Copy Services on S/390</i></p>	<p>This publication tells you how to install, customize, and configure Copy Services on an ESS that is attached to an S/390 or zSeries host system. Copy Services functions include Peer-to-Peer Remote Copy, Extended Remote Copy, FlashCopy™ and, Concurrent Copy. This publication describes the functions, prerequisites, and corequisites and describes how to implement each of the functions into your environment.</p>	<p>SG24-5680</p>
<p><i>Implementing ESS Copy Services on UNIX and Windows NT/2000</i></p>	<p>This publication tells you how to install, customize, and configure ESS Copy Services on UNIX or Windows NT host systems. 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 the S/390 or zSeries. This publication describes the functions and shows you how to implement each of the functions into your environment. It also shows you how to implement these solutions in a high-availability cluster multiprocessing (HACMP) cluster.</p>	<p>SG24-5757</p>
<p><i>Implementing Fibre Channel Attachment on the ESS</i></p>	<p>This book helps you to install, tailor, and configure fibre-channel attachment of open-systems hosts to the ESS. It gives you a broad understanding of the procedures involved and describes the prerequisites and requirements. It also shows you how to implement fibre-channel attachment. This book also describes the steps required to migrate to direct fibre-channel attachment from native SCSI adapters and from fibre-channel attachment through the SAN Data Gateway (SDG).</p>	<p>SG24-6113</p>
<p><i>Implementing the IBM Enterprise Storage Server</i></p>	<p>This book can help you install, tailor, and configure the ESS in your environment.</p>	<p>SG24-5420</p>

Table 2. Other IBM publications related to the ESS. (continued)

Title	Description	Order number
<i>NUMA-Q ESS Integration Release Notes for NUMA Systems</i>	<p>This publication provides information about special procedures and limitations involved in running ESS with Copy Services on an IBM @server xSeries 430 and an IBM NUMA-Q<sup>®</sup> host system.</p> <p>It also provides information on how to:</p> <ul style="list-style-type: none"> <li>• Configure the ESS</li> <li>• Configure the IBM NUMA-Q and xSeries 430 host system</li> <li>• Manage the ESS from the IBM NUMA-Q and xSeries 430 host system with DYNIX/ptx tools</li> </ul>	Part number 1003-80094.
<i>OS/390 MVS System Messages Volume 1 (ABA - ASA)</i>	This publication lists OS/390 and zSeries MVS system messages ABA to ASA.	GC28-1784
<i>z/Architecture Principles of Operation</i>	This publication provides, for reference purposes, a detailed definition of the z/Architecture. It is written as a reference for use primarily by assembler language programmers and describes each function at the level of detail needed to prepare an assembler language program that relies on that function; although anyone concerned with the functional details of z/Architecture will find it useful.	SA22-7832

**Note:** There is no order number for this publication. This publication is not available through IBM ordering systems. Contact your sales representative to obtain this publication.

## Other non-IBM publications

Table 3 lists and describes other related publications that are not available through IBM ordering systems. To order, contact the sales representative at the branch office in your locality.

Table 3. Other IBM publications without order numbers

Title	Description
<i>Quick Start Guide: An Example with Network File System (NFS)</i>	This publication tells you how to configure the Veritas Cluster Server. See also the companion document, <i>Veritas Cluster Server User's Guide</i> .
<i>Veritas Cluster Server Installation Guide</i>	This publication tells you how to install the Veritas Cluster Server. See also the companion document, <i>Veritas Cluster Server Release Notes</i> .
<i>Veritas Cluster Server Release Notes</i>	This publication tells you how to install the Veritas Cluster Server. See also the companion document, <i>Veritas Cluster Server Installation Guide</i> .
<i>Veritas Cluster Server User's Guide</i>	This publication tells you how to configure the Veritas Cluster Server. See also the companion document, <i>Quick Start Guide: An Example with NFS</i> .
<i>Veritas Volume Manager Hardware Notes</i>	This publication tells you how to implement dynamic multipathing.
<i>Veritas Volume Manager Installation Guide</i>	This publication tells you how to install VxVM. It is not available through IBM ordering systems. Contact your sales representative to obtain this document.
<i>Veritas Volume Manager Storage Administrators Guide</i>	This publication tells you how to administer and configure the disk volume groups.

---

## Web sites

Table 4 shows Web sites that have information about the ESS and other IBM storage products.

Table 4. ESS Web sites and descriptions

Web site	Description
<a href="http://www.storage.ibm.com/">www.storage.ibm.com/</a>	This Web site has general information about IBM storage products.
<a href="http://www.storage.ibm.com/hardsoft/products/ess/ess.htm">www.storage.ibm.com/hardsoft/products/ess/ess.htm</a>	This Web site has information about the IBM Enterprise Storage Server (ESS).
<a href="http://ssddom02.storage.ibm.com/disk/ess/documentation.html">ssddom02.storage.ibm.com/disk/ess/documentation.html</a>	This Web site allows you to view and print the ESS publications.
<a href="http://www.storage.ibm.com/hardsoft/products/ess/supserver.htm">www.storage.ibm.com/hardsoft/products/ess/supserver.htm</a>	This Web site provides current information about the host system models, operating systems, and adapters that the ESS supports.
<a href="http://ssddom01.storage.ibm.com/techsup/swtechsup.nsf/support/sddupdates/">ssddom01.storage.ibm.com/techsup/swtechsup.nsf/support/sddupdates/</a>	This Web site provides information about the IBM Subsystem Device Driver.
<a href="http://www.storage.ibm.com/hardsoft/products/sangateway/sangateway.htm">www.storage.ibm.com/hardsoft/products/sangateway/sangateway.htm</a>	This Web site provides information about attaching Storage Area Network or host system that uses an industry-standard, fibre-channel arbitrated loop (FC-AL) topology through the IBM 2108 Storage Area Network Data Gateway Model G07.
<a href="http://www.storage.ibm.com/software/sms/sdm/sdmtech.htm">www.storage.ibm.com/software/sms/sdm/sdmtech.htm</a>	This Web site provides information about the latest updates to Copy Services components including XRC, PPRC, Concurrent Copy, and FlashCopy for S/390 and zSeries.
<a href="http://ssddom01.storage.ibm.com/techsup/swtechsup.nsf/support/sddcliupdates/">ssddom01.storage.ibm.com/techsup/swtechsup.nsf/support/sddcliupdates/</a>	This Web site provides information about the IBM ESS Copy Services Command-Line Interface (CLI).

---

## How to send your comments

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

- e-mail

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

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

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

- Mail or fax

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

International Business Machines Corporation  
RCF Processing Department  
G26/050  
5600 Cottle Road  
San Jose, CA 95193-0001  
U.S.A.



# Chapter 1. Overview of the Subsystem Device Driver

This chapter introduces the IBM TotalStorage Enterprise Storage Server (ESS) Subsystem Device Driver (SDD) and provides an overview of SDD functions.

## Subsystem Device Driver

The Subsystem Device Driver is a pseudo device driver designed to support the multipath configuration environments in the IBM ESS. It resides in a host system with the native disk device driver and provides the following functions:

- Enhanced data availability
- Dynamic I/O load-balancing across multiple paths
- Automatic path failover protection
- Concurrent download of licensed internal code
- Path-selection policies for the host system

As the diagrams in Table 5 show, SDD resides above the disk driver of a host system in the protocol stack and acts as a pseudo device driver. I/O operations that are sent to SDD proceed to the host disk driver after path selection. When an active path experiences a failure (such as a cable or controller failure), SDD dynamically switches to another path.

Table 5. SDD in the protocol stack

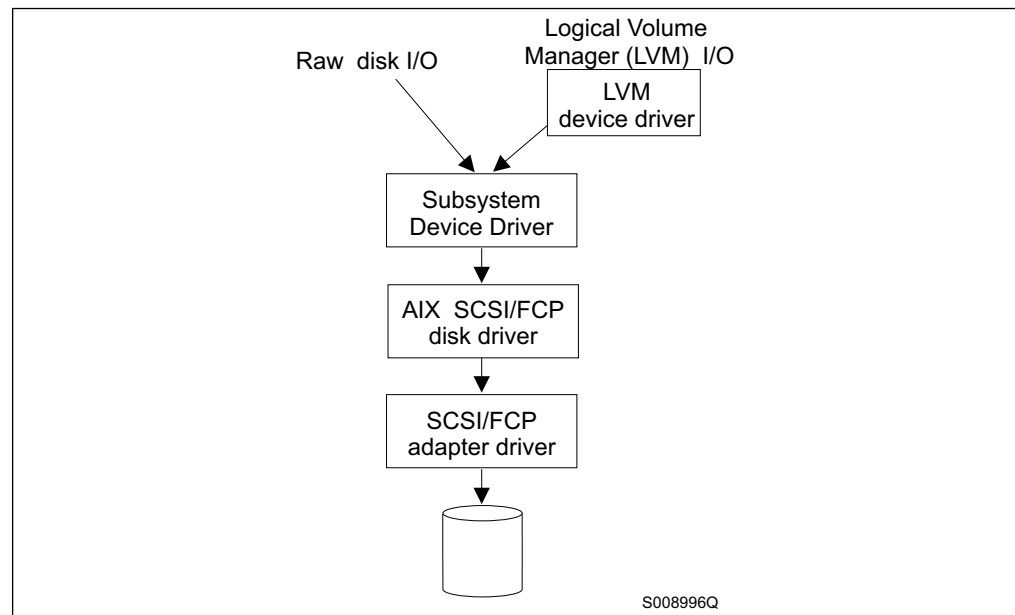
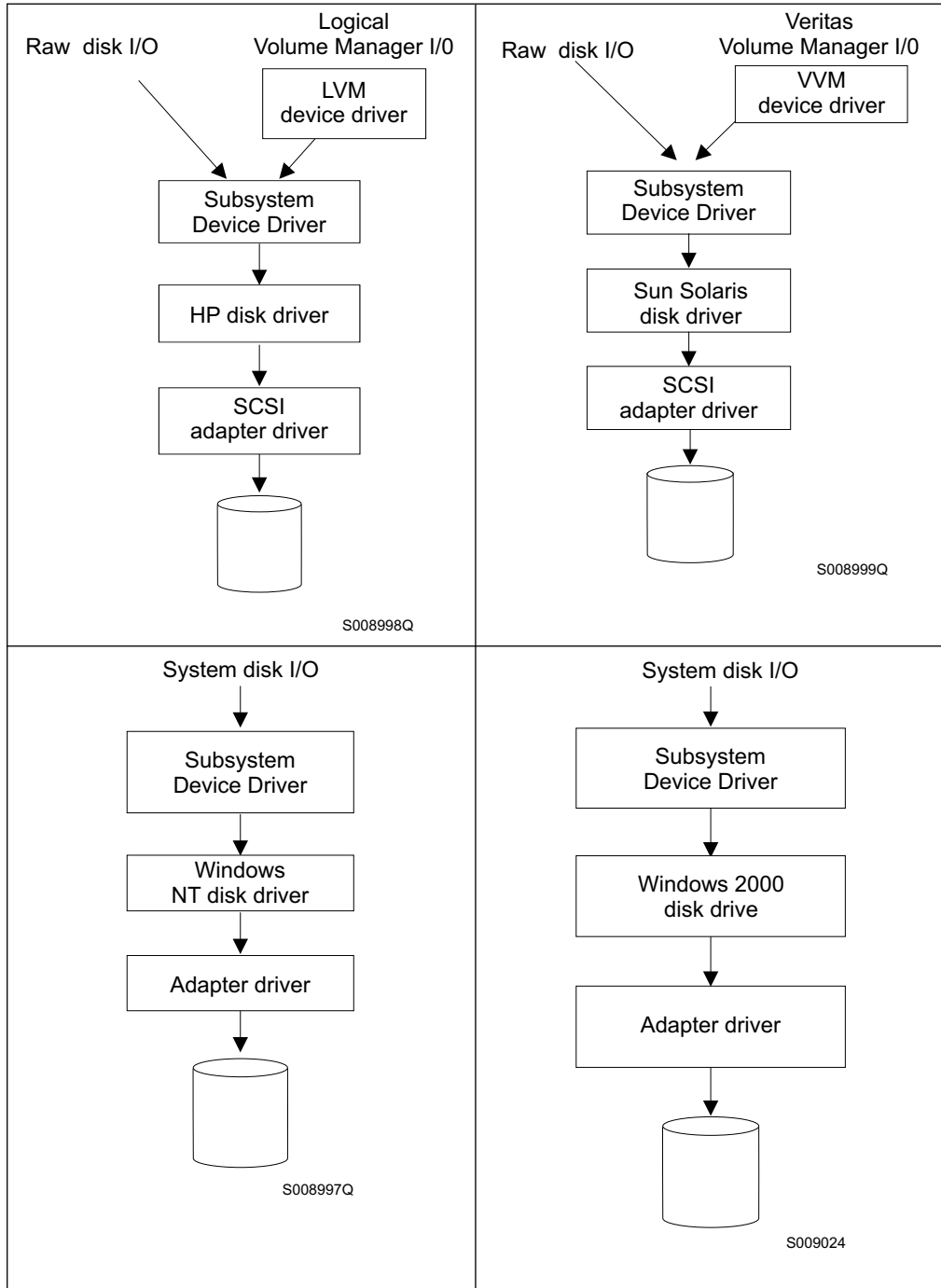


Table 5. SDD in the protocol stack (continued)



Each SDD device represents a unique physical device on the storage server. There can be up to 32 hdisk devices that represent up to 32 different paths to the same physical device.

SDD devices behave almost like hdisk devices. Most operations on an hdisk device can be performed on the SDD device, including commands such as **open**, **close**, **dd**, or **fsck**.



---

## Enhanced data availability

Figure 1 shows that an SDD-residing host system is attached through SCSI or fibre-channel adapters to an ESS that has internal component redundancy and multipath configuration. SDD uses this multipath configuration to enhance data availability. That is, when there is a path failure, SDD reroutes I/O operations from the failing path to an alternate operational path. This capability prevents a single failing bus adapter on the host system, SCSI or fibre-channel cable, or host-interface adapter on the ESS from disrupting data access.

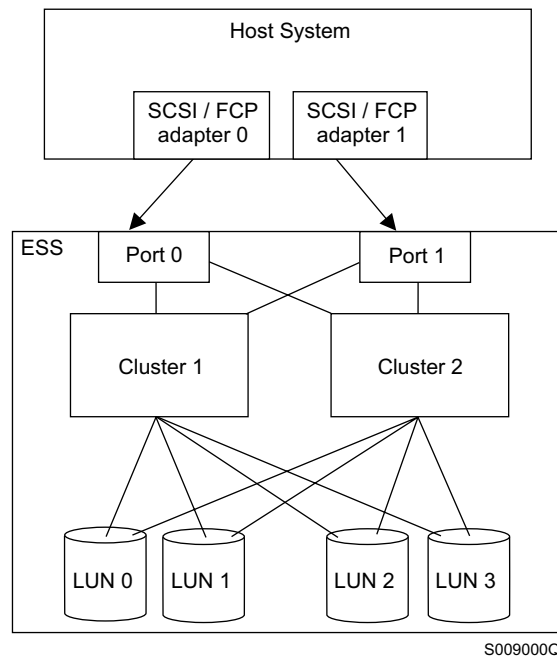


Figure 1. Multipath connections between a host system and the disk storage in an ESS

---

## Dynamic I/O load-balancing

By distributing the I/O workload over multiple active paths, SDD provides dynamic load-balancing and eliminates data-flow bottlenecks. In the event of failure in one data path, SDD automatically switches the affected I/O operations to another active data path, ensuring path-failover protection.

---

## Automatic path-failover protection

The SDD failover protection system is designed to minimize any disruptions in I/O operations and recover I/O operations from a failing data path. SDD provides path-failover protection through the following process:

- Detecting a path failure
- Notifying the host system of the path failure
- Selecting and using an alternate data path

SDD dynamically selects an alternate I/O path when it detects a software or hardware problem.

---

## Concurrent download of licensed internal code

With SDD you can concurrently download and install the licensed internal code while applications continue running. During the download and installation process, the host adapters inside the ESS might not respond to host I/O requests for approximately 30 seconds. SDD makes this process transparent to the host system through its path-selection and retry algorithms.

---

## Path-selection policies for the host system

SDD uses similar path-selection algorithms on all the host systems. There are two modes of operation:

### single-path mode

The host system has only one path that is configured to an ESS logical unit number (LUN). SDD, in single-path mode, has the following characteristics:

- When an I/O error occurs, SDD retries the I/O operation a sufficient number of times to bypass the interval when the ESS host adapters are not available. This I/O error might be caused by the process of concurrently downloading licensed internal code. See “Concurrent download of licensed internal code” for more information.
- SDD never puts this single path into the dead state.

### multiple-path mode

The host system has multiple paths that are configured to an ESS LUN. SDD in multiple-path mode has the following characteristics:

- If an I/O error occurs on a path, SDD does not attempt to use the path again until 2000 successful I/O operations on an operational path. This process is known as *bypassing a path*. SDD bypasses a failing path twice (until the I/O error count reaches three) and then puts the path in the dead state.
- If I/O errors occur consecutively on a path and the I/O error count reaches three, SDD immediately puts the failing path into the dead state. It uses the same bypass algorithm twice on the failed path while it is in the dead state.
- SDD changes the failed path from the dead state back into the open state after a certain number of successful I/O operations on an operational path. As listed in Table 6, the required number of successful I/O operations varies from one host system to another.

Table 6. Required number of successful I/O operations before SDD places a path in the open state

Operating system	Number of I/O operations
AIX	50 000
HP	200 000
Sun Solaris	200 000
Windows 2000	50 000
Windows NT	50 000

- If the first I/O operation fails after the path is put back into the open state, SDD puts the path into the dead state immediately and permanently. In this scenario, you must manually bring the path online by using the **datapath** command. However, if an I/O error occurs on the last operational path to a device, SDD attempts to reuse (or fail back to) a

previously-failed path. SDD *never* puts the last operational path to an ESS LUN into the dead state even if I/O errors have occurred on the path.

- If an I/O error occurs on all the paths to an ESS LUN, SDD returns the I/O error back to the application.



---

## Chapter 2. SDD for an AIX host system

This chapter provides step-by-step procedures for you to install, configure, upgrade, and remove the Subsystem Device Driver on an AIX host system that is attached to an ESS.

---

### Hardware and software requirements

You must install the following hardware and software components to ensure that SDD installs and operates successfully.

#### Hardware

- ESS
- Host system
- SCSI adapters and cables
- Fibre adapters and cables

#### Software

- ibm2105.rte ESS package
- AIX operating system
- SCSI and fibre-channel device drivers

SDD does not support the following environments:

- A host system with a single-path fibre-channel connection to an ESS

**Note:** A host system with a single fibre-channel adapter that connects through a switch to multiple ESS ports is considered a multipath fibre-channel connection; and, thus is a *supported* environment.

- A host system with both a SCSI and fibre-channel connection to a shared ESS LUN
- SDD does not support a system restart from an SDD pseudo device.
- SDD does not support placing system paging devices (for example, /dev/hd6) on an SDD pseudo device.
- SDD 1.3.1.3 installed from the ibmSdd\_421.rte, ibmSdd\_432.rte and ibmSdd\_510.rte filesets do not support any application that depends on a SCSI reserve and release device on AIX 4.2.1, AIX 4.3.2, AIX 4.3.3, and AIX 5.10.

### Host system requirements

To successfully install SDD 1.3.1.3, you must have AIX 4.2.1, AIX 4.3.2, AIX 4.3.3 or AIX 5.1.0 installed on your host system along with the fixes in Table 7.

Table 7. AIX PTF required fixes

AIX level	PTF number	Component name	Component level
4.2.1	IX62304		
	U451711	perfagent.tools	2.2.1.4
	U453402	bos.rte.libc	4.2.1.9
	U453481	bos.adt.prof	4.2.1.11
	U458416	bos.mp	4.2.1.15
	U458478	bos.rte.tty	4.2.1.14

Table 7. AIX PTF required fixes (continued)

AIX level	PTF number	Component name	Component level
	U458496	bos.up	4.2.1.15
	U458505	bos.net.tcp.client	4.2.1.19
	U462492	bos.rte.lvm	4.2.1.16
4.3.2	U461953	bos.rte.lvm	4.3.2.4

**Attention:** You must check for the latest information on APARs, maintenance level fixes, and microcode updates at the following Web site:

[service.software.ibm.com/support/rs6000](http://service.software.ibm.com/support/rs6000)

### ESS requirements

To successfully install SDD, ensure that your ESS meets the following requirements:

- The `ibm2105.rte` ESS package must be installed on your AIX host system.
- The ESS devices must be configured as either an:
  - IBM 2105xxx (SCSI-channel attached device)
  - IBM FC 2105xxx (fibre-channel attached device)

**Note:** xxx is the ESS model number.

### SCSI requirements

To use the SDD SCSI support, ensure your host system meets the following requirements:

- The `bos.adt` package must be installed. The host system can be a uniprocessor or a multiprocessor system, such as SMP.
- A SCSI cable is required to connect each SCSI host adapter to an ESS port.
- The SDD I/O load-balancing and failover features require a minimum of two SCSI adapters.

**Note:** SDD also supports one SCSI adapter on the host system. With single-path access, concurrent download of licensed internal code is supported with SCSI devices.

For information about the SCSI adapters that can attach to your AIX host system, go to the following Web site:

[www.storage.ibm.com/hardsoft/products/ess/supserver.htm](http://www.storage.ibm.com/hardsoft/products/ess/supserver.htm)

### Fibre requirements

**Attention:** You must check for the latest information on fibre-channel device driver APARs, maintenance level fixes, and microcode updates at the following Web site:

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

To use the SDD fibre support, ensure your host system meets the following requirements:

- The AIX host system is an IBM RS/6000® with AIX 4.3.3 or AIX 5.1.0.
- The AIX host system has the fibre-channel device drivers installed along with APARs.
- The `bos.adt` package must be installed. The host system can be a uniprocessor or a multiprocessor system, such as SMP.

- A fiber-optic cable is required to connect each fibre-channel adapter to an ESS port.
- The Emulex LP7000E and LP9002 adapters should be attached to its own PCI bus. These adapters should not be shared with other PCI adapters.

**Note:** Emulex LP9002 is supported with AIX 4.3.3.50 (or later) maintenance level only.

**Attention:** If more than one adapter is attached to a peripheral component interconnect (PCI) bus, both adapter devices will be configured. Sometimes, though, one adapter saturates the entire PCI bus and causes command timeouts.

- The SDD I/O load-balancing and failover features require a minimum of two paths to a device.

For information about the fibre-channel adapters that can be used on your AIX host system go to the following Web site:

[www-1.ibm.com/servers/eserver/pseries/library/hardware\\_docs/](http://www-1.ibm.com/servers/eserver/pseries/library/hardware_docs/)

## Support for 32-bit and 64-bit applications on AIX 4.3.2, AIX 4.3.3, and AIX 5.1.0

Table 8 summarizes SDD 1.3.1.3 support for 32-bit and 64-bit applications on AIX 4.3.2, AIX 4.3.3, and AIX 5.1.0.

*Table 8. Support for 32-bit and 64-bit applications*

SDD Installation Filesets	Application Mode	SDD Interface	AIX Kernel Mode	SDD Support
ibmSdd_432.rte	32-bit, 64-bit	LVM, raw device	32-bit	Yes
ibmSdd_433.rte	32-bit, 64-bit	LVM, raw device	32-bit	Yes
ibmSdd_510.rte	32-bit, 64-bit	LVM, raw device	32-bit, 64-bit	Yes
ibmSdd_510nchacmp.rte	32-bit, 64-bit	LVM, raw device	32-bit, 64-bit	Yes

### Switching between 32-bit and 64-bit modes on AIX 5.1.x host systems

SDD 1.3.1.3 supports AIX 5.1.x host systems that run in both 32-bit and 64-bit kernel modes. You can use the **bootinfo -K** or **ls -al /unix** command to check the current kernel mode in which your AIX 5.1.x host system is running.

The **bootinfo -K** command directly returns the kernel mode information of your host system. The **ls -al /unix** command displays the /unix link information. If the /unix links to /usr/lib/boot/unix\_mp, your AIX 5.1.x host system runs in 32-bit mode. If the /unix links to /usr/lib/boot/unix\_64, your AIX 5.1.x host system runs in 64-bit mode.

If your host system is currently running in 32-bit mode, you can switch it to 64-bit mode by typing the following commands in the given order:

```
ln -sf /usr/lib/boot/unix_64 /unix
ln -sf /usr/lib/boot/unix_64 /usr/lib/boot/unix
bosboot -ak /usr/lib/boot/unix_64
shutdown -Fr
```

The kernel mode of your AIX host system is switched to 64-bit mode after the system restart completes. As a result, SDD automatically switches to 64-bit mode.

If your host system is currently running in 64-bit mode, you can switch it to 32-bit mode by typing the following commands in the given order:

```
ln -sf /usr/lib/boot/unix_mp /unix
ln -sf /usr/lib/boot/unix_mp /usr/lib/boot/unix
bosboot -ak /usr/lib/boot/unix_mp
shutdown -Fr
```

The kernel mode of your AIX host system is switched to 32-bit mode after the system restart completes. As a result, SDD automatically switches to 32-bit mode.

---

## Preparing for SDD installation

Before you install SDD, you must configure the ESS to your host system and the required fibre-channel adapters.

## Configuring the ESS

Before you install SDD, configure your ESS for single-port or multiple-port access for each LUN. SDD requires a minimum of two independent paths that share the same logical unit to use the load-balancing and failover features.

For more information about configuring your IBM Enterprise Storage Server, see *IBM TotalStorage Enterprise Storage Server Introduction and Planning Guide*.

**Note:** Ensure the `ibm2105.rte` installation package is installed.

## Installing fibre-channel device drivers and configuring fibre-channel attached devices

**Attention:** You must check for the latest information on fibre-channel device driver APARs, maintenance level fixes, and microcode updates at the following Web site:  
[techsupport.services.ibm.com/server/fixes](http://techsupport.services.ibm.com/server/fixes)

AIX fibre-channel device drivers are developed by IBM for the Emulex LP7000E adapter.

This section contains the procedures for installing fibre-channel device drivers and configuring fibre-channel devices. These procedures include:

1. Installing the AIX fibre-channel device drivers
2. Installing the Emulex adapter firmware
3. Configuring fibre-channel attached devices

This section also contains procedures for:

- Removing fibre-channel attached devices
- Uninstalling fibre-channel device drivers

**Requirement:** For the fibre-channel support, the AIX host system must be an IBM RS/6000 system with AIX 4.3.3 or AIX 5.1.0. The AIX host system should have the fibre-channel device driver installed along with all APARs.



## Installing the AIX fibre-channel device drivers

**Attention:** You must check for the latest information on fibre-channel device driver APARs, maintenance level fixes, and microcode updates at the following Web site:

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

Perform the following steps to install the AIX fibre-channel device drivers:

1. Install the fibre-channel device drivers from the AIX 4.3.3 compact disc. The fibre-channel device drivers include the following filesets:

**devices.pci.df1000f9**

The adapter device driver for RS/6000 with feature code 6228.

**devices.pci.df1000f7**

The adapter device driver for RS/6000 with feature code 6227.

**devices.common.IBM.fc**

The FCP and SCSI protocol driver.

**devices.fcp.disk**

The FCP disk driver.

2. Check to see if the correct APARS are installed by issuing the **instfix -i | grep IY nnnnn** command (where *nnnnn* represents the APAR numbers). If the APARS are listed, that means that they are installed. If they are installed, go to “Configuring fibre-channel attached devices”. Otherwise, go to step 3.
3. Install the APARS.

The following steps describe how to uninstall the AIX fibre-channel device drivers. There are two methods for uninstalling all of your fibre-channel device drivers. You can:

- Issue the **smitty deinstall** command.
- Manually uninstall the drivers using the **installp** command.

Perform the following steps to use the **smitty deinstall** command:

1. Type **smitty deinstall** at the AIX command prompt and press Enter. The Remove Installed Software panel is displayed.
2. Press F4. All of the software that is installed is displayed.
3. Select the file name of the fibre-channel device driver you want to uninstall. Press Enter. The selected file name is displayed in the **Software Name Field** of the Remove Installed Software panel.
4. Use the Tab key to toggle to **No** in the **PREVIEW Only?** field. Press Enter. The uninstallation process begins.

Perform the following steps to use the **installp** command from the AIX command line:

1. Type **installp -ug devices.pci.df1000f9** and press Enter.
2. Type **installp -ug devices.pci.df1000f7** and press Enter.
3. Type **installp -ug devices.common.IBM.fc** and press Enter.
4. Type **installp -ug devices.fcp.disk** and press Enter.

## Configuring fibre-channel attached devices

The newly installed devices must be configured before they can be used. There are two ways to configure these devices. You can:

- Issue the **cfgmgr** command.
- Issue the **shutdown -rF** command to restart the system.

After the system restarts, use the **lsdev -Cc disk** command to check the ESS fibre-channel protocol (FCP) disk configuration. If the FCP devices are configured correctly, they should be in the Available state. If the FCP devices are configured correctly, go to “Determining the Emulex adapter firmware level” to determine if the proper firmware level is installed.

To remove all fibre-channel attached devices, you must issue the **rmdev -dl fcsN -R** command for each installed FCP adapter, where *N* is the FCP adapter number. For example, if you have two installed FCP adapters (adapter 0 and adapter 1), you must issue both the commands: **rmdev -dl fcs0 -R** and the **rmdev -dl fcs1 -R**.

## Determining the Emulex adapter firmware level

You are required to upgrade to a new adapter firmware if your current adapter firmware is not at the latest level.

### Tip:

- The current firmware level for Emulex LP7000E adapter is sf322A0.
- The current firmware level for Emulex LP9002 adapter is sf382A0.

Perform the following steps to determine the Emulex adapter LP7000E firmware level:

1. Determine the firmware level that is currently installed. Issue the **lscfg -vl fcsN** command. The adapter’s vital product data is displayed.
2. Look at the **ZB** field. The **ZB** field should look something like this:

```
(ZB).....S2F3.22A0
```

To determine the firmware level, ignore the second character in the **ZB** field. In the example, the firmware level is sf322A0.

3. If the adapter firmware level is at the latest level, there is no need to upgrade; otherwise, the firmware level must be upgraded. To upgrade the firmware level, go to “Upgrading the Emulex adapter firmware level”.

## Upgrading the Emulex adapter firmware level

Upgrading the firmware level consists of downloading the firmware (microcode) from your AIX host system to the adapter. Before this can be done, however, the fibre-channel attached devices must be configured. After the devices are configured, you are ready to download the firmware from the AIX host system to the FCP adapter. Perform the following steps to download the firmware:

1. Verify that the correct level of firmware is installed on your AIX host system. Locate the file called df1000f7.131.320.320.320.503. It should be in the /etc/microcode directory. This file was copied into the /etc/microcode directory during the installation of the fibre-channel device drivers.
2. From the AIX command prompt, type **diag** and press Enter.
3. Select the **Task Selection** option.
4. Select the **Download Microcode** option.

5. Select all the fibre-channel adapters to which you want to download firmware. Press F7. The Download panel is displayed with one of the selected adapters highlighted. Press Enter to continue.
6. Type the filename for the firmware that is contained in the /etc/microcode directory and press Enter; or use the **Tab** key to toggle to **Latest**.
7. Follow the instructions that are displayed to download the firmware, one adapter at a time.
8. After the download is complete, issue the **lscfg -v -l fcsN** command to verify the firmware level on each fibre-channel adapter.

---

## Installing the Subsystem Device Driver

You must have root access and AIX system administrator knowledge to install SDD.

To install SDD, use the installation package that is appropriate for your environment. Table 9 lists and describes the SDD installation package file names (filesets).

*Table 9. SDD package file names*

Package file names	Description
ibmSdd_421.rte	AIX 4.2.1
ibmSdd_432.rte	AIX 4.3.2 or AIX 4.3.3  (also use when running HACMP with AIX 4.3.3 in concurrent mode)
ibmSdd_433.rte	AIX 4.3.3  (only use when running HACMP with AIX 4.3.3 in nonconcurrent mode)
ibmSdd_510.rte	AIX 5.1.0  (also use when running HACMP with AIX 5.1.0 in concurrent mode)
ibmSdd_510nchacmp.rte	AIX 5.1.0  (also use when running HACMP with AIX 5.1.0 in nonconcurrent mode)

SDD is released as an installation image. The fileset name is `ibmSdd_nnn.rte`, where *nnn* represents the AIX version level (4.2.1, 4.3.2, 4.3.3 or 5.1.0). For example, the fileset name for the AIX 4.3.2 level is `ibmSdd_432.rte`.

**Note:** The `ibmSdd_432.rte` installation package can be installed on an AIX 4.3.2 or AIX 4.3.3 system.

SDD 1.3.1.3 installed from either the `ibmSdd_432.rte` or `ibmSdd_433.rte` fileset is a 32-bit device driver. This version supports 32-bit and 64-bit mode applications on AIX 4.3.2 and AIX 4.3.3 host systems. A 64-bit mode application can access an SDD device directly or through the logical volume manager (LVM). SDD 1.3.1.3 installed from the `ibmSdd_433.rte` fileset is supported on AIX 4.3.3 and is for HACMP/6000 environments only. For more information about HACMP/6000, see "Understanding the SDD support for High Availability Cluster Multi-Processing (HACMP/6000)" on page 27. It supports nonconcurrent and concurrent modes. However, in order to make the best use of the manner in which the device reserves are made, IBM recommends that you:

- Use the `ibmSdd_432.rte` fileset for SDD 1.3.1.3 when running HACMP with AIX 4.3.3 in concurrent mode.
- Use the `ibmSdd_433.rte` fileset for SDD 1.3.1.3 when running HACMP with AIX 4.3.3 in nonconcurrent mode.

Table 9 on page 13 lists and describes the installation package file names (filesets) for the SDD 1.3.1.3. For more information about HACMP, see “Understanding the SDD support for High Availability Cluster Multi-Processing (HACMP/6000)” on page 27.

The 1.3.1.3 version of the SDD installed from either `ibmSdd_510.rte` or `ibmSdd_510nchacmp.rte` filesets are supported on AIX 5.1.0. It contains both 32-bit and 64-bit drivers. Based on the kernel mode currently running on the system, the AIX loader will load the correct mode of the SDD into the kernel. SDD 1.3.1.3 contained in the `ibmSdd_510nchacmp.rte` fileset supports HACMP/6000 in both concurrent and nonconcurrent modes. IBM recommends that you:

- Install SDD 1.3.1.3 from the `ibmSdd_510.rte` fileset if you run HACMP with AIX 5.1.0 in concurrent code only.
- Install SDD 1.3.1.3 from the `ibmSdd_510nchacmp.rte` fileset if you run HACMP with AIX 5.1.0 in nonconcurrent mode.

The published AIX limitation on one system is 10,000 devices. The combined number of `hdisk` and `vpath` devices should not exceed the number of supported devices by AIX. In a multipath environment, since each path to a disk creates an `hdisk`, the total number of disks being configured can be reduced by the number of paths to each disk.

The installation package installs a number of major files on your AIX system. Table 10 lists the major files that are part of the SDD installation package.

*Table 10. Major files included in the SDD installation package*

Filename	Description
<code>defdpo</code>	Define method of the SDD pseudo parent data path optimizer (dpo)
<code>cfgdpo</code>	Configure method of the SDD pseudo parent dpo
<code>define_vp</code>	Define method of the SDD vpath devices
<code>addpaths</code>	The command that dynamically adds more paths to Subsystem Device Driver devices while they are in Available state. <b>Note:</b> This command is not supported with Subsystem Device Driver for AIX 4.2.1; It is not available if you have the <code>ibmSdd_421.rte</code> fileset installed. This feature only supports Subsystem Device Driver for AIX 4.3.2 and higher.
<code>cfgvpath</code>	Configure method of SDD vpath devices
<code>cfallvpath</code>	Fast-path configure method to configure the SDD pseudo parent dpo and all vpath devices.
<code>vpathdd</code>	SDD
<code>hd2vp</code>	The SDD script that converts an ESS <code>hdisk</code> device volume group to a Subsystem Device Drive <code>vpath</code> device volume group.
<code>vp2hd</code>	The SDD script that converts a SDD <code>vpath</code> device volume group to an ESS <code>hdisk</code> device volume group.
<code>datapath</code>	The SDD driver console command tool.
<code>lsvpcfg</code>	The SDD driver query configuration status command.
<code>mkvg4vp</code>	The command that creates a SDD volume group.

Table 10. Major files included in the SDD installation package (continued)

extendvg4vp	The command that extends SDD devices to a SDD volume group.
dpovgfix	The command that fixes a SDD volume group that has mixed vpath and hdisk physical volumes.
savevg4vp	The command that backs-up all files belonging to a specified volume group with SDD devices.
restvg4vp	The command that restores all files belonging to a specified volume group with SDD devices.

The following procedures assume that SDD will be used to access all of your single and multipath devices.

## Using the System Management Interface Tool (SMIT) for installing SDD

Use the SMIT facility to install SDD. The SMIT facility has two interfaces, nongraphical (type `smitty` to invoke the nongraphical user interface) or graphical (type `smit` to invoke the graphical user interface).

**Note:** The list items on the SMIT panel might be worded differently from one AIX version to another.

Throughout this SMIT procedure, `/dev/cd0` is used for the compact disc drive address. The drive address can be different in your environment. Perform the following SMIT steps to install the SDD package on your system.

1. Log in as the root user.
2. Load the compact disc into the CD-ROM drive.
3. From your desktop window, type `smitty install_update` and press Enter to go directly to the installation panels. The Install and Update Software menu is displayed.
4. Highlight **Install Software** and press Enter.
5. Press F4 to display the INPUT Device/Directory for Software panel.
6. Select the compact disc drive that you are using for the installation; for example, `/dev/cd0`, and press Enter.
7. Press Enter again. The Install Software panel is displayed.
8. Highlight **Software to Install** and press F4. The Software to Install panel is displayed.
9. Select the installation package that is appropriate for your environment. Table 9 on page 13 lists and describes the SDD installation package file names (filesets).
10. Press Enter. The Install and Update from LATEST Available Software panel is displayed with the name of the software you selected to install.
11. Check the default option settings to ensure that they are what you need.
12. Press Enter to install. SMIT responds with the following message:

```
ARE YOU SURE??  
Continuing may delete information you may want to keep.  
This is your last chance to stop before continuing.
```

13. Press Enter to continue. The installation process can take several minutes to complete.
14. When the installation is complete, press F10 to exit from SMIT. Remove the compact disc.

## Verifying your currently installed version of SDD

You can verify your currently installed version of the SDD by issuing one of the following commands:

```
lslpp -l ibmSdd_421.rte
lslpp -l ibmSdd_432.rte
lslpp -l ibmSdd_433.rte
lslpp -l ibmSdd_510.rte
lslpp -l ibmSdd_510nchacmp.rte
```

If you have successfully installed the **ibmSdd\_432.rte** package, the output from the **lslpp -l ibmSdd\_432.rte** command looks like this:

Fileset	Level	State	Description
-----			
Path: /usr/lib/objrepos ibmSdd_432.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V432 V433 for concurrent HACMP
Path: /etc/objrepos ibmSdd_432.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V432 V433 for concurrent HACMP

If you have successfully installed the **ibmSdd\_433.rte** package, the output from the **lslpp -l ibmSdd\_433.rte** command looks like this:

Fileset	Level	State	Description
-----			
Path: /usr/lib/objrepos ibmSdd_433.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V433 for nonconcurrent HACMP
Path: /etc/objrepos ibmSdd_433.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V433 for nonconcurrent HACMP

If you have successfully installed the **ibmSdd\_510.rte** package, the output from the **lslpp -l ibmSdd\_510.rte** command looks like this:

Fileset	Level	State	Description
-----			
Path: /usr/lib/objrepos ibmSdd_510.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V510 for concurrent HACMP
Path: /etc/objrepos ibmSdd_510.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V510 for concurrent HACMP

If you have successfully installed the **ibmSdd\_510nchacmp.rte** package, the output from the **lslpp -l ibmSdd\_510nchacmp.rte** command looks like this:

Fileset	Level	State	Description
Path: /usr/lib/objrepos ibmSdd_510nchacmp.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V510 for nonconcurrent HACMP
Path: /etc/objrepos ibmSdd_510nchacmp.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V510 for nonconcurrent HACMP

## Preparing to configure the Subsystem Device Driver

Before you configure SDD, ensure that:

- The ESS is operational.
- The `ibmSdd_nnn.rte` software is installed on the AIX host system.
- The ESS hdisks are configured correctly on the AIX host system.

Configure the ESS devices before you configure the SDD. If you configure multiple paths to an ESS device, make sure that all paths (hdisks) are in Available state. Otherwise, some SDD devices will lose multiple-path capability.

Perform the following steps:

1. Issue the `lsdev -Cc disk | grep 2105` command to check the ESS device configuration.
2. If you have already created some ESS volume groups, vary off (deactivate) all active volume groups with ESS subsystem disks by using the `varyoffvg` (LVM) command.

**Attention:** Before you vary off a volume group, unmount all file systems in that volume group. If some ESS devices (hdisks) are used as physical volumes of an active volume group, and there are file systems of that volume group being mounted, then you must unmount all file systems, and vary off (deactivate) all active volume groups with ESS SDD disks.

---

## Configuring the Subsystem Device Driver

Perform the following steps to configure SDD using SMIT:

**Note:** The list items on the SMIT panel might be worded differently from one AIX version to another.

1. Type `smitty device` from your desktop window. The Devices menu is displayed.
2. Highlight **Data Path Device** and press Enter. The Data Path Device panel is displayed.
3. Highlight **Define and Configure All Data Path Devices** and press Enter. The configuration process begins.
4. Check the SDD configuration status. See “Displaying the ESS vpath device configuration” on page 35.
5. Enter the `varyonvg` command to vary on all deactivated ESS volume groups.
6. If you want to convert the ESS hdisk volume group to SDD vpath devices, you must run the `hd2vp` utility. (See “`hd2vp` and `vp2hd`” on page 51 for information about this utility.)
7. Mount the file systems for all volume groups that were previously unmounted.

## Unconfiguring Subsystem Device Drivers

Before you unconfigure SDD devices, ensure that:

- All I/O activities on the devices that you need to unconfigure are stopped.
- All file systems belonging to the SDD volume groups are unmounted.

Then, run the `vp2hd` conversion script to convert the volume group from SDD devices (`vpathN`) to ESS devices (`hdisks`).

**Note:** If you are running HACMP with `ibmSdd_433.rte` or `ibmSdd_510nchacmp.rte` files installed on your host system, there are special requirements regarding unconfiguring and removing SDD 1.3.1.3. `vpath` devices. See “Special requirements” on page 32.

Using SMIT, you can unconfigure the SDD devices in two ways. Either you can unconfigure *without deleting* the device information from the Object Database Management (ODM) database, or you can *delete* device information from the ODM database. If you unconfigure *without deleting* the device information, the device remains in the Defined condition. Using either SMIT or the `mkdev -l vpathN` command, you can return the device to the Available condition.

If you delete the device information from the ODM database, that device is removed from the system. To return it, follow the procedure described in “Configuring the Subsystem Device Driver” on page 17.

Perform the following steps to unconfigure SDD devices:

**Note:** The list items on the SMIT panel might be worded differently from one AIX version to another.

1. Type `smitty device` from your desktop window. The Devices menu is displayed.
2. Highlight **Devices** and press Enter. The Devices menu is displayed.
3. Highlight **Data Path Device** and press Enter. The Data Path Device panel is displayed.
4. Highlight **Remove a Data Path Device** and press Enter. A list of all SDD devices and their conditions (either Defined or Available) is displayed.
5. Select the device that you want to unconfigure. Select whether or not you want to delete the device information from the ODM database.
6. Press Enter. The device is unconfigured to the condition that you selected.
7. To unconfigure more SDD devices you have to repeat steps 4-6 for each SDD device.

The fast-path command to unconfigure *all* SDD devices from the Available to the Defined condition is: `rmdev -l dpo -R`. The fast-path command to remove *all* Subsystem Device Driver devices from your system is: `rmdev -dl dpo -R`.

## Verifying the SDD configuration

To check the SDD configuration, you can use either the SMIT Display Device Configuration panel or the `lsvpcfg` console command.

Perform the following steps to verify the SDD configuration on an AIX host system:

**Note:** The list items on the SMIT panel might be worded differently from one AIX version to another.

1. Type `smitty device` from your desktop window. The Devices menu is displayed.



2. Select **Data Path Device** and press Enter. The Data Path Device panel is displayed.
3. Select **Display Data Path Device Configuration** and press Enter to display the condition (Defined or Available) of all SDD pseudo devices and the paths to each device.

If any device is listed as Defined, the configuration was not successful. Check the configuration procedure again. See “Configuring the Subsystem Device Driver” on page 17 for information about the procedure.

Perform the following steps to verify that multiple paths are configured for *each* adapter connected to an ESS port:

1. Type smitty device from your desktop window. The Devices menu is displayed.
2. Highlight **Data Path Device** and press Enter. The Data Path Device panel is displayed.
3. Highlight **Display Data Path Device Adapter Status** and press Enter. All attached paths for each adapter are displayed.

If you want to use the command-line interface to verify the configuration, type `lsvpcfg`.

You should see an output similar to this:

```
vpath0 (Avail pv vpathvg) 018FA067 = hdisk1 (Avail )
vpath1 (Avail ) 019FA067 = hdisk2 (Avail )
vpath2 (Avail ) 01AFA067 = hdisk3 (Avail )
vpath3 (Avail ) 01BFA067 = hdisk4 (Avail ) hdisk27 (Avail )
vpath4 (Avail ) 01CFA067 = hdisk5 (Avail ) hdisk28 (Avail )
vpath5 (Avail ) 01DFA067 = hdisk6 (Avail ) hdisk29 (Avail )
vpath6 (Avail ) 01EFA067 = hdisk7 (Avail ) hdisk30 (Avail )
vpath7 (Avail ) 01FFA067 = hdisk8 (Avail ) hdisk31 (Avail )
vpath8 (Avail ) 020FA067 = hdisk9 (Avail ) hdisk32 (Avail )
vpath9 (Avail pv vpathvg) 02BFA067 = hdisk20 (Avail ) hdisk44 (Avail )
vpath10 (Avail pv vpathvg) 02CFA067 = hdisk21 (Avail ) hdisk45 (Avail )
vpath11 (Avail pv vpathvg) 02DFA067 = hdisk22 (Avail ) hdisk46 (Avail )
vpath12 (Avail pv vpathvg) 02EFA067 = hdisk23 (Avail ) hdisk47 (Avail )
vpath13 (Avail pv vpathvg) 02FFA067 = hdisk24 (Avail ) hdisk48 (Avail )
```

The output shows:

- The name of each pseudo device (for example, vpath13)
- The Defined or Available condition of a pseudo device
- Whether or not the pseudo device is defined to AIX as a physical volume (the pv flag)
- The name of the volume group the device belongs to (for example, vpathvg)
- The unit serial number of the ESS LUN (for example, 02FFA067)
- The names of the AIX disk devices making up the pseudo device and their configuration and physical volume status

## Changing the path-selection policy

SDD supports path-selection policies that increase the performance of a multipath-configured ESS and make path failures transparent to applications. The following path-selection policies are supported:

### load balancing (lb)

The path to use for an I/O operation is chosen by estimating the load on the adapter to which each path is attached. The load is a function of the

number of I/O operations currently in process. If multiple paths have the same load, a path is chosen at random from those paths.

### round robin (rr)

The path to use for each I/O operation is chosen at random from those paths not used for the last I/O operation. If a device has only two paths, SDD alternates between the two.

### failover only (fo)

All I/O operations for the device are sent to the same (preferred) path until the path fails because of I/O errors. Then an alternate path is chosen for subsequent I/O operations.

The path-selection policy is set at the SDD device level. The default path-selection policy for a SDD device is load balancing. You can change the policy for a SDD device with the **chdev** command.

Before changing the path-selection policy, determine the active attributes for the SDD device. Type the `lsattr -E1 vpathN` command. Press Enter, where *N* represents the vpath-number, *N*=[0,1,2,...]. The output should look similar to this:

```
pvid          0004379001b90b3f0000000000000000 Data Path Optimizer Parent False
policy        df                               Scheduling Policy         True
active_hdisk  hdisk1/30C12028                          Active hdisk               False
active_hdisk  hdisk5/30C12028
```

The path-selection policy is the only attribute of an SDD device that can be changed. The valid policies are *rr*, *lb*, *fo*, and *df*. Here are the explanations for these policy values:

- rr** round robin
- fo** failover only
- lb** load balancing
- df** (load balancing) default policy

**Attention:** By changing an SDD device's attribute, the **chdev** command unconfigures and then reconfigures the device. You must ensure that the device is not in use if you are going to change its attribute. Otherwise, the command fails.

Use the following command to change the SDD path-selection policy:

```
chdev -l vpath N -a policy=[rr/fo/lb/df]
```

## Adding paths to SDD devices of a volume group

You can add more paths to SDD devices that belong to a volume group after you have initially configured SDD. This section shows you how to add paths to SDD devices from AIX 4.2.1 and AIX 4.3.2 or higher host systems.

### Adding paths from AIX 4.3.2 or higher host systems

If your host system is AIX 4.3.2 or higher, you can issue the **addpaths** command to add paths to SDD devices of a volume group.

The **addpaths** command allows you to dynamically add more paths to SDD devices while they are in the `Available` state. It also allows you to add paths to vpath devices belonging to active volume groups.

You can issue the **addpaths** command to add a new path to a vpath device that has only one existing path. But the new path is not automatically in the Open state; you must change it to the Open state by closing and reopening the vpath device.

Before you issue the **addpaths** command, make sure that ESS logical volume sharing is enabled for all applicable devices. You can enable ESS logical volume sharing through the ESS Specialist. See *IBM TotalStorage Enterprise Storage Server Web Interface User's Guide* for more information.

Complete the following steps to add paths to SDD devices of a volume group with the **addpaths** command:

1. Issue the **lspv** command to list the physical volumes.
2. Identify the volume group that contains the SDD devices to which you want to add more paths.
3. Verify that all the physical volumes belonging to the SDD volume group are SDD devices (vpathNs). If they are not, you must fix the problem before proceeding to the next step. Otherwise, the entire volume group loses the path-failover protection.

You can issue the **dpovgfix vg-name** command to ensure that all physical volumes within the SDD volume group are SDD devices.

4. Stop all I/O operations by stopping all applications to the volume group.  
The **addpaths** command is designed to add paths when there are no I/O activities. The command fails if it detects active I/Os.
5. Run the AIX configuration manager in one of the following ways to recognize all new hdisk devices. Ensure that all logical drives on the ESS are identified as hdisks before continuing.
  - Issue the **cfgmgr** command *n* times, where *n* represents the number of paths for SDD, **or**
  - Issue the **cfgmgr -l [scsiN/fcsN]** command for each relevant SCSI or FCP adapter.
6. Issue the **addpaths** from the AIX command line to add more paths to the SDD devices.
7. Type the **lsvpcfg** command from the AIX command line to verify the configuration of the SDD devices in the volume group.  
SDD devices should show two or more hdisks associated with each SDD device when the failover protection is required.

### **Adding paths from AIX 4.2.1 host systems**

**Tip:** This **addpaths** command is not supported with Subsystem Device Driver for AIX 4.2.1

To activate additional paths to a SDD device, the related SDD devices must be unconfigured and then reconfigured. The SDD conversion scripts should be run to enable the necessary SDD associations and links between the SDD vpath (pseudo) devices and the ESS hdisk devices.

**Note:** Ensure that logical volume sharing is enabled at the ESS for all applicable devices. Logical volume sharing is enabled using the ESS Specialist. See *IBM TotalStorage Enterprise Storage Server Web Interface User's Guide* for information about enabling volume sharing.

Perform the following steps to activate additional paths to SDD devices of a volume group from your AIX 4.2.1 host system:

1. Identify the volume groups containing the SDD devices to which you want to add additional paths. Type the following command:

```
lspv
```

2. Check if all the physical volumes belonging to that SDD volume group are SDD devices (vpathNs). If they are not, you need to fix the problem.

**Attention:** You must fix this problem with the volume group before proceeding to step 3. Otherwise, the volume group loses path failover capability.

To fix the problem, type the following command:

```
dpovgfix vg-name
```

*Vg-name* represents the volume group.

3. Identify the associated file systems for the selected volume group. Type the following command:

```
lsvgfs vg-name
```

4. Identify the associated mounted file systems for the selected volume group. Type the following command:

```
mount
```

5. Unmount the file systems of the selected volume group listed in step 3. Type the following command:

```
umount mounted-filesystem
```

6. Run the `vp2hd` volume group conversion script to convert the volume group from SDD devices to ESS hdisk devices. Type the following command to run the script:

```
vp2hd vg-name
```

When the conversion script completes, the volume group is in the Active condition (varied on).

7. Vary off the selected volume group in preparation for SDD reconfiguration. Type the following command:

```
varyoffvg vg-name
```

8. Run the AIX configuration manager **cfgmgr** to recognize all new hdisk devices. You can do this in one of two ways:

- Run the **cfgmgr** command *n* times, where *n* represents the number of paths for the SDD. (See Note on page 42 for an explanation of why **cfgmgr** should be run *n* times.)
- Run the **cfgmgr -I [scsiN/fcsN]** command for each relevant SCSI or FCP adapter.

**Note:** Ensure that all logical drives on the ESS are identified as hdisks before continuing.

9. Unconfigure affected SDD devices to the Defined condition by using the **rmdev -l vpathN** command; where *N* represents the vpath-number you want to set to the Defined condition *N*=[0,1,2,...]. This command allows you to unconfigure only SDD devices for which you are adding paths.

**Note:** Issue the **rmdev -l dpo -R** command if you need to unconfigure *all* Subsystem Device Driver devices. SDD volume groups must be inactive before unconfiguring. This command attempts to unconfigure all SDD devices recursively.

10. Reconfigure SDD devices by using either SMIT or the command-line interface. If you are using SMIT, perform the following steps:

**Note:** The list items on the SMIT panel might be worded differently from one AIX version to another.

- a. Type Smitty device from your desktop window. The Devices menu is displayed.
- b. Highlight **Data Path Devices** and press Enter. The Data Path Devices menu is displayed.
- c. Highlight **Define and Configure All Data Path Devices** and press Enter. SMIT executes a script to define and configure all SDD devices that are in the Defined condition.

If you are using the command-line interface, type the `mkdev -l vpathN` command for each SDD device or type the `cfallvpath` command to configure *all* SDD devices.

11. Verify your datapath configuration using either SMIT or the command-line interface.

If you are using SMIT, perform the following steps:

**Note:** The list items on the SMIT panel might be worded differently from one AIX version to another.

- a. Type Smitty device from your desktop window. The Devices menu is displayed.
- b. Highlight **Data Path Devices** and press Enter. The Data Path Devices menu is displayed.
- c. Highlight **Display Data Path Device Configuration** and press Enter.

If you are using the command-line interface, type the `lsvpcfg` command to display the SDD configuration status.

SDD devices should show two or more hdisks associated with each SDD device when failover protection is required.

12. Vary on the volume groups selected in step 3 on page 22. Type the following command:

```
varyonvg vg-name
```

13. Run the `hd2vp` script to convert the volume group from ESS hdisk devices back to SDD vpath devices. Type the following command:

```
hd2vp vg-name
```

14. Mount all file systems for the volume groups that were previously unmounted.

---

## Upgrading SDD for AIX 4.2.1, AIX 4.3.2, AIX 4.3.3, and AIX 5.1.0

### Understanding the SDD support for nondisruptive installation

**Attention:** The nondisruptive installation requires that you:

- Terminate all I/O operations to the SDD volume groups.
- Perform a system restart.

*With* the nondisruptive installation capability, all configurations are automatically updated during the system restart time. The system restart will start all the automatic configuration, which loads the new driver into the kernel of the host system. The nondisruptive installation capability is beneficial if you have a large number of SDD devices, volume groups, and file systems configured.

Without the nondisruptive installation capability, you must *manually* perform the following tasks when upgrading to a later version of SDD:

- Mount file systems
- Unmount file systems
- Vary on volume groups
- Vary off volume groups
- Install a new version of SDD
- Remove a previous version of SDD
- Configure the new version of SDD
- Unconfigure the previous version of SDD
- Convert physical volumes of SDD volume groups from SDD devices to ESS hdisks
- Convert physical volumes of volume groups from ESS hdisks to SDD devices

SDD 1.3.1.3 supports nondisruptive installation if you are upgrading from any one of the filesets listed in Table 11.

Table 11. List of previously installed filesets that are supported with nondisruptive installation

Filesets
ibmSdd_421.rte
ibmSdd.rte.421
ibmSdd_432.rte
ibmSdd.rte.432
ibmSdd_433.rte
ibmSdd.rte.433
ibmSdd_510.rte
ibmSdd_510nchacmp.rte

If you have previously installed from any of the filesets listed in Table 11, with SDD 1.3.1.3 you can upgrade while all of the SDD:

- File systems are mounted
- Volume groups are varied-on

If you are upgrading from a previous version of the SDD that you installed from other filesets, you cannot perform the nondisruptive installation. To upgrade SDD to a newer version, all the SDD filesets must be uninstalled.

## Verifying your previously installed version of SDD

You can verify your previously installed version of the SDD by issuing one of the following commands:

```
ls1pp -l ibmSdd_421.rte
```

```
ls1pp -l ibmSdd.rte.421
```

```
ls1pp -l ibmSdd_432.rte
```

```
ls1pp -l ibmSdd.rte.432
```

```
lslpp -l ibmSdd_433.rte  
lslpp -l ibmSdd.rte.433  
lslpp -l ibmSdd_510.rte  
lslpp -l ibmSdd_510nchacmp.rte
```

If the previous version of the SDD is installed from one of the filesets listed in Table 11 on page 24, proceed to “Upgrading to SDD 1.3.1.3 using a nondisruptive installation”.

If the previous version of the SDD is installed from a fileset *not* listed in Table 11 on page 24, proceed to “Upgrading manually to SDD 1.3.1.3”.

## Upgrading to SDD 1.3.1.3 using a nondisruptive installation

You can use SDD 1.3.1.3 using a nondisruptive installation if you are upgrading from any of the listed filesets. Perform the following steps to upgrade to SDD 1.3.1.3 with a nondisruptive installation:

1. Terminate all I/O operations to the SDD volume groups.
2. Complete the installation instructions provided in “Installing the Subsystem Device Driver” on page 13 .
3. Restart your system by typing `shutdown -rF`
4. Verify the SDD configuration by typing `lsvpcfg`
5. Verify your currently installed version of the SDD by completing the instructions provided in “Verifying your currently installed version of SDD” on page 16

**Attention:** If the physical volumes on an SDD volume group are mixed with `hdisk` devices and `vpath` devices, you must run the `dpovgfix` utility to fix this problem. Otherwise, SDD will not function properly. Issue the **`dpovgfix vg_name`** command to fix this problem.

## Upgrading manually to SDD 1.3.1.3

If you are upgrading from a previous version of the SDD that you installed with a fileset not listed in Table 11 on page 24, you cannot perform a nondisruptive installation. Perform the following steps to upgrade to SDD 1.3.1.3:

1. Remove any `.toc` files generated during previous SDD or DPO installations. Type the following command to delete any `.toc` file found in the `/usr/sys/inst.images` directory:  

```
rm .toc
```

Ensure that this file is removed because it contains information about the previous version of SDD or DPO.
2. Issue the **`lspv`** command to find out all the Subsystem Device Driver volume groups.
3. Issue the **`lsvgfs`** command for each SDD volume group to find out which file systems are mounted. Type the following command:  

```
lsvgfs vg_name
```
4. Issue the **`umount`** command to unmount all file systems belonging to SDD volume groups. Type the following command:  

```
umount filesystem_name
```
5. Run the **`vp2hd`** script to convert the volume group from SDD devices to ESS `hdisk` devices.

6. Issue the **varyoffvg** command to vary off the volume groups. Type the following command:  

```
varyoffvg vg_name
```
7. Remove all SDD devices. Type the following command:  

```
rmdev -dl dpo -R
```
8. Use the **smitty** command to uninstall SDD. Type `smitty deinstall` and press Enter. The uninstall process begins. Complete the uninstall process. See “Removing SDD from an AIX host system” for the step-by-step procedure for uninstalling SDD.
9. Use the **smitty** command to install the newer version of SDD from the compact disc. Type `smitty install` and press Enter. The installation process begins. Go to “Installing the Subsystem Device Driver” on page 13 to complete the installation process.
10. Use the **smitty device** command to configure all the SDD devices to the Available condition. See “Configuring the Subsystem Device Driver” on page 17 for a step-by-step procedure for configuring devices.
11. Issue the **lsvpcfg** command to verify the SDD configuration. Type the following command:  

```
lsvpcfg
```
12. Issue the **varyonvg** command for each volume group that was previously varied offline. Type the following command:  

```
varyonvg vg_name
```
13. Run the **hd2vp** script for each SDD volume group to convert the physical volumes from ESS hdisk devices back to SDD vpath devices. Type the following command:  

```
hd2vp vg_name
```
14. Issue the **lspv** command to verify that all physical volumes of the SDD volume groups are SDD vpath devices.

**Attention:** If the physical volumes on an SDD volume group’s physical volumes are mixed with hdisk devices and vpath devices, you must run the `dpovgfix` utility to fix this problem. Otherwise, SDD will not function properly. Issue the **dpovgfix vg\_name** command to fix this problem.

---

## Removing SDD from an AIX host system

Before you remove the SDD package from your AIX host system, all the SDD devices must be unconfigured and removed from your host system.

**Note:** See “Unconfiguring Subsystem Device Drivers” on page 18. The fast-path **rmdev -dl dpo -R** command removes all the SDD devices from your system. After all SDD devices are removed, perform the following steps to remove SDD.

1. Type `smitty deinstall` from your desktop window to go directly to the Remove Installed Software panel.
2. Type one of the following fileset names in the **SOFTWARE name** field:  

```
ibmSdd_421.rte  

ibmSdd_432.rte  

ibmSdd_433.rte  

ibmSdd_510.rte  

ibmSdd_510nchacmp.rte
```



Then press Enter.

3. Press the Tab key in the **PREVIEW Only?** field to toggle between Yes and No. Select **No** to remove the software package from your AIX host system.

**Note:** If you select **Yes**, the process stops at this point and previews what you are removing. The results of your pre-check are displayed without removing the software. If the condition for any SDD device is either Available or Defined, the process fails.

4. Select **No** for the remaining fields on this panel.
5. Press Enter. SMIT responds with the following message:

```
ARE YOU SURE??  
Continuing may delete information you may want to keep.  
This is your last chance to stop before continuing.
```

6. Press Enter to begin the removal process. This might take a few minutes.
7. When the process is complete, the SDD software package is removed from your system.

---

## Using concurrent download of licensed internal code

Concurrent download of licensed internal code is the capability to download and install licensed internal code on an ESS while applications continue to run. This capability is supported for single-path (SCSI only) and multiple-path (SCSI or FCP) access to an ESS.

**Attention:** During the download of licensed internal code, the AIX error log might overflow and excessive system paging space could be consumed. When the system paging space drops too low it could cause your AIX system to hang. To avoid this problem, you can perform the following steps prior to doing the download:

1. Save the existing error report by typing the following command from the AIX command-line interface:  

```
> errpt > file.save
```
2. Delete the error log from the error log buffer by typing the following command:  

```
> errclear 0
```
3. Enlarge the system paging space by using the SMIT tool.
4. Stop the AIX error log daemon by typing the following command:  

```
/usr/lib/errstop
```

Once you have completed steps 1- 4, you can perform the download of the ESS licensed internal code. After the download completes, type `/usr/lib/errdemon` from the command-line interface to restart the AIX error log daemon.

---

## Understanding the SDD support for High Availability Cluster Multi-Processing (HACMP/6000)

You can run the Subsystem Device Driver in concurrent and nonconcurrent multihost environments in which more than one host is attached to the same LUNs on an ESS. RS/6000 servers running HACMP/6000 in concurrent or nonconcurrent mode are supported. Different SDD releases support different kinds of environments. (See Table 12 on page 29, Table 14 on page 30, Table 13 on page 30 and Table 15 on page 31.)

HACMP/6000 provides a reliable way for clustered IBM RS/6000 servers which share disk resources to recover from server and disk failures. In a HACMP/6000 environment, each RS/6000 server in a cluster is a node. Each node has access to shared disk resources that are accessed by other nodes. When there is a failure, HACMP/6000 transfers ownership of shared disks and other resources based on how you define the relationship among nodes in a cluster. This process is known as *node failover* or *node fallback*. HACMP supports two modes of operation:

**nonconcurrent**

Only one node in a cluster is actively accessing shared disk resources while other nodes are standby.

**concurrent**

Multiple nodes in a cluster are actively accessing shared disk resources.

**Tip:** If you use a mix of nonconcurrent and concurrent resource groups (such as, cascading and rotating resource groups) with HACMP, you should use the nonconcurrent version of SDD.

HACMP/6000 running in concurrent mode is supported with the `ibmSdd_432.rte` fileset for SDD 1.1.4 (SCSI only). HACMP/6000 running in concurrent mode is supported with the `ibmSdd_432.rte` fileset for SDD 1.3.1.3 or later (SCSI and fibre) and `ibmSdd_510.rte` fileset for SDD 1.2.0.0 or later (SCSI and fibre). The `ibmSdd_433.rte` fileset for SDD 1.3.1.3 (or later) and the `ibmSdd_510nchacmp.rte` fileset for SDD 1.3.1.3 are for HACMP/6000 environments only. These versions support nonconcurrent modes. However, in order to make the best use of the manner in which the device reserves are made, IBM recommends that you:

- Use either `ibmSdd_432.rte` fileset for SDD 1.3.1.3, or the `ibmSdd_510.rte` fileset for SDD 1.3.1.3 when running HACMP concurrent mode.
- Use either `ibmSdd_433.rte` fileset for SDD 1.3.1.3, or the `ibmSdd_510nchacmp.rte` fileset for SDD 1.3.1.3 when running HACMP in nonconcurrent mode.

HACMP/6000 is not supported on all models of the ESS. For information about supported ESS models and required ESS microcode levels, go to the following Web site:

[www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates](http://www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates)

SDD supports RS/6000 servers connected to shared disks with SCSI adapters and drives as well as FCP adapters and drives. The kind of attachment support depends on the version of SDD that you have installed. Table 12 on page 29 and Table 14 on page 30 summarizes the software requirements to support HACMP/6000:

Table 12. Software support for HACMP/6000 in concurrent mode

Subsystem Device Driver Version and Release Level	HACMP 4.3.1 + APARs	HACMP 4.4 + APARs
SDD 1.1.4.0 (SCSI only)	<ul style="list-style-type: none"> <li>• IY07392</li> <li>• IY03438</li> <li>• IY11560</li> <li>• IY08933</li> <li>• IY11564</li> <li>• IY12021</li> <li>• IY12056</li> <li>• F model requires IY11110</li> </ul>	<ul style="list-style-type: none"> <li>• IY11563</li> <li>• IY11565</li> <li>• IY12022</li> <li>• IY12057</li> <li>• F model requires IY11480</li> </ul>
SDD 1.2.0.0 (SCSI/FCP)	<ul style="list-style-type: none"> <li>• IY07392</li> <li>• IY13474</li> <li>• IY03438</li> <li>• IY08933</li> <li>• IY11560</li> <li>• IY11564</li> <li>• IY12021</li> <li>• IY12056</li> <li>• F model requires IY11110</li> </ul>	<ul style="list-style-type: none"> <li>• IY13432</li> <li>• IY11563</li> <li>• IY11565</li> <li>• IY12022</li> <li>• IY12057</li> <li>• F model requires IY11480</li> </ul>
SDD 1.2.2.x (SCSI/FCP)	<ul style="list-style-type: none"> <li>• IY07392</li> <li>• IY13474</li> <li>• IY03438</li> <li>• IY08933</li> <li>• IY11560</li> <li>• IY11564</li> <li>• IY12021</li> <li>• IY12056</li> <li>• F model requires IY11110</li> </ul>	<ul style="list-style-type: none"> <li>• IY13432</li> <li>• IY11563</li> <li>• IY11565</li> <li>• IY12022</li> <li>• IY12057</li> <li>• F model requires IY11480</li> </ul>
SDD 1.3.1.3 (SCSI/FCP)	<ul style="list-style-type: none"> <li>• IY07392</li> <li>• IY13474</li> <li>• IY03438</li> <li>• IY08933</li> <li>• IY11560</li> <li>• IY11564</li> <li>• IY12021</li> <li>• IY12056</li> <li>• F model requires IY11110</li> </ul>	<ul style="list-style-type: none"> <li>• IY13432</li> <li>• IY11563</li> <li>• IY11565</li> <li>• IY12022</li> <li>• IY12057</li> <li>• F model requires IY11480</li> </ul>

Table 13. Software support for HAMCP/6000 in nonconcurrent mode

Subsystem Device Driver Version and Release Level	HACMP 4.3.1 + APARs	HACMP 4.4 + APARs
SDD 1.2.2.x (SCSI/FCP)	<ul style="list-style-type: none"> <li>• IY07392</li> <li>• IY13474</li> <li>• IY03438</li> <li>• IY08933</li> <li>• IY11560</li> <li>• IY11564</li> <li>• IY12021</li> <li>• IY12056</li> <li>• IY14682</li> <li>• F model requires IY11110</li> </ul>	<ul style="list-style-type: none"> <li>• IY13432</li> <li>• IY11563</li> <li>• IY11565</li> <li>• IY12022</li> <li>• IY12057</li> <li>• IY14683</li> <li>• F model requires IY11480</li> </ul>
ibmSdd_433.rte fileset for SDD 1.3.1.3 (SCSI/FCP)	<ul style="list-style-type: none"> <li>• IY07392</li> <li>• IY13474</li> <li>• IY03438</li> <li>• IY08933</li> <li>• IY11560</li> <li>• IY11564</li> <li>• IY12021</li> <li>• IY12056</li> <li>• IY14682</li> <li>• F model requires IY11110</li> </ul>	<ul style="list-style-type: none"> <li>• IY13432</li> <li>• IY11563</li> <li>• IY11565</li> <li>• IY12022</li> <li>• IY12057</li> <li>• IY14683</li> <li>• F model requires IY11480</li> </ul>

Table 14. Software support for HACMP/6000 in concurrent mode on AIX 5.1.0 (32-bit kernel only)

Subsystem Device Driver Version and Release Level	HACMP 4.4 + APARs
ibmSdd_510.rte fileset for SDD 1.3.1.3 (SCSI/FCP)	<ul style="list-style-type: none"> <li>• IY11563</li> <li>• IY11565</li> <li>• IY12022</li> <li>• IY12057</li> <li>• IY13432</li> <li>• IY14683</li> <li>• IY17684</li> <li>• IY19089</li> <li>• IY19156</li> <li>• F model requires IY11480</li> </ul>

Table 15. Software support for HACMP/6000 in nonconcurrent mode on AIX 5.1.0 (32-bit kernel only)

Subsystem Device Driver Version and Release Level	HACMP 4.4 + APARs
ibmSdd_510nchacmp.rte fileset for SDD 1.3.1.3 (SCSI/FCP)	<ul style="list-style-type: none"> <li>• IY11563</li> <li>• IY11565</li> <li>• IY12022</li> <li>• IY12057</li> <li>• IY13432</li> <li>• IY14683</li> <li>• IY17684</li> <li>• IY19089</li> <li>• IY19156</li> <li>• F model requires IY11480</li> </ul>

**Note:** For the most up-to-date list of required APARs go to the following Web sites:

- [storage.ibm.com/hardsoft/products/ess/supserver.htm](http://storage.ibm.com/hardsoft/products/ess/supserver.htm)

Even though SDD supports HACMP/6000, certain combinations of features are not supported. Table 16 lists those combinations:

Table 16. HACMP/6000 and supported SDD features

Feature	RS/6000 node running HACMP
ESS concurrent code load	Yes
Subsystem Device Driver load balancing	Yes
SCSI	Yes
FCP (fibre)	Yes
Single-path fibre	No
SCSI and fibre-channel connections to the same LUN from one host (mixed environment)	No

## SDD fileset attributes

The `ibmSdd_433.rte` and `ibmSdd_510nchacmp.rte` filesets for SDD 1.3.1.3 have different features compared with `ibmSdd_432.rte` and `ibmSdd_510.rte` filesets for SDD 1.3.1.3. The `ibmSdd_433.rte` and `ibmSdd_510nchacmp.rte` filesets implement the SCSI-3 Persistent Reserve command set, in order to support HACMP in nonconcurrent mode with single-point failure protection. The `ibmSdd_433.rte` and `ibmSdd_510nchacmp.rte` filesets require the ESS G3 level microcode on the ESS to support the SCSI-3 Persistent Reserve command set. If the ESS G3 level microcode is not installed, the `ibmSdd_433.rte` and `ibmSdd_510nchacmp.rte` filesets will switch the multipath configuration to a single-path configuration. There is no single-point failure protection for single-path configurations.

The `ibmSdd_433.rte` and `ibmSdd_510nchacmp.rte` filesets have a new attribute under its pseudo parent (`dpo`), that reflects whether the ESS supports the Persistent Reserve Command set or not. The attribute name is `persistent_resv`. If SDD detects that G3 level microcode is installed, the `persistent_resv` attribute is created in the CuAt ODM and its value is set to `yes`; otherwise this attribute only exists in the PdAt

ODM and its value is set to no (default). You can use the following command to check the *persistent\_resv* attribute, after the SDD device configuration is complete:

```
odmget -q "name = dpo" CuAt
```

If your attached ESS has the G3 microcode, the output should look similar to this:

```
name = "dpo"
attribute = "persistent_resv"
value = "yes"
generic = "D"
rep = "s1"
nls_index = 0
```

In order to implement the Persistent Reserve command set, each host server needs a unique 8-byte reservation key. There are 2 ways to get a unique reservation key. In HACMP/6000 environments, HACMP/6000 generates a unique key for each node in the ODM database. When SDD cannot find that key in the ODM database, it generates a unique reservation key by using the middle 8 bytes of the output from the **uname -m** command.

To check the Persistent Reserve Key of a node, provided by HACMP, type the command:

```
odmget -q "name = ioaccess" CuAt
```

The output should look similar to this:

```
name = "ioaccess"
attribute = "perservekey"
value = "01043792"
type = "R"
generic = ""
rep = "s"
nls_index = 0
```

## Special requirements

There is a special requirement regarding unconfiguring and removing the `ibmSdd_433.rte` and `ibmSdd_510nchacmp.rte` filesets for SDD 1.3.1.3 vpath devices. You must unconfigure and remove the vpath devices *before* you unconfigure and remove the vpath devices' underlying ESS hdisks. Otherwise if the ESS hdisks are unconfigured and removed first, the persistent reserve will not be released on physical device, even though the vpath devices have been successfully unconfigured and removed.

SDD does not automatically create the *pvid* attribute in the ODM database for each vpath device. The AIX disk driver automatically creates the *pvid* attribute in the ODM database, if a *pvid* exists on the physical device; however, SDD does not. Therefore, the first time you import a new SDD volume group to a new cluster node, you must import the volume group using hdisks as physical volumes. Next, run the `hd2vp` conversion script (see "SDD utility programs" on page 50) to convert the volume group's physical volumes from ESS hdisks to vpath devices. This conversion step not only create *pvid* attributes for all vpath devices which belong to that imported volume group, it also deletes the *pvid* attributes for these vpath devices' underlying hdisks. Later on you can import and vary on the volume group directly from the vpath devices. These special requirements apply to both concurrent and nonconcurrent volume groups.

Under certain conditions, the state of a physical device's *pvid* on a system is not always as expected. So it is necessary to determine the state of a *pvid* as displayed by the **lspv** command, in order to select the appropriate import volume group action.

There are four scenarios:

**Scenario 1.** *lspv* displays *pvid*'s for both *hdisk*s and *vpath*:

```
>lspv
hdisk1 003dfc10a11904fa None
hdisk2 003dfc10a11904fa None
vpath0 003dfc10a11904fa None
```

**Scenario 2.** *lspv* displays *pvid*'s for *hdisk*s only:

```
>lspv
hdisk1 003dfc10a11904fa None
hdisk2 003dfc10a11904fa None
vpath0 none None
```

For both Scenario 1 and Scenario 2, the volume group should be imported using the *hdisk* names and then converted using the **hd2vp** command:

```
>importvg -y vg_name -V major# hdisk1
>hd2vp vg_name
```

**Scenario 3.** *lspv* displays the *pvid* for *vpath* only:

```
>lspv
hdisk1 none None
hdisk2 none None
vpath0 003dfc10a11904fa None
```

For Scenario 3, the volume group should be imported using the *vpath* name:

```
>importvg -y vg_name -V major# vpath0
```

**Scenario 4.** *lspv* does not display the *pvid* on the *hdisk*s or the *vpath*:

```
>lspv
hdisk1 none None
hdisk2 none None
vpath0 none None
```

For Scenario 4, the *pvid* will need to be placed in the *odm* for the *vpath* devices and then the volume group can be imported using the *vpath* name:

```
>chdev -l vpath0 -a pv=yes
>importvg -y vg_name -V major# vpath0
```

**Note:** See "Importing a volume group with SDD" on page 37 for a detailed procedure for importing a volume group with the SDD devices.

### Recovering paths that are lost during HACMP/6000 node failover

Normally, when there is a node failure, HACMP/6000 transfers ownership of shared disks and other resources, through a process known as node failover. Certain situations, such as, a loose or disconnected SCSI or fibre-adapter card, can cause your *vpath* devices to lose one or more underlying paths during node failover. Perform the following steps to recover these paths:

- Check to ensure that all the underlying paths (*hdisk*s) are in the *Available* state
- Issue the **addpaths** command to add the lost paths back to the SDD devices.

If your vpath devices have lost one or more underlying paths that belong to an active volume group, you can use either the Add Paths to Available Data Path Devices SMIT panel or run the **addpaths** command from the AIX command line to recover the lost paths. Go to “Adding paths to SDD devices of a volume group” on page 20 for more information about the **addpaths** command.

**Note:** Simply running the **cfgmgr** command while the vpath devices are in the Available state will not recover the lost paths; that is why you need to run the **addpaths** command to recover the lost paths.

SDD does not support the **addpaths** command for AIX 4.2.1; it is not available if you have the `ibmSdd_421.rte` filesset installed (this feature only supports SDD for AIX 4.3.2 and higher.) If you have the `ibmSdd_421.rte` filesset installed, and if your vpath devices have lost one or more underlying paths and they belong to an active volume group, perform the following steps to recover the lost paths:

**Note:**

- When there is a node failure, HACMP/6000 transfers ownership of shared disks and other resources, through a process known as node failover. To recover these paths, you need to first check to ensure that all the underlying paths (hdisks) are in the Available state. Next, you need to unconfigure and reconfigure your SDD vpath devices.
  - Simply running the **cfgmgr** command while vpath devices are in the Available state will not recover the lost paths; that is why you need to unconfigure and reconfigure the vpath devices.
1. Issue the **lspv** command to find the volume group name for the vpath devices that have lost paths.
  2. Issue the **lsvgfs vg-name** command to find out the file systems for the volume group.
  3. Issue the **mount** command to find out if any file systems of the volume group were mounted. Issue the **umount filesystem-name** command to unmount any file systems that were mounted.
  4. Issue the **vp2hd vg-name** command to convert the volume group’s physical volumes from vpath devices to ESS hdisks.
  5. Vary off the volume group. This puts the physical volumes (hdisks) in the Close state.
  6. Issue the **rmdev -l vpathN** command on each vpath device that has lost a path; run the **mkdev -l vpathN** command on the same vpath devices to recover the paths.
  7. Issue the **lsvpcfg** or **lsvpcfg vpathN<sub>0</sub> vpathN<sub>1</sub> vpathN<sub>2</sub>** command to ensure that all the paths are configured.
  8. Vary on the volume group.
    - Issue the **varyonvg vg-name** command for nonconcurrent volume groups.
    - Issue the **varyonvg -u vg-name** or **/usr/sbin/cluster/events/utlis/convaryonvg vg-name** command for concurrent volume groups
  9. Issue the **hd2vp vg-name** command to convert the volume group’s physical volumes back to SDD vpath devices.
  10. Mount all the file systems which were unmounted at 3.



---

## Providing load-balancing and failover protection

SDD provides load-balancing and failover protection for AIX applications and for the LVM when ESS vpath devices are used. These devices must have a minimum of two paths to a physical logical unit number (LUN) for failover protection to exist.

### Displaying the ESS vpath device configuration

To provide failover protection, an ESS vpath device must include a minimum of two paths. Both the SDD vpath device and the ESS hdisk devices must all be in the Available condition. In the following example, vpath0, vpath1, and vpath2 all have a single path and, therefore, will not provide failover protection because there is no alternate path to the ESS LUN. The other SDD vpath devices have two paths and, therefore, can provide failover protection.

To display which ESS vpath devices are available to provide failover protection, use either the Display Data Path Device Configuration SMIT panel, or run the **lsvpcfg** command. Perform the following steps to use SMIT:

**Note:** The list items on the SMIT panel might be worded differently from one AIX version to another.

1. Type `smitty device` from your desktop window. The Devices panel is displayed.
2. Select **Data Path Devices** and press Enter. The Data Path Devices panel is displayed.
3. Select **Display Data Path Device Configuration** and press Enter.

You will see an output similar to the following:

```
vpath0 (Avail pv vpathvg) 018FA067 = hdisk1 (Avail )
vpath1 (Avail ) 019FA067= hdisk2 (Avail )
vpath2 (Avail ) 01AFA067 = hdisk3 (Avail )
vpath3 (Avail ) 01BFA067 = hdisk4 (Avail ) hdisk27 (Avail )
vpath4 (Avail ) 01CFA067 = hdisk5 (Avail ) hdisk28 (Avail )
vpath5 (Avail ) 01DFA067 = hdisk6 (Avail ) hdisk29 (Avail )
vpath6 (Avail ) 01EFA067 = hdisk7 (Avail ) hdisk30 (Avail )
vpath7 (Avail ) 01FFA067 = hdisk8 (Avail ) hdisk31 (Avail )
vpath8 (Avail ) 020FA067 = hdisk9 (Avail ) hdisk32 (Avail )
vpath9 (Avail pv vpathvg) 02BFA067 = hdisk20 (Avail ) hdisk44 (Avail )
vpath10 (Avail pv vpathvg) 02CFA067 = hdisk21 (Avail ) hdisk45 (Avail )
vpath11 (Avail pv vpathvg) 02DFA067 = hdisk22 (Avail ) hdisk46 (Avail )
vpath12 (Avail pv vpathvg) 02EFA067 = hdisk23 (Avail ) hdisk47 (Avail )
vpath13 (Avail pv vpathvg) 02FFA067 = hdisk24 (Avail ) hdisk48 (Avail )
```

Figure 2. Output from the Display Data Path Device Configuration SMIT panel

The following information is displayed:

- The name of each SDD vpath device, such as vpath1.
- The configuration condition of the SDD vpath device. It is either Defined or Available. There is no failover protection if only one path is in the Available condition. At least two paths to each SDD vpath device must be in the Available condition to have failover protection.

**Example of vpath devices with or without failover protection:** vpath0, vpath1, or vpath2 has a single path and therefore does not have failover protection. The other ESS vpath devices each have two paths and thus can provide failover protection. The requirement for failover protection is that the ESS vpath device, and at least two hdisk devices making it up, must be in the Available condition.

**Attention:** The configuration condition also indicates whether or not the SDD vpath device is defined to AIX as a physical volume (pv flag). If pv is displayed for *both* SDD vpath devices and ESS hdisk devices, you might not have failover protection. Issue the **dpovgfix** command to fix this problem.

- The name of the volume group to which the device belongs, such as vpathvg
- The unit serial number of the ESS LUN, such as 019FA067
- The names of the AIX disk devices that comprise the SDD vpath devices, their configuration conditions, and the physical volume status.

You can also use the **datapath** command to display information about an SDD vpath device. This command displays the number of paths to the device. For example, the **datapath query device 10** command might produce this output:

```

DEV#: 10  DEVICE NAME: vpath10  TYPE: 2105B09  SERIAL: 02CFA067
-----
Path#    Adapter/Hard Disk  State   Mode    Select  Errors
  0      scsi6/hdisk21     OPEN   NORMAL  44      0
  1      scsi5/hdisk45     OPEN   NORMAL  43      0

```

The sample output shows that device vpath10 has two paths and both are operational.

## Configuring a volume group for failover protection

You can create a volume group with SDD vpath devices using the Logical Volume Groups SMIT panel. Choose the SDD vpath devices that have failover protection for the volume group.

It is possible to create a volume group that has only a single path (see Figure 2 on page 35) and then add paths later by reconfiguring the ESS. (See “Adding paths to SDD devices of a volume group” on page 20 for information about adding paths to a SDD device.) However, an SDD volume group does not have failover protection if any of its physical volumes only has a single path.

Perform the following steps to create a new volume group with SDD vpaths:

1. Type **smitty** from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type **smi t** to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **System Storage Management (Physical & Logical Storage)** and press Enter. The System Storage Management (Physical & Logical Storage) panel is displayed.
3. Select **Logical Volume Manager** and press Enter. The Volume Group panel is displayed.
4. Select **Volume Group** and press Enter. The Add Volume Group with Data Path Devices panel is displayed.
5. Select **Add Volume Group with Data Path Devices** and press Enter.

**Note:** Press F4 while highlighting the **PHYSICAL VOLUME names** field to list all the available SDD vpaths.

If you use a script file to create a volume group with SDD vpath devices, you must modify your script file and replace the **mkvg** command with the **mkvg4vp** command.

All the functions that apply to a regular volume group also apply to an SDD volume group. Use SMIT to create a logical volume group (mirrored, striped, or compressed) or a file system (mirrored, striped, or compressed) on an SDD volume group.

Once you create the volume group, AIX creates the SDD vpath device as a physical volume (pv). In Figure 2 on page 35, vpath9 through vpath13 are included in a volume group and they become physical volumes. To list all the physical volumes known to AIX, use the **lspv** command. Any ESS vpath devices that were created into physical volumes are included in the output similar to the following:

```

hdisk0      0001926922c706b2    rootvg
hdisk1      none                    None
...
hdisk10     none                    None
hdisk11     00000000e7f5c88a    None
...
hdisk48     none                    None
hdisk49     00000000e7f5c88a    None
vpath0      00019269aa5bc858    None
vpath1      none                    None
vpath2      none                    None
vpath3      none                    None
vpath4      none                    None
vpath5      none                    None
vpath6      none                    None
vpath7      none                    None
vpath8      none                    None
vpath9      00019269aa5bbadd    vpathvg
vpath10     00019269aa5bc4dc    vpathvg
vpath11     00019269aa5bc670    vpathvg
vpath12     000192697f9fd2d3    vpathvg
vpath13     000192697f9fde04    vpathvg

```

To display the devices that comprise a volume group, enter the **lsvg -p vg-name** command. For example, the **lsvg -p vpathvg** command might produce the following output:

```

PV_NAME      PV STATE  TOTAL PPs  FREE PPs  FREE DISTRIBUTION
vpath9       active    29         4         00..00..00..00..04
vpath10      active    29         4         00..00..00..00..04
vpath11      active    29         4         00..00..00..00..04
vpath12      active    29         4         00..00..00..00..04
vpath13      active    29         28        06..05..05..06..06

```

The example output indicates that the **vpathvg** volume group uses physical volumes vpath9 through vpath13.

## Importing a volume group with SDD

You can import a new volume group definition from a set of physical volumes with SDD vpath devices using the Volume Groups SMIT panel.

**Note:** To use this feature, you must either have root user authority or be a member of the system group.

**Attention:** SDD does not automatically create the *pvid* attribute in the ODM database for each vpath device. The AIX disk driver automatically creates the *pvid* attribute in the ODM database, if a *pvid* exists on the physical device. Therefore, the first time you import a new SDD volume group to a new cluster node, you must import the volume group using hdisks as physical volumes. Next, run the hd2vp conversion script (see “SDD utility programs” on page 50) to convert the volume group’s physical volumes from ESS hdisks to vpath devices. This conversion step not only creates *pvid* attributes for all vpath devices which belong to that imported volume group, it also deletes the *pvid* attributes for these vpath devices’ underlying hdisks. Later on you can import and vary on the volume group directly from the vpath devices. These special requirements apply to both concurrent and nonconcurrent volume groups.

Under certain conditions, the state of a *pvid* on a system is not always as we expected. So it is necessary to determine the state of a *pvid* as displayed by the **lspv** command, in order to select the appropriate action.

There are four scenarios:

**Scenario 1.** lspv displays pvid’s for both hdisks and vpath:

```
>lspv
hdisk1 003dfc10a11904fa None
hdisk2 003dfc10a11904fa None
vpath0 003dfc10a11904fa None
```

**Scenario 2.** lspv displays pvid’s for hdisks only:

```
>lspv
hdisk1 003dfc10a11904fa None
hdisk2 003dfc10a11904fa None
vpath0 none None
```

For both Scenario 1 and Scenario 2, the volume group should be imported using the disk names and then converted using the **hd2vp** command:

```
>importvg -y vg_name -V major# hdisk1
>hd2vp vg_name
```

**Scenario 3.** lspv displays the *pvid* for vpath only:

```
>lspv
hdisk1 none None
hdisk2 none None
vpath0 003dfc10a11904fa None
```

For Scenario 3, the volume group should be imported using the vpath name:

```
>importvg -y vg_name -V major# vpath0
```

**Scenario 4.** lspv does not display the *pvid* on the hdisks or the vpath:

```
>lspv
hdisk1 none None
hdisk2 none None
vpath0 none None
```

For Scenario 4, the *pvid* will need to be placed in the ODM for the vpath devices and then the volume group can be imported using the vpath name:

```
>chdev -l vpath0 -a pv=yes
>importvg -y vg_name -V major# vpath0
```

See “Special requirements” on page 32 for special requirements regarding

unconfiguring and removing the `ibmSdd_433.rte` or `ibmSdd_510nchacmp.rte` filesets for SDD 1.3.1.3 vpath devices.

Perform the following steps to import a volume group with SDD devices:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
  - The list items on the SMIT panel might be worded differently from one AIX version to another.
2. Select **System Storage Management (Physical & Logical Storage)** and press Enter. The System Storage Management (Physical & Logical Storage) panel is displayed.
  3. Select **Logical Volume Manager** and press Enter. The Volume Group panel is displayed.
  4. Select **Volume Groups** and press Enter. The Volume Groups panel is displayed.
  5. Select **Import a Volume Group** and press Enter. The Import a Volume Group panel is displayed.
  6. In the Import a Volume Group panel, perform the following tasks:
    - Type in the volume group you want to import.
    - Type in the physical volumes that you want to import over.
    - Press Enter after making all desired changes.

You can press the F4 key for a list of choices.

## Exporting a volume group with SDD

You can export a volume group definition from a set of physical volumes with SDD vpath devices using the Volume Groups SMIT panel.

The **exportvg** command removes the definition of the volume group specified by the Volume Group parameter from the system. Since all system knowledge of the volume group and its contents are removed, an exported volume group is no longer accessible. The **exportvg** command does not modify any user data in the volume group.

A volume group is a nonshared resource within the system; it should not be accessed by another system until it has been explicitly exported from its current system and imported on another. The primary use of the **exportvg** command, coupled with the **importvg** command, is to allow portable volumes to be exchanged between systems. Only a complete volume group can be exported, not individual physical volumes.

Using the **exportvg** command and the **importvg** command, you can also switch ownership of data on physical volumes shared between two systems.

**Note:** To use this feature, you must either have root user authority or be a member of the system group.

Perform the following steps to export a volume group with SDD devices:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **System Storage Management (Physical & Logical Storage)** and press Enter. The System Storage Management (Physical & Logical Storage) panel is displayed.
3. Select **Logical Volume Manager** and press Enter. The Volume Group panel is displayed.
4. Select **Volume Groups** and press Enter. The Volume Groups panel is displayed.
5. Select **Export a Volume Group** and press Enter. The Export a Volume Group panel is displayed.
6. Type in the volume group to export and press Enter.

You can use the F4 key to select which volume group you want to export.

## Losing failover protection

AIX can only create volume groups from disk (or pseudo) devices that are physical volumes. If a volume group is created using a device that is not a physical volume, AIX makes it a physical volume as part of the procedure of creating the volume group. A physical volume has a physical volume identifier (pvid) written on its sector 0 and also has a pvid attribute attached to the device attributes in the CuAt ODM. The `lspv` command lists all the physical volumes known to AIX. Here is a sample output from this command:

```

hdisk0      0001926922c706b2   rootvg
hdisk1      none                None
...
hdisk10     none                None
hdisk11     00000000e7f5c88a   None
...
hdisk48     none                None
hdisk49     00000000e7f5c88a   None
vpath0      00019269aa5bc858   None
vpath1      none                None
vpath2      none                None
vpath3      none                None
vpath4      none                None
vpath5      none                None
vpath6      none                None
vpath7      none                None
vpath8      none                None
vpath9      00019269aa5bbadd   vpathvg
vpath10     00019269aa5bc4dc   vpathvg
vpath11     00019269aa5bc670   vpathvg
vpath12     000192697f9fd2d3   vpathvg
vpath13     000192697f9fde04   vpathvg

```

In some cases, access to data is not lost, but failover protection might not be present. Failover protection can be lost in several ways:

- Through the loss of a device path.
- By creating a volume group from single-path vpath (pseudo) devices.
- As a side effect of running the disk change method.

- Through running the **mksysb restore** command.
- By manually deleting devices and running the configuration manager (**cfgmgr**).

The following sections provide more information about the ways that failover protection can be lost.

### Through the loss of a device path

Due to hardware errors, SDD might remove one or more paths to a vpath pseudo device. A pseudo device loses failover protection when it only has a single path. You can use the **datapath query device** command to show the state of paths to a pseudo device. You cannot use any Dead path for I/O operations.

### By creating a volume group from single-path vpath (pseudo) devices

A volume group created using any single-path pseudo devices does not have failover protection because there is no alternate path to the ESS LUN.

### As a side effect of running the disk change method

It is possible to modify attributes for an hdisk device by running the **chdev** command. The **chdev** command invokes the hdisk configuration method to make the requested change. In addition, the hdisk configuration method sets the pvid attribute for an hdisk if it determines that the hdisk has a pvid written on sector 0 of the LUN. This causes the vpath pseudo device and one or more of its hdisks to have the same pvid attribute in the ODM. If the volume group containing the vpath pseudo device is activated, the LVM uses the first device it finds in the ODM with the desired pvid to activate the volume group.

As an example, if you issue the **lsvpcfg** command, the following output is displayed:

```
vpath0 (Avail pv vpathvg) 018FA067 = hdisk1 (Avail )
vpath1 (Avail ) 019FA067 = hdisk2 (Avail )
vpath2 (Avail ) 01AFA067 = hdisk3 (Avail )
vpath3 (Avail ) 01BFA067 = hdisk4 (Avail ) hdisk27 (Avail )
vpath4 (Avail ) 01CFA067 = hdisk5 (Avail ) hdisk28 (Avail )
vpath5 (Avail ) 01DFA067 = hdisk6 (Avail ) hdisk29 (Avail )
vpath6 (Avail ) 01EFA067 = hdisk7 (Avail ) hdisk30 (Avail )
vpath7 (Avail ) 01FFA067 = hdisk8 (Avail ) hdisk31 (Avail )
vpath8 (Avail ) 020FA067 = hdisk9 (Avail ) hdisk32 (Avail )
vpath9 (Avail pv vpathvg) 02BFA067 = hdisk20 (Avail ) hdisk44 (Avail )
vpath10 (Avail pv vpathvg) 02CFA067 = hdisk21 (Avail ) hdisk45 (Avail )
vpath11 (Avail pv vpathvg) 02DFA067 = hdisk22 (Avail ) hdisk46 (Avail )
vpath12 (Avail pv vpathvg) 02EFA067 = hdisk23 (Avail ) hdisk47 (Avail )
vpath13 (Avail pv vpathvg) 02FFA067 = hdisk24 (Avail ) hdisk48 (Avail )
```

The following example of a **chdev** command could also set the pvid attribute for an hdisk:

```
chdev -l hdisk46 -a queue_depth=30
```

For this example, the output of the **lsvpcfg** command would look similar to this:

```

vpath0 (Avail pv vpathvg) 018FA067 = hdisk1 (Avail )
vpath1 (Avail ) 019FA067 = hdisk2 (Avail )
vpath2 (Avail ) 01AFA067 = hdisk3 (Avail )
vpath3 (Avail ) 01BFA067 = hdisk4 (Avail ) hdisk27 (Avail )
vpath4 (Avail ) 01CFA067 = hdisk5 (Avail ) hdisk28 (Avail )
vpath5 (Avail ) 01DFA067 = hdisk6 (Avail ) hdisk29 (Avail )
vpath6 (Avail ) 01EFA067 = hdisk7 (Avail ) hdisk30 (Avail )
vpath7 (Avail ) 01FFA067 = hdisk8 (Avail ) hdisk31 (Avail )
vpath8 (Avail ) 020FA067 = hdisk9 (Avail ) hdisk32 (Avail )
vpath9 (Avail pv vpathvg) 02BFA067 = hdisk20 (Avail ) hdisk44 (Avail )
vpath10 (Avail pv vpathvg) 02CFA067 = hdisk21 (Avail ) hdisk45 (Avail )
vpath11 (Avail pv vpathvg) 02DFA067 = hdisk22 (Avail ) hdisk46 (Avail pv vpathvg)
vpath12 (Avail pv vpathvg) 02EFA067 = hdisk23 (Avail ) hdisk47 (Avail )
vpath13 (Avail pv vpathvg) 02FFA067 = hdisk24 (Avail ) hdisk48 (Avail )

```

The output of the **lsvpcfg** command shows that vpath11 contains hdisk22 and hdisk46. However, hdisk46 is the one with the pv attribute set. If you run the **lsvg -p vpathvg** command again, you might see something like this:

```

vpathvg:
PV_NAME          PV STATE   TOTAL PPs   FREE PPs   FREE DISTRIBUTION
vpath10         active     29          4          00..00..00..00..04
hdisk46       active     29          4          00..00..00..00..04
vpath12         active     29          4          00..00..00..00..04
vpath13         active     29          28         06..05..05..06..06

```

Notice that now device vpath11 has been replaced by hdisk46. That is because hdisk46 is one of the hdisk devices included in vpath11 and it has a pvid attribute in the ODM. In this example, the LVM used hdisk46 instead of vpath11 when it activated volume group vpathvg. The volume group is now in a mixed mode of operation because it partially uses vpath pseudo devices and partially uses hdisk devices. This is a problem that must be fixed because failover protection is effectively disabled for the vpath11 physical volume of the vpathvg volume group.

**Note:** The way to fix this problem with the mixed volume group is to run the **dpovgfix vg-name** command after running the **chdev** command.

### By manually deleting devices and running the configuration manager (cfgmgr)

Assume that vpath3 is made up of hdisk4 and hdisk27 and that vpath3 is currently a physical volume. If the vpath3, hdisk4, and hdisk27 devices are all deleted by using the **rmdev** command and then **cfgmgr** is invoked at the command line, only one path of the original vpath3 is configured by AIX. The following commands would produce this situation:

```

rmdev -d1 vpath3 rmdev -d1 hdisk4 rmdev -d1 hdisk27
cfgmgr

```

The **datapath query device** command displays the vpath3 configuration status.

Next, all paths to the vpath must be restored. You can restore the paths in one of the following ways:

- Issue **cfgmgr** once for each installed SCSI or fibre-channel adapter.
- Issue **cfgmgr n** times, where *n* represents the number of paths per SDD device.

**Tip:** Running the AIX configuration manager (**cfgmgr**) *n* times for *n*-path configurations of ESS devices is not always required. It depends on whether the ESS device has been used as a physical volume of a volume group or not. If it has, it is necessary to run **cfgmgr n** times for an *n*-path configuration. Since the ESS device has been used as a physical volume of a volume group before, it



has a pvid value written on its sector 0. When the first SCSI or fibre adapter is configured by **cfgmgr**, the AIX disk driver configuration method creates a pvid attribute in the AIX ODM database with the pvid value it read from the device. It then creates a logical name (hdiskN), and puts the hdiskN in the Defined condition. When the second adapter is configured, the AIX disk driver configuration method reads the pvid from the same device again, and searches the ODM database to see if there is already a device with the same pvid in the ODM. If there is a match, and that hdiskN is in a Defined condition, the AIX disk driver configuration method does not create another hdisk logical name for the same device. That is why only one set of hdisks gets configured the first time **cfgmgr** runs. When **cfgmgr** runs for the second time, the first set of hdisks are in the Available condition, so a new set of hdisks are Defined and configured to the Available condition. That is why you must run **cfgmgr** *n* times to get *n* paths configured. If the ESS device has never belonged to a volume group, that means there is no pvid written on its sector 0. In that case, you only need to run **cfgmgr** command once to get all multiple paths configured.

**Note:**

The **addpaths** command allows you to dynamically add more paths to Subsystem Device Driver devices while they are in Available state. In addition, this command allows you to add paths to vpath devices (which are then opened) belonging to active volume groups.

This command will open a new path (or multiple paths) automatically if the vpath is in the Open state, and the original number of paths of the vpath is more than one. You can use either the Add Paths to Available Data Path Devices SMIT panel, or run the **addpaths** command from the AIX command line. Go to “Adding paths to SDD devices of a volume group” on page 20 section for more information about the **addpaths** command.

SDD does not support the **addpaths** command for AIX 4.2.1.

If you have the `ibmSdd_421.rte` fileset installed, you can run the **cfgmgr** command instead of restarting the system after all the ESS hdisk devices are restored, you must unconfigure *all* SDD devices to the Defined condition. Then reconfigure the SDD devices to the Available condition in order to restore all paths to the SDD (vpath) devices.

The following command shows an example of how to unconfigure an SDD device to the Defined condition using the command-line interface:

```
rmdev -l vpathN
```

The following command shows an example of how to unconfigure *all* SDD devices to the Defined condition using the command-line interface:

```
rmdev -l dpo -R
```

The following command shows an example of how to configure a vpath device to the Available condition using the command-line interface:

```
mkdev -l vpathN
```

The following command shows an example of how to configure all vpath devices to the Available condition using the SMIT:

```
smitty device
```

The following command shows an example of how to configure all vpath devices to the Available condition using the command-line interface:

```
cfallvpath
```

### Recovering from mixed volume groups

Run the `dpovgfix` shell script to recover a mixed volume group. The syntax is **`dpovgfix vg-name`**. The script tries to find a pseudo device corresponding to each `hdisk` in the volume group and replaces the `hdisk` with the `vpath` pseudo device. In order for the shell script to be executed, all mounted file systems of this volume group have to be unmounted. After successful completion of the `dpovgfix` shell script, mount the file systems again.

### Extending an existing Subsystem Device Driver volume group

You can extend a volume group with SDD `vpath` devices using the Logical Volume Groups SMIT panel. The SDD `vpath` devices to be added to the volume group should be chosen from those that can provide failover protection. It is possible to add an SDD `vpath` device to an SDD volume group that has only a single path (`vpath0` in Figure 2 on page 35) and then add paths later by reconfiguring the ESS. With a single path, failover protection is not provided. (See “Adding paths to SDD devices of a volume group” on page 20 for information about adding paths to an SDD device.)

Perform the following steps to extend a volume group with SDD devices:

1. Type `smi` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **System Storage Management (Physical & Logical Storage)** and press Enter. The System Storage Management (Physical & Logical Storage) panel is displayed.
3. Select **Logical Volume Manager** and press Enter. The Volume Group panel is displayed.
4. Select **Volume Group** and press Enter. The Add Volume Group with Data Path Devices panel is displayed.
5. Select **Add Volume Group with Data Path Devices** and press Enter.
6. Type in the volume group name and physical volume name and press Enter. You can also use the F4 key to list all the available SDD devices, and you can select the devices you want to add to the volume group.

If you use a script file to extend an existing SDD volume group, you must modify your script file and replace the `extendvg` command with the `extendvg4vp` command.

### Backing-up all files belonging to a Subsystem Device Driver volume group

You can back up all files belonging to a specified volume group with Subsystem Device Driver `vpath` devices using the Volume Groups SMIT panel.

To backup a volume group with SDD devices, go to “Accessing the Back Up a Volume Group with Data Path Devices SMIT panel” on page 49.

If you use a script file to back up all files belonging to a specified SDD volume group, you must modify your script file and replace the **savevg** command with the **savevg4vp** command.

**Attention:** Backing-up files (running the **savevg4vp** command) will result in the loss of all material previously stored on the selected output medium. Data integrity of the archive may be compromised if a file is modified during system backup. Keep system activity at a minimum during the system backup procedure.

### Restoring all files belonging to a Subsystem Device Driver volume group

You can restore all files belonging to a specified volume group with Subsystem Device Driver vpath devices using the Volume Groups SMIT panel.

To restore a volume group with SDD devices and go to “Accessing the Remake a Volume Group with Data Path Devices SMIT panel” on page 50.

If you use a script file to restore all files belonging to a specified SDD volume group, you must modify your script file and replace the **restvg** command with the **restvg4vp** command.

### SDD-specific SMIT panels

SDD supports several special SMIT panels. Some SMIT panels provide SDD-specific functions, while other SMIT panels provide AIX functions (but requires SDD-specific commands). For example, the Add a Volume Group with Data Path Devices function uses the SDD **mkvg4vp** command, instead of the AIX **mkvg** command. Table 17 lists the SDD-specific SMIT panels and how you can use them.

Table 17. SDD-specific SMIT panels and how to proceed

SMIT panels	How to proceed:
Display Data Path Device Configuration	Go to: “Accessing the Display Data Path Device Configuration SMIT panel” on page 46
Display Data Path Device Status	“Accessing the Display Data Path Device Status SMIT panel” on page 46
Display Data Path Device Adapter Status	“Accessing the Display Data Path Device Adapter Status SMIT panel” on page 46
Define and Configure all Data Path Devices	“Accessing the Define and Configure All Data Path Devices SMIT panel” on page 47
Add Paths to Available Data Path Devices <b>Note:</b> SDD does not support the <b>addpaths</b> command for AIX 4.2.1; it supports this command for AIX 4.3.2 or higher.	“Accessing the Add Paths to Available Data Path Devices SMIT panel” on page 47
Configure a Defined Data Path Device	“Accessing the Configure a Defined Data Path Device SMIT panel” on page 47
Remove a Data Path Device	“Accessing the Remove a Data Path Device SMIT panel” on page 48
Add a Volume Group with Data Path Devices	“Accessing the Add a Volume Group with Data Path Devices SMIT panel” on page 48
Add a Data Path Volume to a Volume Group	“Accessing the Add a Data Path Volume to a Volume Group SMIT panel” on page 48

Table 17. SDD-specific SMIT panels and how to proceed (continued)

Remove a copy from a datapath Logical Volume	“Accessing the Remove a copy from a datapath Logical Volume SMIT panel” on page 49
Back Up a Volume Group with Data Path Devices	“Accessing the Back Up a Volume Group with Data Path Devices SMIT panel” on page 49
Remake a Volume Group with Data Path Devices	“Accessing the Remake a Volume Group with Data Path Devices SMIT panel” on page 50

**Accessing the Display Data Path Device Configuration SMIT panel:** Perform the following steps to access the Display Data Path Device Configuration panel:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **Devices** and press Enter. The Devices panel is displayed.
3. Select **Data Path Devices** and press Enter. The Data Path Devices panel is displayed.
4. Select **Display Data Path Device Configuration** and press Enter.

**Accessing the Display Data Path Device Status SMIT panel:** Perform the following steps to access the Display Data Path Device Status panel:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **Devices** and press Enter. The Devices panel is displayed.
3. Select **Data Path Devices** and press Enter. The Data Path Devices panel is displayed.
4. Select **Display Data Path Device Status** and press Enter.

**Accessing the Display Data Path Device Adapter Status SMIT panel:** Perform the following steps to access the Display Data Path Device Status panel:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **Devices** and press Enter. The Devices panel is displayed.

3. Select **Data Path Devices** and press Enter. The Data Path Devices panel is displayed.
4. Select **Display Data Path Device Status** and press Enter.

**Accessing the Define and Configure All Data Path Devices SMIT panel:** To access the Define and Configure All Data Path Devices panel, perform the following steps:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **Devices** and press Enter. The Devices panel is displayed.
3. Select **Data Path Devices** and press Enter. The Data Path Devices panel is displayed.
4. Select **Define and Configure All Data Path Devices** and press Enter.

**Accessing the Add Paths to Available Data Path Devices SMIT panel:** Perform the following steps to access the Add Paths to Available Data Path Devices panel:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **Devices** and press Enter. The Devices panel is displayed.
3. Select **Data Path Devices** and press Enter. The Data Path Devices panel is displayed.
4. Select **Add Paths to Available Data Path Devices** and press Enter.

**Note:** This SMIT panel is not available if you have the `ibmSdd_421.rte` fileset installed. SDD does not support the **addpaths** command for AIX 4.2.1; it supports this command for AIX 4.3.2 or higher.

**Accessing the Configure a Defined Data Path Device SMIT panel:** Perform the following steps to access the Configure a Defined Data Path Device panel:

1. Type `SMITTY` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **Devices** and press Enter. The Devices panel is displayed.

3. Select **Data Path Devices** and press Enter. The Data Path Devices panel is displayed.
4. Select **Configure a Defined Data Path Device** and press Enter.

**Accessing the Remove a Data Path Device SMIT panel:** Perform the following steps to access the Remove a Data Path Device panel:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **Devices** and press Enter. The Devices panel is displayed.
3. Select **Data Path Devices** and press Enter. The Data Path Devices panel is displayed.
4. Select **Remove a Data Path Device** and press Enter.

**Accessing the Add a Volume Group with Data Path Devices SMIT panel:**

Perform the following steps to access the Add a volume group with data path devices panel:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **System Storage Management (Physical & Logical Storage)** and press Enter. The System Storage Management (Physical & Logical Storage) panel is displayed.
3. Select **Logical Volume Manager** and press Enter. The Volume Group panel is displayed.
4. Select **Volume Groups** and press Enter. The Add Volume Group with Data Path Devices panel is displayed.
5. Select **Add Volume Group with Data Path Devices** and press Enter.

**Note:** Press F4 while highlighting the **PHYSICAL VOLUME names** field to list all the available SDD vpaths.

**Accessing the Add a Data Path Volume to a Volume Group SMIT panel:**

Perform the following steps to access the Add a Data Path Volume to a Volume Group panel:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.

- The list items on the SMIT panel might be worded differently from one AIX version to another.
2. Select **System Storage Management (Physical & Logical)** and press Enter. The System Storage Management (Physical & Logical) panel is displayed.
  3. Select **Logical Volume Manager** and press Enter. The Logical Volume Manager panel is displayed.
  4. Select **Volume Group** and press Enter. The Volume Group panel is displayed.
  5. Select **Add a Data Path Volume to a Volume Group** and press Enter.
  6. Type the volume group name and physical volume name and press Enter. Alternately, you can use the F4 key to list all the available SDD vpath devices and use the F7 key to select the physical volumes you want to add.

***Accessing the Remove a copy from a datapath Logical Volume SMIT panel:***

Perform the following steps to access the Remove a copy from a datapath Logical Volume panel:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
  - The list items on the SMIT panel might be worded differently from one AIX version to another.
2. Select **Logical Volume manager** and press Enter. The Logical Volume manager panel is displayed.
  3. Select **Volume Groups** and press Enter. The Volume Groups panel is displayed.
  4. Select **Set Characteristics of a Volume Group** and press Enter. The Set Characteristics of a Volume Group panel is displayed.
  5. Select **Remove a Copy from a datapath Logical Volume** and press Enter. The Remove a Physical Volume from a Volume Group panel is displayed.

***Accessing the Back Up a Volume Group with Data Path Devices SMIT panel:***

Perform the following steps to access the Back Up a Volume Group with Data Path Devices panel and to backup a volume group with SDD devices:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
  - The list items on the SMIT panel might be worded differently from one AIX version to another.
2. Select **System Storage Management (Physical & Logical Storage)** and press Enter. The System Storage Management (Physical & Logical Storage) panel is displayed.
  3. Select **Logical Volume Manager** and press Enter. The Volume Group panel is displayed.
  4. Select **Volume Groups** and press Enter. The Volume Groups panel is displayed.

5. Select **Back Up a Volume Group with Data Path Devices** and press Enter. The Back Up a Volume Group with Data Path Devices panel is displayed.
6. In the Back Up a Volume Group with Data Path Devices panel, perform the following steps:
  - Type in the Backup DEVICE or FILE name.
  - Type in the Volume Group to back up.
  - Press Enter after making all desired changes.

**Tip:** You can also use the F4 key to list all the available SDD devices, and you can select the devices or files you want to backup.

**Attention:** Backing-up files (running the **savevg4vp** command) will result in the loss of all material previously stored on the selected output medium. Data integrity of the archive may be compromised if a file is modified during system backup. Keep system activity at a minimum during the system backup procedure.

***Accessing the Remake a Volume Group with Data Path Devices SMIT panel:***

Perform the following steps to access the Remake a Volume Group with Data Path Devices panel and restore a volume group with SDD devices:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smitt` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **System Storage Management (Physical & Logical Storage)** and press Enter. The System Storage Management (Physical & Logical Storage) panel is displayed.
3. Select **Logical Volume Manager** and press Enter. The Volume Group panel is displayed.
4. Select **Volume Groups** and press Enter. The Volume Groups panel is displayed.
5. Select **Remake a Volume Group with Data Path Devices** and press Enter. The Remake a Volume Group with Data Path Devices panel is displayed.
6. Type in the Restore DEVICE or FILE name, and press Enter. You can also use the F4 key to list all the available SDD devices, and you can select the devices or files you want to restore.

***SDD utility programs:***

**addpaths:** You can use the **addpaths** command to dynamically add more paths to SDD devices while they are in the Available state. In addition, this command allows you to add paths to vpath devices (which are then opened) belonging to active volume groups.

This command will open a new path (or multiple paths) automatically if the vpath is in OPEN state, and the original number of path of the vpath is more than one. You can use either the Add Paths to Available Data Path Devices SMIT panel, or run the **addpaths** command from the AIX command line.



SDD does not support the **addpaths** command for AIX 4.2.1. It is not available if you have the `ibmSdd_421.rte` fileset installed. SDD supports the **addpaths** command for AIX 4.3.2 or higher.

For more information about this command, go to “Adding paths to SDD devices of a volume group” on page 20.

*hd2vp and vp2hd:* SDD provides two conversion scripts, `hd2vp` and `vp2hd`. The `hd2vp` script converts a volume group from ESS hdisks into SDD vpaths, and the `vp2hd` script converts a volume group from SDD vpaths into ESS hdisks. Use the `vp2hd` program when you want to configure your applications back to original ESS hdisks, or when you want to remove the SDD from your AIX host system.

**Note:** You must convert all your applications and volume groups to the original ESS hdisk device special files before removing SDD.

The syntax for these conversion scripts is as follows:

```
hd2vp  vgname
vp2hd  vgname
```

These two conversion programs require that a volume group contain either *all* original ESS hdisks or *all* SDD vpaths. The program fails if a volume group contains both kinds of device special files (mixed volume group).

**Tip:** Always use SMIT to create a volume group of SDD devices. This avoids the problem of a mixed volume group.

*dpovgfix:* You can use the `dpovgfix` script tool to recover mixed volume groups.

Performing AIX system management operations on adapters and ESS hdisk devices can cause original ESS hdisks to be contained within a SDD volume group. This is known as a mixed volume group. Mixed volume groups happen when a SDD volume group is inactivated (varied off), and certain AIX commands to the hdisk put the `pvid` attribute of hdisk back into the ODM database. The following is an example of a command that does this:

```
chdev -l hdiskN -a queue_depth=30
```

If this disk is an active hdisk of a vpath that belongs to an SDD volume group, and you run the **varyonvg** command to activate this SDD volume group, LVM might pick up the hdisk device rather than the vpath device. The result is that an SDD volume group partially uses SDD vpath devices, and partially uses ESS hdisk devices. The result is the volume group loses path failover capability for that physical volume. The `dpovgfix` script tool fixes this problem. The command syntax is:

```
dpovgfix vg-name
```

*lsvpcfg:* You can use the `lsvpcfg` script tool to display the configuration status of SDD devices. This displays the configuration status for all SDD devices. The **lsvpcfg** command can be issued in two ways.

1. The command can be issued without parameters. The command syntax is:

```
lsvpcfg
```

See “Verifying the SDD configuration” on page 18 for an example of the output and what it means.

2. The command can also be issued using the vpath device name as a parameter. The command syntax is:

```
lsvpcfg vpathN0 vpathN1 vpathN2
```

You will see output similar to this:

```
vpath10 (Avail pv ) 13916392 = hdisk95 (Avail ) hdisk179 (Avail )  
vpath20 (Avail ) 02816392 = hdisk23 (Avail ) hdisk106 (Avail )  
vpath30 (Avail ) 10516392 = hdisk33 (Avail ) hdisk116 (Avail )
```

See “Verifying the SDD configuration” on page 18 for an explanation of the output.

*mkvg4vp*: You can use the **mkvg4vp** command to create an SDD volume group. For more information about this command, go to “Configuring a volume group for failover protection” on page 36.

*extendvg4vp*: You can use the **extendvg4vp** command to extend an existing SDD volume group. For more information about this command, go to “Extending an existing Subsystem Device Driver volume group” on page 44.

## Using ESS devices directly

After you configure the SDD, it creates SDD devices (vpath devices) for ESS LUNs. ESS LUNs are accessible through the connection between the AIX host server SCSI or FCP adapter and the ESS ports. The AIX disk driver creates the original or ESS devices (hdisks). Therefore, with SDD, an application now has two ways in which to access ESS devices.

To use the SDD load-balancing and failover features and access ESS devices, your application must use the SDD vpath devices rather than the ESS hdisk devices.

Two types of applications use ESS disk storage. One type of application accesses ESS devices through the SDD vpath device (raw device). The other type of application accesses ESS devices through the AIX logical volume manager (LVM). For this type of application, you must create a volume group with the SDD vpath devices.

If your application used ESS hdisk device special files directly before installing SDD, convert it to using the SDD vpath device special files. After installing SDD, perform the following steps:

1. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smi t` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

2. Select **Devices** and press Enter. The Devices panel is displayed.
3. Select **Data Path Devices** and press Enter. The Data Path Devices panel is displayed.
4. Select **Display Data Path Device Configuration**. The system displays all SDD vpaths with their attached multiple paths (hdisks).

5. Search the list of hdisks to locate the hdisks your application is using.
6. Replace each hdisk with its corresponding SDD vpath device.

**Note:** Depending upon your application, the manner in which you replace these files is different. If this is a new application, use the SDD vpath rather than hdisk to use the SDD load-balancing and failover features.

**Note:** Alternately, you can type `lsvpcfg` from the command-line interface rather than using SMIT. This displays all configured SDD vpath devices and their underlying paths (hdisks).

## Using ESS devices through AIX LVM

### Attention:

- You must use the System Management Interface Tool (SMIT). The SMIT facility runs in two interfaces, nongraphical (type `smitty` to invoke the nongraphical user interface) or graphical (type `SMIT` to invoke the graphical user interface).
- Do not use the **mkvg** command directly. Otherwise, the path failover capability could be lost.

If your application accesses ESS devices through LVM, determine the volume group that it uses before you convert volume groups. Then, perform the following steps to convert the volume group from the original ESS device hdisks to the SDD vpaths:

1. Determine the file systems or logical volumes that your application accesses.
2. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.
3. Select **System Storage Management (Physical & Logical Storage)** and press Enter. The System Storage Management (Physical & Logical Storage) panel is displayed.
4. Select **Logical Volume Manager** and press Enter. The Logical Volume Manager panel is displayed.
5. Select **Logical Volume** and press Enter. The Logical Volume panel is displayed.
6. Select **List All Logical Volumes by Volume Group** to determine the logical volumes that belong to this volume group and their logical volume mount points.
7. Press Enter. The logical volumes are listed by volume group.

To determine the file systems, perform the following steps:

- a. Type `smitty` from your desktop window. The System Management Interface Tool is displayed.
  - b. Select **Logical Volume Manager** and press Enter. The Logical Volume Manager panel is displayed.
  - c. Select **File Systems** and press Enter. The File Systems panel is displayed.
  - d. Select **List All File Systems** to locate all file systems that have the same mount points as the logical volumes.
  - e. Press Enter. The file systems are listed.
  - f. Note the file system name of that volume group and the file system mount point, if it is mounted.
  - g. Unmount these file systems.
8. Enter the following to convert the volume group from the original ESS hdisks to SDD vpaths:

```
hd2vp vgroupname
```

9. When the conversion is complete, mount all file systems that you previously unmounted.

When the conversion is complete, your application now accesses ESS physical LUNs through SDD vpath devices. This provides load balancing and failover protection for your application.

## Migrating a non-SDD volume group to an ESS SDD multipath volume group in concurrent mode

Before you migrate your non-SDD volume group to an SDD volume group, make sure that you have completed the following tasks:

- The SDD for the AIX host system is installed and configured. To see if SDD is installed, issue one of the following commands:

```
lslpp -l ibmSdd_421.rte
lslpp -l ibmSdd_432.rte
lslpp -l ibmSdd_433.rte
lslpp -l ibmSdd_510.rte
lslpp -l ibmSdd_510nchacmp.rte
```

An example of output from the **lslpp** command is:

Fileset	Level	State	Description
Path: /usr/lib/objrepos ibmSdd_432.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V432 V433 for concurrent HACMP
Path: /etc/objrepos ibmSdd_432.rte	1.3.1.3	COMMITTED	IBM Subsystem Device Driver AIX V432 V433 for concurrent HACMP

- The ESS subsystem devices to which you want to migrate have multiple paths configured per LUN. To check the status of your SDD configuration, use the System Management Interface Tool (SMIT) or issue the **lsvpcfg** command from the command line. To use SMIT:
  - Type **smitty** and press Enter from your desktop window. The System Management Interface Tool panel is displayed.
  - Tip:**
    - The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type **smit** to invoke the graphical user interface.
    - The list items on the SMIT panel might be worded differently from one AIX version to another.
  - Select **Devices** and press Enter. The Devices panel is displayed.
  - Select **Data Path Device** and press Enter. The Data Path Device panel is displayed.
  - Select **Display Data Path Device Configuration** and press Enter. A list is displayed of the pseudo devices and whether there are multiple paths configured for the devices.
- Make sure the SDD vpath devices you are going to migrate to do not belong to any other volume group, and that the corresponding physical device (ESS LUN) does not have a pvid written on it. Issue the **lsvpcfg** command output to check the SDD vpath devices that you are going to use for migration. Make sure there is no pv displayed for this vpath and its paths (hdisks). If a LUN has never

belonged to any volume group, there is no pvid written on it. In case there is a pvid written on the LUN and the LUN does not belong to any volume group, you need to clear the pvid from the LUN before using it to migrate a volume group. The commands to clear the pvid are:

```
chdev -l hdiskN -a pv=clear
chdev -l vpathN -a pv=clear
```

**Attention:** Exercise care when clearing a pvid from a device with this command. Issuing this command to a device that *does* belong to an existing volume group can cause system failures.

You should complete the following steps to migrate a non-SDD volume group to a multipath SDD volume group in concurrent mode:

1. Add new SDD vpath devices to an existing non-SDD volume group:
    - a. Type `smitty` and press Enter from your desktop window. The System Management Interface Tool panel is displayed.
- Tip:**
- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smit` to invoke the graphical user interface.
  - The list items on the SMIT panel might be worded differently from one AIX version to another.
- b. Select **System Storage Management (Physical & Logical)** and press Enter. The System Storage Management (Physical & Logical) panel is displayed.
  - c. Select **Logical Volume Manager** and press Enter. The Logical Volume Manager panel is displayed.
  - d. Select **Volume Group** and press Enter. The Volume Group panel is displayed.
  - e. Select **Add a Data Path Volume to a Volume Group** and press Enter.
  - f. Type the volume group name and physical volume name and press Enter. Alternately, you can use the F4 key to list all the available SDD vpath devices and use the F7 key to select the physical volumes you want to add.
2. Mirror logical volumes from the original volume to a Subsystem Device Driver ESS volume. Issue the command:

```
smitty mklvcopy
```

Use the new Subsystem Device Driver vpath devices for copying all logical volumes. Do not forget to include JFS log volumes.

**Note:** The command `smitty mklvcopy` copies one logical volume at a time. A fast-path command to mirror *all* the logical volumes on a volume group is **mirrorvg**.

3. Synchronize logical volumes (LVs) or force synchronization. Issue the following command to synchronize all the volumes:

```
smitty syncvg
```

There are two options on the `smitty` panel:

- Synchronize by Logical Volume
- Synchronize by Physical Volume

The fast way to synchronize logical volumes is to select the **Synchronize by Physical Volume** option.

4. Remove the mirror and delete the original LVs. Type the following command to remove the original copy of the logical volumes from all original non-Subsystem Device Driver physical volumes:

```
smitty rmlvcopy
```

5. Remove the original non-Subsystem Device Driver devices from the volume group. Type the following command:

```
smitty reducevg
```

The Remove a Physical Volume panel is displayed. Remove all non-SDD devices.

**Note:** A non-SDD volume group can consist of non-ESS or ESS hdisk devices. There is no failover protection unless multiple paths are configured for each LUN.

### Migrating an existing non-SDD volume group to SDD vpath devices in concurrent mode

This procedure shows how to migrate an existing AIX volume group to use SDD vpath (pseudo) devices that have multipath capability. You do not take the volume group out of service. The example shown starts with a volume group, vg1, made up of one ESS device, hdisk13.

To perform the migration, you must have vpath devices available that are greater than or equal to the size of each of the hdisks making up the volume group. In this example, we have a pseudo device, vpath12, with two paths, hdisk14 and hdisk30, that we will migrate the volume group to.

1. Add the vpath device to the volume group as an Available volume:
  - a. Type `smitty` and press Enter from your desktop window. The System Management Interface Tool panel is displayed.

**Tip:**

- The SMIT facility runs in two interfaces, nongraphical and graphical. This procedure uses the nongraphical interface. You can type `smit` to invoke the graphical user interface.
- The list items on the SMIT panel might be worded differently from one AIX version to another.

- b. Select **System Storage Management (Physical & Logical)** and press Enter. The System Storage Management (Physical & Logical) panel is displayed.
- c. Select **Logical Volume Manager** and press Enter. The Logical Volume Manager panel is displayed.
- d. Select **Volume Group** and press Enter. The Volume Group panel is displayed.
- e. Select **Add a Data Path Volume to a Volume Group** and press Enter.
- f. Type `vg1` in the **Volume Group Name** field. Type `vpath12` in the **Physical Volume Name** field. Press Enter.

You can also type the command:

```
extendvg4vp -f vg1 vpath12
```

2. Mirror logical volumes from the original volume to the new SDD vpath volume:
  - a. Type `smitty` and press Enter from your desktop window. The System Management Interface Tool panel is displayed.

- b. Select **System Storage Management (Physical & Logical)** and press Enter. The System Storage Management (Physical & Logical) panel is displayed.
  - c. Select **Logical Volume Manager** and press Enter. The Logical Volume Manager panel is displayed.
  - d. Select **Volume Group** and press Enter. The Volume Group panel is displayed.
  - e. Select **Mirror a Volume Group** and press Enter. The Mirror a Volume Group panel is displayed.
  - f. Type a volume group name. Type a physical volume name. Press Enter.  
You can also type the command:  

```
mirrorvg vg1 vpath12
```
3. Synchronize the logical volumes in the volume group:
    - a. Type `smitty` and press Enter from your desktop window. The System Management Interface Tool panel is displayed.
    - b. Select **System Storage Management (Physical & Logical)** and press Enter. The System Storage Management (Physical & Logical) panel is displayed.
    - c. Select **Logical Volume Manager** and press Enter. The Logical Volume Manager panel is displayed.
    - d. Select **Volume Group** and press Enter. The Volume Group panel is displayed.
    - e. Select **Synchronize LVM Mirrors** and press Enter. The Synchronize LVM Mirrors panel is displayed.
    - f. Select **Synchronize by Physical Volume**.

You can also type the command:  

```
syncvg -p hdisk13 vpath12
```
  4. Delete copies of all logical volumes from the original physical volume:
    - a. Type `smitty` and press Enter from your desktop window. The System Management Interface Tool panel is displayed.
    - b. Select **Logical Volumes** and press Enter. The Logical Volumes panel is displayed.
    - c. Select **Set Characteristic of a Logical Volume** and press Enter. The Set Characteristic of a Logical Volume panel is displayed.
    - d. Select **Remove Copy from a Logical Volume** and press Enter. The Remove Copy from a Logical Volume panel is displayed.

You can also type the command:  

```
rmlvcopy loglv01  
1 hdisk13 and rmlvcopy lv01 1 hdisk13
```
  5. Remove the old physical volume from the volume group:
    - a. Type `smitty` and press Enter from your desktop window. The System Management Interface Tool panel is displayed.
    - b. Select **Logical Volume manager** and press Enter. The Logical Volume manager panel is displayed.
    - c. Select **Volume Groups** and press Enter. The Volume Groups panel is displayed.
    - d. Select **Set Characteristics of a Volume Group** and press Enter. The Set Characteristics of a Volume Group panel is displayed.

- e. Select **Remove a Physical Volume from a Volume Group** and press Enter. The Remove a Physical Volume from a Volume Group panel is displayed.

You can also type the command:

```
reducevg vg1 hdisk13
```

## Using the trace function

SDD supports AIX trace functions. The SDD trace ID is 2F8. Trace ID 2F8 traces routine entry, exit, and error paths of the algorithm. To use it, manually turn on the trace function before the program starts to run, then turn off the trace function either after the program stops, or any time you need to read the trace report. To start the trace function, type:

```
trace -a -j 2F8
```

To stop the trace function, type:

```
trcstop
```

To read the report, type:

```
trcrpt | pg
```

**Note:** To perform the AIX trace function, you must have the bos.sysmgt.trace fileset installed on your system.

## Error log messages

SDD logs error conditions into the AIX errlog system. To check if SDD has generated an error log message, type the following command:

```
errpt -a | grep VPATH
```

The following list shows the SDD error log messages and explains each one:

### **VPATH\_XBUF\_NOMEM**

An attempt was made to open an SDD vpath file and to allocate kernel-pinned memory. The system returned a null pointer to the calling program and kernel-pinned memory was not available. The attempt to open the file failed.

### **VPATH\_PATH\_OPEN**

SDD device file failed to open one of its paths (hdisks). An attempt to open a vpath device is successful if at least one attached path opens. The attempt to open a vpath device fails only when *all* the vpath device paths fail to open.

### **VPATH\_DEVICE\_OFFLINE**

Several attempts to retry an I/O request for a vpath device on a path have failed. The path state is set to Dead and the path is taken offline. Issue the **datapath** command to set the offline path to online. For more information, see “Chapter 7. Using the datapath commands” on page 125.

### **VPATH\_DEVICE\_ONLINE**

SDD supports Dead path auto\_failback and Dead path reclamation. A Dead path is selected to send an I/O, after it has been bypassed by 2000 I/O requests on an operational path. If the I/O is successful, the Dead path is put Online, and its state is changed back to Open; a Dead path is put Online, and its state changes to Open after it has been bypassed by 50 000 I/O requests on an operational path.



## **New and modified error log messages by SDD for HACMP**

The following list shows the new and modified error log messages generated by SDD installed from the `ibmSdd_433.rte` or `ibmSdd_510nchacmp.rte` fileset. This SDD release is for HACMP environments only. See “SDD fileset attributes” on page 31 for more information on this release.

### **VPATH\_DEVICE\_OPEN**

The SDD device file failed to open one of its paths (hdisk). An attempt to open a vpath device is successful if at least one attached path opens. The attempt to open a vpath device fails only when *all* the vpath device paths fail to open. In addition, this error log message is posted when the vpath device fails to register its underlying paths or fails to read the persistent reserve key for the device.

### **VPATH\_OUT\_SERVICE**

There is no path available to retry an I/O request that failed for a vpath device. The I/O request is returned to the calling program and this error log is posted.

### **VPATH\_FAIL\_RELPRESERVE**

An attempt was made to close a vpath device that was not opened with the **RETAIN\_RESERVE** option on the persistent reserve. The attempt to close the vpath device was successful; however, the persistent reserve was not released. The user is notified that the persistent reserve is still in effect, and this error log is posted.

### **VPATH\_RESV\_CFLICT**

An attempt was made to open a vpath device, but the reservation key of the vpath device is different from the reservation key currently in effect. The attempt to open the device fails and this error log is posted. The device could not be opened because it is currently reserved by someone else.



---

## Chapter 3. SDD for a Windows NT host system

This chapter provides procedures for you to install, configure, remove, and use the SDD on a Windows NT host system that is attached to an ESS. For updated and additional information not included in this chapter, see the README file on the compact disc or visit the SDD Web site at:

[www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates](http://www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates)

---

### Verifying the hardware and software requirements

#### Hardware

You must have the following hardware and software components in order to successfully install SDD.

- ESS
- Host system
- SCSI adapters and cables
- Fibre adapters and cables

#### Software

- Windows NT operating system
- SCSI and fibre-channel device drivers

#### Non-support environments

SDD does not support the following environments:

- A host system with a single-path fibre-channel connection to an ESS.

**Note:** A host system with a single fibre adapter that connects through a switch to multiple ESS ports is considered a multipath fibre-channel connection; and, thus is a *supported* environment.

- A host system with SCSI channel connections and a single-path fibre-channel connection to an ESS.
- A host system with both a SCSI channel and fibre-channel connection to a shared LUN.
- SDD 1.2.1 or higher does not support I/O load-balancing in a Windows NT clustering environment.
- You cannot store the Windows NT operating system or a paging file on an SDD-controlled multipath device.

#### ESS requirements

To successfully install SDD, ensure that your host system is configured to the ESS as an Intel-based PC (personal computer) server with Windows NT 4.0 or higher.

#### Host system requirements

To successfully install SDD, your Windows NT host system must be an Intel-based system with Windows NT Version 4.0 Service Pack 3 or higher installed. The host system can be a uniprocessor or a multiprocessor system.

## SCSI requirements

To use the SDD SCSI support, ensure your host system meets the following requirements:

- No more than 32 SCSI adapters are attached.
- A SCSI cable connects each SCSI host adapter to an ESS port.
- If you need the SDD I/O load-balancing and failover features, ensure that a minimum of two SCSI adapters is installed.

**Note:** SDD also supports one SCSI adapter on the host system. With single-path access, concurrent download of licensed internal code is supported with SCSI devices. However, the load-balancing and failover features are not available.

- For information about the SCSI adapters that can attach to your Windows NT host system, go to the following Web site:

[www.storage.ibm.com/hardsoft/products/ess/supserver.htm](http://www.storage.ibm.com/hardsoft/products/ess/supserver.htm)

## Fibre requirements

To use the SDD fibre support, ensure that your host system meets the following requirements:

- No more than 256 fibre-channel adapters are attached.
- A fiber-optic cable connects each fibre-channel adapter to an ESS port.
- If you need the SDD I/O load-balancing and failover features, ensure that a minimum of two fibre adapters is installed.

For information about the fibre-channel adapters that can attach to your Windows NT host system, go to the following Web site:

[www.storage.ibm.com/hardsoft/products/ess/supserver.htm](http://www.storage.ibm.com/hardsoft/products/ess/supserver.htm)

---

## Preparing for SDD installation

Before you install SDD, you must configure the ESS to your host system and required fibre-channel adapters are attached.

## Configuring the ESS

Before you install SDD, configure your ESS for single-port or multipoint access for each LUN. SDD requires a minimum of two independent paths that share the same LUN to use the load-balancing and failover features.

For information about configuring your ESS, see *IBM Enterprise Storage Server Introduction and Planning Guide*.

## Configuring fibre-channel adapters

You must configure the fibre-channel adapters that are attached to your Windows NT host system before you install SDD. Follow the adapter-specific configuration instructions to configure the adapters attached to your Windows NT host systems.

SDD supports Emulex LP8000 with the full port driver. When you configure Emulex LP8000 for multipath functions, select Allow Multiple paths to SCSI Targets in the Emulex Configuration Tool panel.

Make sure that your Windows NT host system has Service Pack 3 or higher. See *IBM TotalStorage Enterprise Storage Server Host System Attachment Guide* for more information about installing and configuring fibre-channel adapters for your Windows NT host systems.

## Configuring SCSI adapters

**Attention:** Failure to disable the BIOS of attached nonstart devices may cause your system to attempt to start from an unexpected nonstart device.

Before you install and use SDD, you must configure your SCSI adapters. For SCSI adapters that attach start devices, ensure that the BIOS for the adapter is *enabled*. For all other adapters that attach nonstart devices, ensure that the BIOS for the adapter is *disabled*.

**Note:** When the adapter shares the SCSI bus with other adapters, the BIOS must be *disabled*.

---

## Installing the Subsystem Device Driver

The following section describes how to install SDD. Make sure that all hardware and software requirements are met before you install the Subsystem Device Driver. See “Verifying the hardware and software requirements” on page 77 for more information.

Perform the following steps to install the SDD filter and application programs on your system:

1. Log on as the administrator user.
2. Insert the SDD installation compact disc into the CD-ROM drive.
3. Start the Windows NT Explorer program.
4. Select the CD-ROM drive. A list of all the installed directories on the compact disc is displayed.
5. Select the \winNt\IBMsdd directory.
6. Run the setup.exe program. The Installshield starts.
7. Click **Next**. The Software License agreement is displayed.
8. Click **Yes**. The User Information window opens.
9. Type your name and your company name.
10. Click **Next**. The Choose Destination Location window opens.
11. Click **Next**. The Setup windows opens.
12. Select the type of setup you prefer from the following setup choices. IBM recommends that you select **Typical**.

### **Typical**

Selects all options.

### **Compact**

You select the minimum required options *only* (the installation driver and the README file).

### **Custom**

Select the options that you need.

13. Click **Next**. The Setup Complete window opens.
14. Click **Finish**. The SDD program prompts you to start your computer again.
15. Click **Yes** to start your computer again. When you log on again, you see a **Subsystem Device Driver Management** entry in your Program menu containing the following files:

- a. SDD management
- b. Subsystem Device Driver manual
- c. README file

**Note:** You can use the **datapath query device** command to verify the SDD installation. SDD is successfully installed if the command runs successfully.

## Configuring the Subsystem Device Driver

To activate SDD, you need to restart your Windows NT system after it is installed. In fact, a restart is required to activate multipath support whenever a new file system or partition is added.

## Adding paths to SDD devices

**Attention:** Ensure that SDD is installed *before* you add a new path to a device. Otherwise, the Windows NT server could lose the ability to access existing data on that device.

This section contains the procedures for adding paths to SDD devices in multipath environments.

### Reviewing the existing SDD configuration information

Before adding any additional hardware, review the configuration information for the adapters and devices currently on your Windows NT server.

Verify that the number of adapters and the number of paths to each ESS volume match the known configuration. Perform the following steps to display information about the adapters and devices:

1. You must log on as an administrator user to have access to the Windows NT disk administrator.
2. Click **Start** → **Program** → **Subsystem Device Driver** → **Subsystem Device Driver Management**. An MS-DOS window opens.
3. Type `datapath query adapter` and press Enter. The output includes information about all the installed adapters. In the example shown in the following output, one SCSI adapter has 10 active paths:

```
Active Adapters :1
Adpt#   Adapter Name   State   Mode   Select   Errors   Paths   Active
  0     Scsi Port6 Bus0  NORMAL  ACTIVE  542      0       10      10
```

4. Type `datapath query device` and press Enter. In the example shown in the following output, 10 devices are attached to the SCSI path:

```

Total Devices : 10
DEV#:  0  DEVICE NAME: Disk2 Part0  TYPE: 2105E20  SERIAL: 00A12028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk2 Part0  OPEN  NORMAL  14      0
DEV#:  1  DEVICE NAME: Disk2 Part1  TYPE: 2105E20  SERIAL: 00A12028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk2 Part1  OPEN  NORMAL  94      0
DEV#:  2  DEVICE NAME: Disk3 Part0  TYPE: 2105E20  SERIAL: 00B12028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk3 Part0  OPEN  NORMAL  16      0
DEV#:  3  DEVICE NAME: Disk3 Part1  TYPE: 2105E20  SERIAL: 00B12028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk3 Part1  OPEN  NORMAL  94      0
DEV#:  4  DEVICE NAME: Disk4 Part0  TYPE: 2105E20  SERIAL: 00D12028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk4 Part0  OPEN  NORMAL  14      0
DEV#:  5  DEVICE NAME: Disk4 Part1  TYPE: 2105E20  SERIAL: 00D12028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk4 Part1  OPEN  NORMAL  94      0
DEV#:  6  DEVICE NAME: Disk5 Part0  TYPE: 2105E20  SERIAL: 50812028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk5 Part0  OPEN  NORMAL  14      0
DEV#:  7  DEVICE NAME: Disk5 Part1  TYPE: 2105E20  SERIAL: 50812028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk5 Part1  OPEN  NORMAL  94      0
DEV#:  8  DEVICE NAME: Disk6 Part0  TYPE: 2105E20  SERIAL: 60012028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk6 Part0  OPEN  NORMAL  14      0
DEV#:  9  DEVICE NAME: Disk6 Part1  TYPE: 2105E20  SERIAL: 60012028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0      Scsi Port6 Bus0/Disk6 Part1  OPEN  NORMAL  94      0

```

## Installing and configuring additional paths

Perform the following steps to install and configure additional paths to a vpath device:

1. Install any additional hardware on the Windows NT server.
2. Install any additional hardware on the ESS.
3. Configure the new paths to the server.
4. Restart the Windows NT server. Restarting will ensure correct multipath access to both existing and new storage and to your Windows NT server.
5. Verify that the path is added correctly. See “Verifying additional paths are installed correctly” on page 66.

## Verifying additional paths are installed correctly

After installing additional paths to SDD devices, verify the following conditions:

- All additional paths have been installed correctly
- The number of adapters and the number of paths to each ESS volume match the updated configuration.
- The Windows disk numbers of all primary paths are labeled as path #0.

Perform the following steps to verify that the additional paths have been installed correctly:

1. Click **Start** → **Program** → **Subsystem Device Driver** → **Subsystem Device Driver Management**. An MS-DOS window opens.
2. Type datapath query adapter and press Enter. The output includes information about any additional adapters that were installed. In the example shown in the following output, an additional path is installed to the previous configuration:

```
Active Adapters :2
```

Adpt#	Adapter Name	State	Mode	Select	Errors	Paths	Active
0	Scsi Port6 Bus0	NORMAL	ACTIVE	188	0	10	10
1	Scsi Port7 Bus0	NORMAL	ACTIVE	204	0	10	10

3. Type datapath query device and press Enter. The output includes information about any additional devices that were installed. In the example shown in the following output, the output includes information about the new SCSI adapter that was assigned:



Total Devices : 10

```
DEV#: 0 DEVICE NAME: Disk2 Part0 TYPE: 2105E20 SERIAL: 00A12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk2 Part0   OPEN  NORMAL     5      0
  1      Scsi Port7 Bus0/Disk7 Part0   OPEN  NORMAL     9      0

DEV#: 1 DEVICE NAME: Disk2 Part1 TYPE: 2105E20 SERIAL: 00A12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk2 Part1   OPEN  NORMAL    32      0
  1      Scsi Port7 Bus0/Disk7 Part1   OPEN  NORMAL    32      0

DEV#: 2 DEVICE NAME: Disk3 Part0 TYPE: 2105E20 SERIAL: 00B12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk3 Part0   OPEN  NORMAL     7      0
  1      Scsi Port7 Bus0/Disk8 Part0   OPEN  NORMAL     9      0

DEV#: 3 DEVICE NAME: Disk3 Part1 TYPE: 2105E20 SERIAL: 00B12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk3 Part1   OPEN  NORMAL    28      0
  1      Scsi Port7 Bus0/Disk8 Part1   OPEN  NORMAL    36      0

DEV#: 4 DEVICE NAME: Disk4 Part0 TYPE: 2105E20 SERIAL: 00D12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk4 Part0   OPEN  NORMAL     8      0
  1      Scsi Port7 Bus0/Disk9 Part0   OPEN  NORMAL     6      0

DEV#: 5 DEVICE NAME: Disk4 Part1 TYPE: 2105E20 SERIAL: 00D12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk4 Part1   OPEN  NORMAL    35      0
  1      Scsi Port7 Bus0/Disk9 Part1   OPEN  NORMAL    29      0

DEV#: 6 DEVICE NAME: Disk5 Part0 TYPE: 2105E20 SERIAL: 50812028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk5 Part0   OPEN  NORMAL     6      0
  1      Scsi Port7 Bus0/Disk10 Part0   OPEN  NORMAL     8      0

DEV#: 7 DEVICE NAME: Disk5 Part1 TYPE: 2105E20 SERIAL: 50812028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk5 Part1   OPEN  NORMAL    24      0
  1      Scsi Port7 Bus0/Disk10 Part1   OPEN  NORMAL    40      0

DEV#: 8 DEVICE NAME: Disk6 Part0 TYPE: 2105E20 SERIAL: 60012028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk6 Part0   OPEN  NORMAL     8      0
  1      Scsi Port7 Bus0/Disk11 Part0   OPEN  NORMAL     6      0

DEV#: 9 DEVICE NAME: Disk6 Part1 TYPE: 2105E20 SERIAL: 60012028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port6 Bus0/Disk6 Part1   OPEN  NORMAL    35      0
  1      Scsi Port7 Bus0/Disk11 Part1   OPEN  NORMAL    29      0
```

The definitive way to identify unique volumes on the ESS is by the serial number displayed. The volume appears at the SCSI level as multiple disks (more properly, Adapter/Bus/ID/LUN), but it's the same volume on the ESS. The previous example shows two paths to each partition (path 0: Scsi Port6 Bus0/Disk2, and path 1: Scsi Port7 Bus0/Disk7).

The example shows partition 0 (Part0) for each of the devices. This partition stores information about the Windows partition on the drive. The operating system masks this partition from the user, but it still exists. In general, you will see one more partition from the output of the **datapath query device** command than what is being displayed from the Disk Administrator application.

## Upgrading the Subsystem Device Driver

If you attempt to install *over* an existing version of SDD or Data Path Optimizer (DPO), the installation fails. You must uninstall any previous version of the SDD or DPO before installing a new version of SDD.

Perform the following steps to upgrade to a newer SDD version:

1. Uninstall the previous version of SDD. (See “Removing the Subsystem Device Driver” on page 72 for instructions.)

**Attention:** After uninstalling the previous version, you must *immediately* install the new version of SDD to avoid any potential data loss. If you perform a system restart before installing the new version, you may lose access to your assigned volumes.

2. Install the new version of SDD. (See “Installing the Subsystem Device Driver” on page 63 for instructions.)

## Adding or modifying a multipath storage configuration to the ESS

This section contains the procedures for adding new storage to an existing configuration in multipath environments.

### Reviewing the existing SDD configuration information

Before adding any additional hardware, review the configuration information for the adapters and devices currently on your Windows NT server.

Verify that the number of adapters and the number of paths to each ESS volume match the known configuration. Perform the following steps to display information about the adapters and devices:

1. Click **Start** → **Program** → **Subsystem Device Driver** → **Subsystem Device Driver Management**. An MS-DOS window opens.
2. Type `datapath query adapter` and press Enter. The output includes information about all the installed adapters. In the example shown in the following output, two SCSI adapters are installed on the Windows NT host server:

```
Active Adapters :2
Adpt#   Adapter Name   State   Mode   Select   Errors   Paths   Active
  0   Scsi Port6 Bus0  NORMAL  ACTIVE   188       0       10       10
  1   Scsi Port7 Bus0  NORMAL  ACTIVE   204       0       10       10

Previous configuration with one additional path
```

3. Type `datapath query device` and press Enter. In the example shown in the following output, 10 devices are attached to the SCSI path:

Total Devices : 10

```
DEV#: 0 DEVICE NAME: Disk2 Part0 TYPE: 2105E20 SERIAL: 00A12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk2 Part0  OPEN  NORMAL    5      0
  1   Scsi Port7 Bus0/Disk7 Part0   OPEN  NORMAL    9      0

DEV#: 1 DEVICE NAME: Disk2 Part1 TYPE: 2105E20 SERIAL: 00A12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk2 Part1  OPEN  NORMAL   32      0
  1   Scsi Port7 Bus0/Disk7 Part1  OPEN  NORMAL   32      0

DEV#: 2 DEVICE NAME: Disk3 Part0 TYPE: 2105E20 SERIAL: 00B12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk3 Part0  OPEN  NORMAL    7      0
  1   Scsi Port7 Bus0/Disk8 Part0  OPEN  NORMAL    9      0

DEV#: 3 DEVICE NAME: Disk3 Part1 TYPE: 2105E20 SERIAL: 00B12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk3 Part1  OPEN  NORMAL   28      0
  1   Scsi Port7 Bus0/Disk8 Part1  OPEN  NORMAL   36      0

DEV#: 4 DEVICE NAME: Disk4 Part0 TYPE: 2105E20 SERIAL: 00D12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk4 Part0  OPEN  NORMAL    8      0
  1   Scsi Port7 Bus0/Disk9 Part0  OPEN  NORMAL    6      0

DEV#: 5 DEVICE NAME: Disk4 Part1 TYPE: 2105E20 SERIAL: 00D12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk4 Part1  OPEN  NORMAL   35      0
  1   Scsi Port7 Bus0/Disk9 Part1  OPEN  NORMAL   29      0

DEV#: 6 DEVICE NAME: Disk5 Part0 TYPE: 2105E20 SERIAL: 50812028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk5 Part0  OPEN  NORMAL    6      0
  1   Scsi Port7 Bus0/Disk10 Part0  OPEN  NORMAL    8      0

DEV#: 7 DEVICE NAME: Disk5 Part1 TYPE: 2105E20 SERIAL: 50812028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk5 Part1  OPEN  NORMAL   24      0
  1   Scsi Port7 Bus0/Disk10 Part1  OPEN  NORMAL   40      0

DEV#: 8 DEVICE NAME: Disk6 Part0 TYPE: 2105E20 SERIAL: 60012028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk6 Part0  OPEN  NORMAL    8      0
  1   Scsi Port7 Bus0/Disk11 Part0  OPEN  NORMAL    6      0

DEV#: 9 DEVICE NAME: Disk6 Part1 TYPE: 2105E20 SERIAL: 60012028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk6 Part1  OPEN  NORMAL   35      0
  1   Scsi Port7 Bus0/Disk11 Part1  OPEN  NORMAL   29      0
```

## Adding new storage to existing configuration

Perform the following steps to install additional storage:

1. Install any additional hardware to the ESS.
2. Configure the new storage to the server.
3. Restart the Windows NT server. Restarting will ensure correct multipath access to both existing and new storage and to your Windows NT server.

4. Verify that the new storage is added correctly. See "Verifying new storage is installed correctly".

### Verifying new storage is installed correctly

After adding new storage to existing configuration, you should verify the following conditions:

- The new storage is correctly installed and configured.
- The number of adapters and the number of paths to each ESS volume match the updated configuration.
- The Windows disk numbers of all primary paths are labeled as path #0.

Perform the following steps to verify that the additional storage has been installed correctly:

1. Click **Start** → **Program** → **Subsystem Device Driver** → **Subsystem Device Driver Management**. An MS-DOS window opens.
2. Type `datapath query adapter` and press Enter. The output includes information about all the installed adapters. In the example shown in the following output, two SCSI adapters are installed on the Windows NT host server:

```
Active Adapters :2
```

Adpt#	Adapter Name	State	Mode	Select	Errors	Paths	Active
0	Scsi Port6 Bus0	NORMAL	ACTIVE	295	0	16	16
1	Scsi Port7 Bus0	NORMAL	ACTIVE	329	0	16	16

3. Type `datapath query device` and press Enter. The output includes information about any additional devices that were installed. In the example shown in the following output, the output includes information about the new devices that were assigned:

Total Devices : 16

```
DEV#: 0 DEVICE NAME: Disk2 Part0 TYPE: 2105E20 SERIAL: 00A12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk2 Part0  OPEN  NORMAL    9      0
  1   Scsi Port7 Bus0/Disk10 Part0  OPEN  NORMAL    5      0

DEV#: 1 DEVICE NAME: Disk2 Part1 TYPE: 2105E20 SERIAL: 00A12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk2 Part1  OPEN  NORMAL   26      0
  1   Scsi Port7 Bus0/Disk10 Part1  OPEN  NORMAL   38      0

DEV#: 2 DEVICE NAME: Disk3 Part0 TYPE: 2105E20 SERIAL: 00B12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk3 Part0  OPEN  NORMAL    9      0
  1   Scsi Port7 Bus0/Disk11 Part0  OPEN  NORMAL    7      0

DEV#: 3 DEVICE NAME: Disk3 Part1 TYPE: 2105E20 SERIAL: 00B12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk3 Part1  OPEN  NORMAL   34      0
  1   Scsi Port7 Bus0/Disk11 Part1  OPEN  NORMAL   30      0

DEV#: 4 DEVICE NAME: Disk4 Part0 TYPE: 2105E20 SERIAL: 31512028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk4 Part0  OPEN  NORMAL    8      0
  1   Scsi Port7 Bus0/Disk12 Part0  OPEN  NORMAL    6      0

DEV#: 5 DEVICE NAME: Disk4 Part1 TYPE: 2105E20 SERIAL: 31512028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk4 Part1  OPEN  NORMAL   35      0
  1   Scsi Port7 Bus0/Disk12 Part1  OPEN  NORMAL   28      0

DEV#: 6 DEVICE NAME: Disk5 Part0 TYPE: 2105E20 SERIAL: 00D12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk5 Part0  OPEN  NORMAL    5      0
  1   Scsi Port7 Bus0/Disk13 Part0  OPEN  NORMAL    9      0

DEV#: 7 DEVICE NAME: Disk5 Part1 TYPE: 2105E20 SERIAL: 00D12028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk5 Part1  OPEN  NORMAL   28      0
  1   Scsi Port7 Bus0/Disk13 Part1  OPEN  NORMAL   36      0

DEV#: 8 DEVICE NAME: Disk6 Part0 TYPE: 2105E20 SERIAL: 40812028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk6 Part0  OPEN  NORMAL    5      0
  1   Scsi Port7 Bus0/Disk14 Part0  OPEN  NORMAL    9      0

DEV#: 9 DEVICE NAME: Disk6 Part1 TYPE: 2105E20 SERIAL: 40812028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk6 Part1  OPEN  NORMAL   25      0
  1   Scsi Port7 Bus0/Disk14 Part1  OPEN  NORMAL   38      0

DEV#: 10 DEVICE NAME: Disk7 Part0 TYPE: 2105E20 SERIAL: 50812028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk7 Part0  OPEN  NORMAL    7      0
  1   Scsi Port7 Bus0/Disk15 Part0  OPEN  NORMAL    7      0

DEV#: 11 DEVICE NAME: Disk7 Part1 TYPE: 2105E20 SERIAL: 50812028
=====
Path#          Adapter/Hard Disk      State   Mode   Select  Errors
  0   Scsi Port6 Bus0/Disk7 Part1  OPEN  NORMAL   34      0
  1   Scsi Port7 Bus0/Disk15 Part1  OPEN  NORMAL   30      0
```

```

DEV#: 12  DEVICE NAME: Disk8 Part0  TYPE: 2105E20  SERIAL: 60012028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0   Scsi Port6 Bus0/Disk8 Part0  OPEN  NORMAL  7      0
  1   Scsi Port7 Bus0/Disk16 Part0  OPEN  NORMAL  7      0

DEV#: 13  DEVICE NAME: Disk8 Part1  TYPE: 2105E20  SERIAL: 60012028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0   Scsi Port6 Bus0/Disk8 Part1  OPEN  NORMAL  29     0
  1   Scsi Port7 Bus0/Disk16 Part1  OPEN  NORMAL  35     0

DEV#: 14  DEVICE NAME: Disk9 Part0  TYPE: 2105E20  SERIAL: 00812028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0   Scsi Port6 Bus0/Disk9 Part0  OPEN  NORMAL  6      0
  1   Scsi Port7 Bus0/Disk17 Part0  OPEN  NORMAL  8      0

DEV#: 15  DEVICE NAME: Disk9 Part1  TYPE: 2105E20  SERIAL: 00812028
=====
Path#          Adapter/Hard Disk  State  Mode  Select  Errors
  0   Scsi Port6 Bus0/Disk9 Part1  OPEN  NORMAL  28     0
  1   Scsi Port7 Bus0/Disk17 Part1  OPEN  NORMAL  36     0

```

The definitive way to identify unique volumes on the ESS is by the serial number displayed. The volume appears at the SCSI level as multiple disks (more properly, Adapter/Bus/ID/LUN), but it's the same volume on the ESS. The previous example shows two paths to each partition (path 0: Scsi Port6 Bus0/Disk2, and path 1: Scsi Port7 Bus0/Disk10).

The example shows partition 0 (Part0) for each of the device. This partition stores information about the Windows partition on the drive. The operating system masks this partition from the user, but it still exists. In general, you will see one more partition from the output of the **datapath query device** command than what is being displayed from the Disk Administrator application.

---

## Removing the Subsystem Device Driver

Perform the following steps to uninstall SDD on a Windows NT host system:

1. Log on as the administrator user.
2. Click **Start** —> **Settings** —> **Control Panel**. The Control Panel window opens.
3. Double click **Add/Remove Programs**. The Add/Remove Programs window opens.
4. In the Add/Remove Programs window, select Subsystem Device Driver from the Currently installed programs selection list.
5. Click on the **Add/Remove** button.

**Attention:** After uninstalling the previous version, you must *immediately* install the new version of SDD to avoid any potential data loss. If you perform a system restart before installing the new version, you may lose access to your assigned volumes. (See "Installing the Subsystem Device Driver" on page 63 for instructions.)

---

## Displaying the current version of the Subsystem Device Driver

You can display the current SDD version on a Windows NT host system by viewing the `sddpath.sys` file properties. Perform the following steps to view the properties of the `sddpath.sys` file:

1. Click **Start** → **Run** → **Programs** → **Accessories** → **Windows Explorer**. Windows will open Windows Explorer.
2. In Windows Explorer, go to *your\_installation\_directory\_letter*:\Winnt\system32\drivers directory where (*your\_installation\_directory\_lette* is the directory letter where you have installed the `sddpath.sys` file).
3. Click the `sddpath.sys` file in *your\_installation\_directory\_letter*:\Winnt\system32\drivers directory where *your\_installation\_directory\_letter* refers to the letter of the directory in which you have installed the `sddpath.sys` file.
4. Right-click on the `sddpath.sys` file and then click **Properties**. The **sddpath.sys** properties window will open.
5. In the `sddpath.sys` properties window, click **Version**. The file version and copyright information about the `sddpath.sys` file is displayed.

---

## Support for Windows NT clustering

The following items are required to support the Windows NT operating system in a clustering environment:

- SDD 1.2.1 or higher
- Windows NT 4.0 Enterprise Edition

**Note:** SDD 1.2.1 or higher does not support I/O load-balancing in a Windows NT clustering environment.

## Special considerations in the Windows NT clustering environment

There are subtle differences in the way that SDD handles path reclamation in a Windows NT clustering environment compared to a nonclustering environment. When the Windows NT server loses a path in a nonclustering environment, the path condition changes from open to dead and the adapter condition changes from active to degraded. The adapter and path condition will not change until the path is made operational again. When the Windows NT server loses a path in a clustering environment, the path condition changes from open to dead and the adapter condition changes from active to degraded. However, after a period of time, the path condition changes back to open and the adapter condition changes back to normal, even if the path has not been made operational again.

The **datapath set adapter # offline** command operates differently in a clustering environment as compared to a nonclustering environment. In a clustering environment, the **datapath set adapter offline** command does not change the condition of the path if the path is active or being reserved. If you issue the command, the following message is displayed: to preserve access some paths left online.

## Configuring a Windows NT cluster with SDD

The following variables are used in this procedure:

*server\_1* represents the first server with two host bus adapters (HBAs).

*server\_2* represents the second server with two HBAs.

*hba\_a* represents the first HBA for *server\_1*.

*hba\_b* represents the second HBA for *server\_1*.

*hba\_c* represents the first HBA for *server\_2*.

*hba\_d* represents the second HBA for *server\_2*.

Perform the following steps to configure a Windows NT cluster with SDD:

1. Configure LUNs on the ESS as shared for all HBAs on both *server\_1* and *server\_2*.
2. Connect *hba\_a* to the ESS, and restart *server\_1*.
3. Click **Start** → **Programs** → **Administrative Tools** → **Disk Administrator**.  
The Disk Administrator is displayed. Use the Disk Administrator to verify the number of LUNs that are connected to *server\_1*.  
The operating system recognizes each additional path to the same LUN as a device.
4. Disconnect *hba\_a* and connect *hba\_b* to the ESS. Restart *server\_1*.
5. Click **Start** → **Programs** → **Administrative Tools** → **Disk Administrator**.  
The Disk Administrator is displayed. Use the Disk Administrator to verify the number of LUNs that are connected to *server\_1*.  
If the number of LUNs that are connected to *server\_1* is correct, proceed to 6.  
If the number of LUNs that are connected to *server\_1* is incorrect, perform the following steps:
  - a. Verify that the cable for *hba\_b* is connected to the ESS.
  - b. Verify your LUN configuration on the ESS.
  - c. Repeat steps 2 - 5.
6. Install SDD on *server\_1*, and restart *server\_1*.  
For installation instructions, go to "Installing the Subsystem Device Driver" on page 63 section.
7. Connect *hba\_c* to the ESS, and restart *server\_2*.
8. Click **Start** → **Programs** → **Administrative Tools** → **Disk Administrator**.  
The Disk Administrator is displayed. Use the Disk Administrator to verify the number of LUNs that are connected to *server\_2*.  
The operating system recognizes each additional path to the same LUN as a device.
9. Disconnect *hba\_c* and connect *hba\_d* to the ESS. Restart *server\_2*.
10. Click **Start** → **Programs** → **Administrative Tools** → **Disk Administrator**.  
The Disk Administrator is displayed. Use the Disk Administrator to verify that the correct number of LUNs are connected to *server\_2*.  
If the number of LUNs that are connected to *server\_2* is correct, proceed to 11.  
If the number of LUNs that are connected to *server\_2* is incorrect, perform the following steps:
  - a. Verify that the cable for *hba\_d* is connected to the ESS.
  - b. Verify your LUN configuration on the ESS.
  - c. Repeat steps 7 - 10.
11. Install SDD on *server\_2*, and restart *server\_2*.  
For installation instructions, go to "Installing the Subsystem Device Driver" on page 63 section.
12. Connect both *hba\_c* and *hba\_d* on *server\_2* to the ESS, and restart *server\_2*.



13. Use the **datapath query adapter** and **datapath query device** commands to verify the number of LUNs and paths on *server\_2*.
14. Click **Start** → **Programs** → **Administrative Tools** → **Disk Administrator**. The Disk Administrator is displayed. Use the Disk Administrator to verify the number of LUNs as online devices. You also need to verify that all additional paths are shown as offline devices.
15. Format the raw devices with NTFS.  
Make sure to keep track of the assigned drive letters on *server\_2*.
16. Connect both *hba\_a* and *hba\_b* on *server\_1* to the ESS, and restart *server\_1*.
17. Use the **datapath query adapter** and **datapath query device** commands to verify the correct number of LUNs and paths on *server\_1*.  
Verify that the assigned drive letters on *server\_1* match the assigned drive letters on *server\_2*.
18. Restart *server\_2*.
  - Install the Microsoft® Cluster Server (MSCS) software on *server\_1*, restart *server\_1*, reapply Service Pack 5 (or higher) to *server\_1*, and restart *server\_1* again.
  - Install the MSCS software on *server\_2*, restart *server\_2*, reapply Service Pack 5 (or higher) to *server\_2*, and restart *server\_2* again.
19. Use the **datapath query adapter** and **datapath query device** commands to verify the correct number of LUNs and paths on *server\_1* and *server\_2*. (This step is optional.)

**Note:** You can use the **datapath query adapter** and **datapath query device** commands to show all the physical volumes and logical volumes for the host server. The secondary server only shows the physical volumes and the logical volumes that it owns.



---

## Chapter 4. SDD for a Windows 2000 host system

This chapter provides procedures for you to install, configure, remove, and use the SDD on a Windows 2000 host system that is attached to an ESS. For updated and additional information not included in this chapter, see the README file on the compact disc or visit the SDD Web site at:

[www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates](http://www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates)

---

### Verifying the hardware and software requirements

You must have the following hardware and software components in order to install SDD:

#### Hardware

- ESS
- Host system
- SCSI adapters and cables
- Fibre adapters and cables

#### Software

- Windows 2000 operating system with Service Pack 2 or higher
- SCSI and fibre-channel device drivers

### Non-supported environments

SDD does not support the following environments:

- A host system with a single-path fibre-channel connection to an ESS.

**Note:** A host system with a single fibre adapter that connects through a switch to multiple ESS ports is considered a multipath fibre-channel connection; and, thus is a *supported* environment.

- A host system with SCSI channel connections and a single-path fibre-channel connection to an ESS.
- A host system with both a SCSI channel and fibre-channel connection to a shared LUN.
- Windows 2000 operating system or a paging file on an SDD-controlled multipath device.
- SDD in a non-concurrent environment in which more than one host is attached to the same logical unit number (LUN) on a Enterprise Storage Server; for example, in a multi-host environment. However, concurrent multi-host environments are supported.

### ESS requirements

To successfully install SDD, make sure that you configure the ESS devices as IBM 2105xxx (where xxx is the ESS model number) on your Windows 2000 host system.

### Host system requirements

To successfully install SDD, your host system should have Windows 2000 Service Pack 2 installed. The host system can be a uniprocessor or a multiprocessor system.

To install all components, you must have 1 MB (MB equals approximately 1 000 000 bytes) of disk space available.

### **SCSI requirements**

To use the SDD SCSI support, ensure your host system meets the following requirements:

- No more than 32 SCSI adapters are attached.
- A SCSI cable connects each SCSI host adapter to an ESS port.
- If you need the SDD I/O load-balancing and failover features ensure that a minimum of two SCSI adapters is installed.

**Note:** SDD also supports one SCSI adapter on the host system. With single-path access, concurrent download of licensed internal code is supported with SCSI devices. However, the load-balancing and failover features are not available.

- For information about the SCSI adapters that can attach to your Windows 2000 host system, go to the following Web site:

[www.storage.ibm.com/hardsoft/products/ess/supserver.htm](http://www.storage.ibm.com/hardsoft/products/ess/supserver.htm)

### **Fibre requirements**

To use the SDD fibre support, ensure that your host system meets the following requirements:

- No more than 256 fibre-channel adapters are attached.
- A fiber-optic cable connects each fibre-channel adapter to an ESS port.
- If you need the SDD I/O load-balancing and failover features, ensure that a minimum of two fibre-channel adapters is installed.

- For information about the fibre-channel adapters that can attach to your Windows 2000 host system go to the following Web site at:

[www.storage.ibm.com/hardsoft/products/ess/supserver.htm](http://www.storage.ibm.com/hardsoft/products/ess/supserver.htm)

---

## **Preparing for SDD installation**

Before you install SDD, you must configure the ESS to your host system and required fibre-channel adapters are attached.

### **Configuring the ESS**

Before you install SDD, configure your ESS for single-port or multiport access for each LUN. SDD requires a minimum of two independent paths that share the same logical unit to use the load-balancing and failover features.

For information about configuring your ESS, see the *IBM Enterprise Storage Server Introduction and Planning Guide*.

**Note:** During heavy usage, the Windows 2000 operating system might slow down while trying to recover from error conditions.

### **Configuring fibre-channel adapters**

You must configure the fibre-channel adapters that are attached to your Windows 2000 host system before you install SDD. Follow the adapter-specific configuration instructions to configure the adapters attached to your Windows 2000 host systems.

SDD supports Emulex LP8000 with the full port driver. When you configure Emulex LP8000 for multipath functions, select Allow Multiple Paths to SCSI Targets in the Emulex Configuration Tool panel.

Make sure that your Windows 2000 host system has Service Pack 2 or higher. See *IBM TotalStorage Enterprise Storage Server Host System Attachment Guide* for more information about installing and configuring fibre-channel adapters for your Windows 2000 host systems.

## Configuring SCSI adapters

**Attention:** Failure to disable the BIOS of attached nonstart devices may cause your system to attempt to restart from an unexpected nonstart device.

Before you install and use SDD, you must configure your SCSI adapters. For SCSI adapters that attach start devices, ensure that the BIOS for the adapter is *enabled*. For all other adapters that attach nonstart devices, ensure that the BIOS for the adapter is *disabled*.

**Note:** When the adapter shares the SCSI bus with other adapters, the BIOS must be *disabled*.

---

## Installing the Subsystem Device Driver

The following section describes how to install SDD. Make sure that all hardware and software requirements are met before you install the Subsystem Device Driver. See “Verifying the hardware and software requirements” on page 77 for more information.

Perform the following steps to install the SDD filter and application programs on your system:

1. Log on as the administrator user.
2. Insert the SDD installation CD-ROM into the selected drive.
3. Start the Windows 2000 Explorer program.
4. Select the CD-ROM drive. A list of all the installed directories on the compact disc is displayed.
5. Select the \win2k\IBMsdd directory.
6. Run the setup.exe program. The Installshield starts.
7. Click **Next**. The Software Licensing Agreement window opens.
8. Click **Yes**. The User Information window opens.
9. Type your name and your company name.
10. Click **Next**. The Choose Destination Location window opens.
11. Click **Next**. The Setup window opens.
12. Select the type of setup you prefer from the following setup choices. IBM recommends that you select **Typical**.

**Typical**

Selects all options.

**Compact**

Selects the minimum required options *only* (the installation driver and README file).

**Custom**

You select the options that you need.

13. Click **Next**. The Setup Complete window opens.
14. Click **Finish**. The SDD program prompts you to start your computer again.
15. Click **Yes** to start your computer again. When you log on again, you see a **Subsystem Device Driver** entry in your Program menu containing the following files:
  - a. Subsystem Device Driver management
  - b. Subsystem Device Driver manual
  - c. README file

**Note:** You can verify that SDD has been successfully installed by issuing the **datapath query device** command. If the command executes, SDD is installed.

---

## Configuring the Subsystem Device Driver

To activate SDD, you need to restart your Windows 2000 system after it is installed. In fact, a restart is required to activate multipath support whenever a new file system or partition is added.

### Adding paths to SDD devices

**Attention:** Ensure that SDD is installed *before* you add additional paths to a device. Otherwise, the Windows 2000 server could lose the ability to access existing data on that device.

Before adding any additional hardware, review the configuration information for the adapters and devices currently on your Windows 2000 server. Perform the following steps to display information about the adapters and devices:

1. You must log on as an administrator user to have access to the Windows 2000 Computer Management.
2. Click **Start** → **Program** → **Subsystem Device Driver** → **Subsystem Device Driver Management**. An MS-DOS window opens.
3. Type `datapath query adapter` and press Enter. The output includes information about all the installed adapters. In the example shown in the following output, one SCSI adapter is installed:

```
Active Adapters :1
```

Adpt#	Adapter Name	State	Mode	Select	Errors	Paths	Active
0	Scsi Port1 Bus0	NORMAL	ACTIVE	4057	0	8	8

4. Type `datapath query device` and press Enter. In the example shown in the following output, 8 devices are attached to the SCSI path:

```

Total Devices : 8
DEV#: 0 DEVICE NAME: Disk7 Part7 TYPE: 2105E20 SERIAL: 01312028
=====
Path#          Adapter/Hard Disk   State   Mode   Select  Errors
 0          Scsi Port1 Bus0/Disk7 Part0  OPEN   NORMAL 1045     0
DEV#: 1 DEVICE NAME: Disk6 Part6 TYPE: 2105E20 SERIAL: 01212028
=====
Path#          Adapter/Hard Disk   State   Mode   Select  Errors
 0          Scsi Port1 Bus0/Disk6 Part0  OPEN   NORMAL  391     0
DEV#: 2 DEVICE NAME: Disk5 Part5 TYPE: 2105E20 SERIAL: 01112028
=====
Path#          Adapter/Hard Disk   State   Mode   Select  Errors
 0          Scsi Port1 Bus0/Disk5 Part0  OPEN   NORMAL 1121     0
DEV#: 3 DEVICE NAME: Disk4 Part4 TYPE: 2105E20 SERIAL: 01012028
=====
Path#          Adapter/Hard Disk   State   Mode   Select  Errors
 0          Scsi Port1 Bus0/Disk4 Part0  OPEN   NORMAL  332     0
DEV#: 4 DEVICE NAME: Disk3 Part3 TYPE: 2105E20 SERIAL: 00F12028
=====
Path#          Adapter/Hard Disk   State   Mode   Select  Errors
 0          Scsi Port1 Bus0/Disk3 Part0  OPEN   NORMAL  375     0
DEV#: 5 DEVICE NAME: Disk2 Part2 TYPE: 2105E20 SERIAL: 31412028
=====
Path#          Adapter/Hard Disk   State   Mode   Select  Errors
 0          Scsi Port1 Bus0/Disk2 Part0  OPEN   NORMAL  258     0
DEV#: 6 DEVICE NAME: Disk1 Part1 TYPE: 2105E20 SERIAL: 31312028
=====
Path#          Adapter/Hard Disk   State   Mode   Select  Errors
 0          Scsi Port1 Bus0/Disk1 Part0  OPEN   NORMAL  267     0
DEV#: 7 DEVICE NAME: Disk0 Part0 TYPE: 2105E20 SERIAL: 31212028
=====
Path#          Adapter/Hard Disk   State   Mode   Select  Errors
 0          Scsi Port1 Bus0/Disk0 Part0  OPEN   NORMAL  268     0

```

### Activating additional paths

Perform the following steps to activate additional paths to a vpath device:

1. Install any additional hardware on the Windows 2000 server or the ESS.
2. Restart the Windows 2000 server.
3. Verify that the path is added correctly. See “Verifying additional paths are installed correctly”.

### Verifying additional paths are installed correctly

After installing additional paths to SDD devices, verify that the additional paths have been installed correctly.

Perform the following steps to verify that the additional paths have been installed correctly:

1. Click **Start** → **Program** → **Subsystem Device Driver** → **Subsystem Device Driver Management**. An MS-DOS window opens.
2. Type datapath query adapter and press Enter. The output includes information about any additional adapters that were installed. In the example shown in the following output, an additional SCSI adapter has been installed:

Active Adapters :2

Adpt#	Adapter Name	State	Mode	Select	Errors	Paths	Active
0	Scsi Port1 Bus0	NORMAL	ACTIVE	1325	0	8	8
1	Scsi Port2 Bus0	NORMAL	ACTIVE	1312	0	8	8

3. Type datapath query device and press Enter. The output should include information about any additional devices that were installed. In this example, the output includes information about the new SCSI adapter and the new device numbers that were assigned. The following output is displayed:

```
Total Devices : 8
DEV#: 0 DEVICE NAME: Disk7 Part7 TYPE: 2105E20 SERIAL: 01312028
=====
Path#      Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port1 Bus0/Disk7 Part0   OPEN  NORMAL    190     0
  1      Scsi Port2 Bus0/Disk15 Part0   OPEN  NORMAL    179     0
DEV#: 1 DEVICE NAME: Disk6 Part6 TYPE: 2105E20 SERIAL: 01212028
=====
Path#      Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port1 Bus0/Disk6 Part0   OPEN  NORMAL    179     0
  1      Scsi Port2 Bus0/Disk14 Part0   OPEN  NORMAL    184     0
DEV#: 2 DEVICE NAME: Disk5 Part5 TYPE: 2105E20 SERIAL: 01112028
=====
Path#      Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port1 Bus0/Disk5 Part0   OPEN  NORMAL    194     0
  1      Scsi Port2 Bus0/Disk13 Part0   OPEN  NORMAL    179     0
DEV#: 3 DEVICE NAME: Disk4 Part4 TYPE: 2105E20 SERIAL: 01012028
=====
Path#      Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port1 Bus0/Disk4 Part0   OPEN  NORMAL    187     0
  1      Scsi Port2 Bus0/Disk12 Part0   OPEN  NORMAL    173     0
DEV#: 4 DEVICE NAME: Disk3 Part3 TYPE: 2105E20 SERIAL: 00F12028
=====
Path#      Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port1 Bus0/Disk3 Part0   OPEN  NORMAL    215     0
  1      Scsi Port2 Bus0/Disk11 Part0   OPEN  NORMAL    216     0
DEV#: 5 DEVICE NAME: Disk2 Part2 TYPE: 2105E20 SERIAL: 31412028
=====
Path#      Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port1 Bus0/Disk2 Part0   OPEN  NORMAL    115     0
  1      Scsi Port2 Bus0/Disk10 Part0   OPEN  NORMAL    130     0
DEV#: 6 DEVICE NAME: Disk1 Part1 TYPE: 2105E20 SERIAL: 31312028
=====
Path#      Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port1 Bus0/Disk1 Part0   OPEN  NORMAL    122     0
  1      Scsi Port2 Bus0/Disk9 Part0    OPEN  NORMAL    123     0
DEV#: 7 DEVICE NAME: Disk0 Part0 TYPE: 2105E20 SERIAL: 31212028
=====
Path#      Adapter/Hard Disk      State   Mode   Select  Errors
  0      Scsi Port1 Bus0/Disk0 Part0   OPEN  NORMAL    123     0
  1      Scsi Port2 Bus0/Disk8 Part0    OPEN  NORMAL    128     0
```

---

## Upgrading the Subsystem Device Driver

Perform the following steps to upgrade to a newer version of SDD:

1. Uninstall the previous version of SDD. (See “Removing the Subsystem Device Driver” on page 83for instructions.)



**Attention:** After uninstalling the previous version, you must *immediately* install the new version of SDD to avoid any potential data loss. If you perform a system restart before installing the new version, you may lose access to your assigned volumes.

2. Install the new version of SDD. (See “Installing the Subsystem Device Driver” on page 79 for instructions.)

---

## Removing the Subsystem Device Driver

Perform the following steps to uninstall SDD on a Windows 2000 host system:

1. Log on as the administrator user.
2. Click **Start** → **Settings** → **Control Panel**. The Control Panel opens.
3. Double click **Add/Remove Programs**. The Add/Remove Programs window opens.
4. In the Add/Remove Programs window, select the Subsystem Device Driver from the Currently installed programs selection list.
5. Click on the **Change/Remove** button.

**Attention:** After uninstalling the previous version, you must *immediately* install the new version of SDD to avoid any potential data loss. If you perform a system restart before installing the new version, you may lose access to your assigned volumes. (See “Installing the Subsystem Device Driver” on page 79 for instructions.)

---

## Displaying the current version of the Subsystem Device Driver

You can display the current version of SDD on a Windows 2000 host system by viewing the `sddpath.sys` file properties. Perform the following steps to view the properties of `sddpath.sys` file:

1. Click **Start** → **Run** → **Programs** → **Accessories** → **Windows Explorer** to open Windows Explorer.
2. In Windows Explorer, go to `your_installation_directory_drive_letter:\Winnt\system32\drivers` directory where `your_installation_directory_drive_letter` is the letter of the directory in which you have installed the `sddpath.sys` file.
3. Click the `sddpath.sys` file in `your_installation_directory_drive_letter:\Winnt\system32\drivers` directory.
4. Right-click on the `sddpath.sys` file, and then click **Properties**. The `sddpath.sys` properties window opens.
5. In the `sddpath.sys` properties window, click **Version**. The file version and copyright information about the `sddpath.sys` file is displayed.

---

## Support for Windows 2000 clustering

SDD 1.3.0.0 or higher is required to support Windows 2000 clustering. SDD 1.3.0.0 or higher does not support I/O load-balancing in a Windows 2000 clustering environment.

When running Windows 2000 clustering, failover/failback may not occur when the last path is being removed from the shared resources. See *Microsoft article Q294173* for additional information. Windows 2000 does not support dynamic disks in the MSCS environment.

## Special considerations in the Windows 2000 clustering environment

There are subtle differences in the way that SDD handles path reclamation in a Windows 2000 clustering environment compared to a nonclustering environment. When the Windows 2000 server loses a path in a nonclustering environment, the path condition changes from open to dead and the adapter condition changes from active to degraded. The adapter and path condition will not change until the path is made operational again. When the Windows 2000 server loses a path in a clustering environment, the path condition changes from open to dead and the adapter condition changes from active to degraded. However, after a period of time, the path condition changes back to open and the adapter condition changes back to normal, even if the path has not been made operational again.

The **datapath set adapter # offline** command operates differently in a clustering environment as compared to a nonclustering environment. In a clustering environment, the **datapath set adapter offline** command does not change the condition of the path if the path is active or being reserved. If you issue the command, the following message is displayed: to preserve access some paths left online.

## Preparing to Configure a Windows 2000 cluster with SDD

If you use QLogic 2200 adapters and QLogic driver 8.00.08 in Windows 2000 clustering, you need to import the ql22clus.reg registry file to your environment before configuring a Windows 2000 cluster with SDD.

Perform the following steps to import the ql22clus.reg registry file to your environment:

1. Click **Start** → **Run**.
2. In the **Open** field, type regedit. Press Enter. The Registry Editor window opens.
3. From the Registry Editor Import panel, click **Registry** → **Import Registry File**. The Import Registry File window opens.
4. In the **File Name** field, type:  
*your\_CD-ROM\_drive\_letter\Win2k\IBMSdd\ql22clus.reg*  
(where *your\_CD-ROM\_drive\_letter\* is the drive letter for your CD-ROM).  
  
**Note:** If you don't know the location, you can use the **Look in:** tool to browse for the ql22clus.reg registry file.
5. Press Enter.

## Configuring a Windows 2000 cluster with SDD

The following variables are used in this procedure:

*server\_1* represents the first server with two host bus adapters (HBAs).

*server\_2* represents the second server with two HBAs.

*hba\_a* represents the first HBA for *server\_1*.

*hba\_b* represents the second HBA for *server\_1*.

*hba\_c* represents the first HBA for *server\_2*.

*hba\_d* represents the second HBA for *server\_2*.

Perform the following steps to configure a Windows 2000 cluster with SDD:

1. Configure LUNs on the ESS as shared for all HBAs on both *server\_1* and *server\_2*.
2. Connect *hba\_a* to the ESS, and restart *server\_1*.
3. Click **Start** → **Programs** → **Administrative Tools** → **Computer Management**. The Computer Management window opens. From the Computer Management window, select Storage and then Disk Management to work with the storage devices attached to the host system.  
The operating system will recognize each additional path to the same LUN as a device.
4. Disconnect *hba\_a* and connect *hba\_b* to the ESS. Restart *server\_1*.
5. Click **Start** → **Programs** → **Administrative Tools** → **Computer Management**. The Computer Management window opens. From the Computer Management window, select Storage and then Disk Management to verify the correct number of LUNs that are connected to *server\_1*.  
If the number of LUNs that are connected to *server\_1* is correct, proceed to 6.  
If the number of LUNs that are connected to *server\_1* is incorrect, perform the following steps:
  - a. Verify that the cable for *hba\_b* is connected to the ESS.
  - b. Verify your LUN configuration on the ESS.
  - c. Repeat steps 2 - 5.
6. Install SDD on *server\_1*, and restart *server\_1*.  
For installation instructions, go to “Installing the Subsystem Device Driver” on page 79 section.
7. Connect *hba\_c* to the ESS, and restart *server\_2*.
8. Click **Start** → **Programs** → **Administrative Tools** → **Computer Management**. The Computer Management window opens. From the Computer Management window, select Storage and then Disk Management to verify the correct number of LUNs that are connected to *server\_2*.  
The operating system will see each additional path to the same LUN as a device.
9. Disconnect *hba\_c* and connect *hba\_d* to the ESS. Restart *server\_2*.
10. Click **Start** → **Programs** → **Administrative Tools** → **Computer Management**. The Computer Management window is displayed. From the Computer Management window, select Storage and then Disk Management to verify the correct number of LUNs that are connected to *server\_2*.  
If the number of LUNs that are connected to *server\_2* is correct, proceed to 11.  
If the number of LUNs that are connected to *server\_2* is incorrect, perform the following steps:
  - a. Verify that the cable for *hba\_d* is connected to the ESS.
  - b. Verify your LUN configuration on the ESS.
  - c. Repeat steps 7 - 10.
11. Install SDD on *server\_2*, and restart *server\_2*.  
For installation instructions, go to “Installing the Subsystem Device Driver” on page 79 section.
12. Connect both *hba\_c* and *hba\_d* on *server\_2* to the ESS, and restart *server\_2*.
13. Use the **datapath query adapter** and **datapath query device** commands to verify the correct number of LUNs and paths on *server\_2*.

14. Click **Start** → **Programs** → **Administrative Tools** → **Computer Management**. The Computer Management window opens. From the Computer Management window, select Storage and then Disk Management to verify that the actual number of LUNs as online devices is correct.
15. Format the raw devices with NTFS.  
Make sure to keep track of the assigned drive letters on *server\_2*.
16. Connect both *hba\_a* and *hba\_b* on *server\_1* to the ESS, and restart *server\_1*.
17. Use the **datapath query adapter** and **datapath query device** commands to verify the correct number of LUNs and paths on *server\_1*.  
Verify that the assigned drive letters on *server\_1* match the assigned drive letters on *server\_2*.
18. Restart *server\_2*.
  - Install the MSCS software on *server\_1*, restart *server\_1*, reapply Service Pack 2 or higher to *server\_1*, and restart *server\_1* again.
  - Install the MSCS software on *server\_2*, restart *server\_2*, reapply Service Pack 2 to *server\_2*, and restart *server\_2* again.
19. Use the **datapath query adapter** and **datapath query device** commands to verify the correct number of LUNs and paths on *server\_1* and *server\_2*. (This step is optional.)

**Note:** You can use the **datapath query adapter** and **datapath query device** commands to show all the physical and logical volumes for the host server. The secondary server only shows the physical volumes and the logical volumes that it owns.

---

## Chapter 5. SDD for a Hewlett-Packard host system

This chapter provides procedures for you to install, configure, remove, and use the SDD on a Hewlett-Packard (HP) host system that is attached to an ESS. For updated and additional information not included in this manual, please see the README file on the compact disc or go to the SDD Web site at:

[www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates](http://www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates)

---

### Verifying the hardware and software requirements

You must meet the following minimum hardware and software requirements for installing SDD on your HP host system:

- A PA-RISC system running HP-UX 11.00
- A multiport storage subsystem, such as ESS
- At least one SCSI host adapter (two are required for load balancing and failover)  
To install SDD and use the input-output (I/O) load-balancing and failover features, you need a minimum of two SCSI or fibre-channel adapters.

A host system with a single fibre adapter that connects through a switch to multiple ESS ports is considered a multiple fibre-channel connection.

For information on the fibre-channel adapters that can be used on your HP host system go to [www.storage.ibm.com/hardsoft/products/ess/supserver.htm](http://www.storage.ibm.com/hardsoft/products/ess/supserver.htm)

- A SCSI cable to connect each SCSI host adapter to a storage system controller port
- Subsystem LUNs which have been created and confirmed for multi-port access
- A fiber-optic cable to connect each fibre-channel adapter to a ESS port

SDD does not support the following environments:

- A system start from an SDD pseudo device
- A system paging file on an SDD pseudo device
- A host system with a single-path fibre connection to an ESS
- A host system with SCSI connections and a single-path fibre connection to an ESS
- A host system with both a SCSI and fibre-channel connection to a shared LUN.

### Support for 32-bit and 64-bit applications on HP-UX 11.0 and HP-UX 11i

SDD supports 32-bit and 64-bit applications on HP-UX 11.0. and HP-UX 11i

**Attention:** HP patches (as appropriate for a 32-bit or 64-bit application) must be installed on your host system to ensure that SDD operates successfully. See Table 19 on page 89.

### Understanding how SDD works for an HP host system

SDD resides above the HP SCSI disk driver (sdisk) in the protocol stack (see ).

SDD devices behave exactly like sdisk devices. Any operation on an sdisk device can be performed on the SDD device, including commands such as **mount**, **open**, **close**, **umount**, **dd**, **newfs**, or **fsck**. For example, with SDD you use the **mount /dev/dsk/vpath0 /mnt1** command instead of the HP-UX **mount /dev/dsk/clt2d0 /mnt1** command.

SDD acts as a pass-through agent. I/O operations sent to SDD are passed to an sdisk driver after path selection. When an active path experiences a failure (such as a cable or controller failure), SDD dynamically switches to another path. The device driver dynamically balances the load based on the workload of the adapter.

SDD also supports one SCSI adapter on the host system. With single-path access, concurrent download of licensed internal code is supported. However, the load-balancing and failover features are not available.

---

## Preparing for SDD installation

Before you install SDD, you must configure the ESS to your host system and required fibre-channel adapters are attached.

## Configuring the ESS

Before you install SDD, configure your ESS for single-port or multiport access for each LUN. SDD requires a minimum of two independent paths that share the same logical unit to use the load-balancing and failover features.

For information about configuring your ESS, see *IBM Enterprise Storage Server Introduction and Planning Guide*.

## Planning for installation

Before you install SDD on your HP host, you need to understand what kind of software runs on your host. The way you install SDD depends on the kind of software you have running. There are two types of special device files that are supported:

- Block device files
- Character device files

There are three possible scenarios for installing SDD. The scenario you choose depends on the kind of software you have installed:

### Scenario 1

Your system has no software applications (other than UNIX) or DBMS that communicates directly to the HP-UX disk device layer.

### Scenario 2

Your system already has a software application or DBMS, such as Oracle, that communicates directly with the HP-UX disk device layer.

### Scenario 3

Your system already has SDD and you want to upgrade the software.

Table 18 further describes the various installation scenarios and how you should proceed.

*Table 18. SDD installation scenarios*

Installation scenario	Description	How to proceed
Scenario 1	<ul style="list-style-type: none"> <li>• SDD is not installed.</li> <li>• No software application or DBMS communicates directly to sdisk interface.</li> </ul>	Go to: <ol style="list-style-type: none"> <li>1. "Installing the Subsystem Device Driver" on page 89</li> <li>2. "Standard UNIX applications" on page 94</li> </ol>

Table 18. SDD installation scenarios (continued)

Scenario 2	<ul style="list-style-type: none"> <li>SDD is not installed.</li> <li>An existing application package or DBMS communicates directly to the sdisk interface.</li> </ul>	Go to: <ol style="list-style-type: none"> <li>“Installing the Subsystem Device Driver”</li> <li>“Using applications with SDD” on page 94</li> </ol>
Scenario 3	SDD is installed.	Go to “Upgrading the Subsystem Device Driver” on page 92

For SDD to operate properly on HP-UX 11.0 and HP-UX 11i, ensure that the patches in Table 19 are installed on your host system.

Table 19. HP patches necessary for proper operation of SDD

Application mode	HP patch	Patch description
32-bit	PHKL_20674	Fix VxFS unmount hang & NMF, sync panics
32-bit	PHKL_20915	Trap-related panics/hangs
32-bit	PHKL_21834	Fibre channel Mass Storage Driver Patch
32-bit	PHKL_22759	SCSI IO Subsystem Cumulative patch
32-bit	PHKL_23001	Signal, threads, spinlock, scheduler, IDS, q3p
32-bit	PHKL_23406	Probe, sysproc, shmem, thread cumulative patch
32-bit or 64-bit	PHKL_21392	VxFS performance, hang, icache, DPFs
32-bit or 64-bit	PHKL_21624	start, JFS, PA8600, 3Gdata, NFS, IDS, PM, VM, async
32-bit or 64-bit	PHKL_21989	SCSI IO Subsystem Cumulative patch
64-bit	PHKL_21381	Fibre Channel Mass Storage driver

## Installing the Subsystem Device Driver

Before you install SDD, make sure that you have root access to your HP host system and that all the required hardware and software is ready.

Perform the following steps to install SDD on your HP host system:

- Make sure that the SDD compact disc (CD) is available.
- Insert the CD into your CD-ROM drive.
- Mount the CD-ROM drive using the **mount** command. Here are two examples of the **mount** command:

```
mount /dev/dsk/c0t2d0 /cdrom
```

or

```
mount /dev/dsk/c0t2d0 /your_installation_directory
```

where */cdrom* or */your\_installation\_directory* is the name of the directory to which you want to mount the CD-ROM drive.

- Run the **sam** program.
 

```
> sam
```
- Select **Software Management**.
- Select **Install Software to Local Host**.

7. At this point, the **SD Install - Software Selection** panel is displayed. Almost immediately afterwards, a Specify Source menu is displayed:
  - a. For **Source Depot Type**, select the local CD-ROM.
  - b. For **Source Depot Path**, choose the directory and the IBMdpo.depot file.  
 For 32-bit mode applications, use:  
`/cdrom/hp32bit/IBMdpo.depot`  
 or  
`/your_installation_directory/hp32bit/IBMdpo.depot`  
 For 64-bit mode applications, use:  
`/cdrom/hp64bit/IBMdpo.depot`  
 or  
`/your_installation_directory/hp32bit/IBMdpo.depot`
  - c. Click **OK**.  
 You will see output similar to that in either Figure 3 or Figure 4.

Name	Revision	Information	Size(Kb)
<b>IBMdpo_tag</b> ->	B.11.00.01	IBMdpo Driver 32-bit	<i>nnnn</i>

Figure 3. IBMdpo Driver 32-bit

Name	Revision	Information	Size(Kb)
<b>IBMdpo_tag</b> ->	B.11.00.01	IBMdpo Driver 64-bit	<i>nnnn</i>

Figure 4. IBMdpo Driver 64-bit

8. Click the **IBMdpo\_tag** product.
9. Click **Actions** from the Bar menu, and then click **Mark for Install**.
10. Click **Actions** from the Bar menu, and then click **Install (analysis)**. An Install Analysis panel, is displayed showing the status of **Ready**.
11. Click **OK** to proceed. A Confirmation window opens which states that the installation will begin.
12. Type Yes and press Enter. The analysis phase starts.
13. After the analysis phase has finished, another Confirmation window opens informing you that the system will be restarted after installation is complete. Type Yes and press Enter. The installation of IBMdpo will now proceed.
14. An Install window opens informing you about the progress of the IBMdpo software installation. This is what the window looks like:

```

Press 'Product Summary' and/or 'Logfile' for more target information.
Target          : XXXXX
Status          : Building kernel
Percent Complete : 17%
Kbytes Installed : 276 of 1393
Time Left (minutes) : 1
Product Summary  Logfile
Done             Help
  
```

The **Done** option is not available when the installation is in progress. It becomes available after the installation process completes.



15. Click **Done**. A Note window opens informing you that the local system will restart with the newly installed software.
16. Click **OK** to proceed. The following message is displayed on the machine console before it restarts:

```
* A reboot of this system is being invoked. Please wait.

*** FINAL System shutdown message (XXXXX) ***
System going down IMMEDIATELY
```

**Note:** You can use the **datapath query device** command to verify the SDD installation. SDD is successfully installed if the command executes successfully.

## Post-installation

After SDD is installed, the device driver resides above the HP SCSI disk driver (sdisk) in the protocol stack. In other words, SDD now communicates to the HP-UX device layer. The SDD software installation procedure installs a number of SDD components and updates some system files. Those components and files are listed in the following tables.

Table 20. SDD components installed for HP host systems

File	Location	Description
libvpath.a	/usr/conf/lib	SDD device driver
vpath	/usr/conf/master.d	SDD configuration file
Executables	/opt/IBMdpo/bin	Configuration and status tools
README.sd	/opt/IBMdpo	README file
defvpath	/sbin	SDD configuration file used during startup

Table 21. System files updated for HP host systems

File	Location	Description
system	/stand/build	Forces the loading of the SDD device driver
lvrc	/etc	Causes the <b>defvpath</b> command to run at start time

Table 22. SDD commands and their descriptions for HP host systems

Command	Description
cfgvpath	Configures vpath devices
defvpath	Second part of the <b>cfgvpath</b> command configuration during startup time
showvpath	Lists the configuration mapping between SDD devices and underlying disks
datapath	SDD driver console command tool

If you are not using a DBMS or an application package that communicates directly to the sdisk interface, the installation procedure is nearly complete. However, you still need to customize HP-UX so that standard UNIX applications can use SDD. Go

to “Standard UNIX applications” on page 94 for instructions. If you have a DBMS or an application package installed that communicates directly to the sdisk interface, such as Oracle, go to “Using applications with SDD” on page 94 and read the information specific to the application you are using.

During the installation process, the following files were copied from the IBMdpo\_depot to the system:

#### # Kernel-related files

- /usr/conf/lib/libvpath.a
- /usr/conf/master.d/vpath

#### # SDD driver related files

- /opt/IBMdpo
- /opt/IBMdpo/bin
- /opt/IBMdpo/README.sd
- /opt/IBMdpo/bin/cfgvpath
- /opt/IBMdpo/bin/datapath
- /opt/IBMdpo/bin/defvpath
- /opt/IBMdpo/bin/libvpath.a
- /opt/IBMdpo/bin/pathtest
- /opt/IBMdpo/bin/showvpath
- /opt/IBMdpo/bin/vpath
- /sbin/defvpath

In addition, the /stand/vmunix kernel was created with the device driver. The /stand/system directory was modified in order to add the device driver entry into the file. After these files were created, the /opt/IBMdpo/bin/cfgvpath program was initiated in order to create vpaths in the /dev/dsk and /dev/rdisk directories for all IBM disks which are available on the system. This information is stored in the /opt/IBMdpo file for use after restarting the machine.

**Note:** SDD devices are found in /dev/rdisk and /dev/dsk. The device is named according to the SDD number. A device with a number of 0 would be /dev/rdisk/vpath0.

## Upgrading the Subsystem Device Driver

Upgrading the SDD consists of removing and reinstalling the IBMdpo package. If you are upgrading SDD, go to 92 and then go to “Installing the Subsystem Device Driver” on page 89.

The following procedure explains how to remove the SDD. You must uninstall the current level of SDD before upgrading to a newer level.

Complete the following procedure to uninstall SDD:

1. Restart or unmount all SDD file systems.
2. If you are using SDD with a database, such as Oracle, edit the appropriate database configuration files (database partition) to remove all the SDD devices.
3. Run the **sam** program.  
> sam
4. Click **Software Management**.
5. Click **Remove Software**.

6. Click **Remove Local Host Software**.
7. Click the **IBMdpo\_tag** selection.
  - a. Click **Actions** from the Bar menu, and then select **Mark for Remove**.
  - b. Click **Actions** from the Bar menu, and then select **Remove (analysis)**. A Remove Analysis window opens and shows the status of Ready.
  - c. Click **OK** to proceed. A Confirmation window opens and indicates that the uninstallation will begin.
  - d. Type Yes. The analysis phase starts.
  - e. After the analysis phase has finished, another Confirmation window opens indicating that the system will be restarted after the uninstallation is complete. Type Yes and press Enter. The uninstallation of IBMdpo begins.
  - f. An Uninstall window opens showing the progress of the IBMdpo software uninstallation. This is what the panel looks like:

```

Target      : XXXXX
Status      : Executing unconfigure
Percent Complete : 17%
Kbytes Removed : 340 of 2000
Time Left (minutes) : 5
Removing Software : IBMdpo_tag,.....
  
```

The **Done** option is not available when the installation is in progress. It becomes available after the installation process completes.

8. Click **Done**. A Note window opens informing you that the local system will restart with the newly installed software.
9. Click **OK** to proceed. The following message is displayed on the machine console before it restarts:

```

* A reboot of this system is being invoked. Please wait.

*** FINAL System shutdown message (XXXXX) ***
System going down IMMEDIATELY
  
```

**Note:** When SDD has been successfully uninstalled, the first part of the procedure for upgrading the SDD is complete. To complete an upgrade, you need to reinstall SDD. See the installation procedure in “Installing the Subsystem Device Driver” on page 89.

## Changing an SDD hardware configuration

When adding or removing multiport SCSI devices, you must reconfigure SDD to recognize the new devices. Perform the following steps to reconfigure SDD:

1. Restart the system by typing:
 

```
shutdown -r 0
```
2. Issue the **cfgvpath** command to reconfigure the vpath by typing:
 

```
/opt/IBMdpo/bin/cfgvpath -c
```
3. Restart the system by typing:
 

```
shutdown -r 0
```

---

## Using applications with SDD

If your system already has a software application or a DBMS installed that communicates directly with the HP-UX disk device drivers, you need to insert the new SDD device layer between the software application and the HP-UX disk device layer. You also need to customize the software application to have it communicate with the SDD devices instead of the HP-UX devices.

In addition, many software applications and DBMSs need to control certain device attributes such as ownership and permissions. Therefore, you must ensure that the new SDD devices that these software applications or DBMSs access in the future have the same attributes as the HP-UX sdisk devices that they replace. You need to customize the application or DBMS to accomplish this.

This section contains the procedures for customizing the following software applications and DBMS for use with SDD:

- Standard UNIX applications
- Network File System file systems
- Oracle

### Standard UNIX applications

If you have not already done so, install SDD using the procedure in “Installing the Subsystem Device Driver” on page 89. When this is done, SDD resides above the HP SCSI disk driver (sdisk) in the protocol stack. In other words, SDD now communicates to the HP-UX device layer. To use standard UNIX applications with SDD, you must make some changes to your logical volumes. You must convert your existing logical volumes or create new ones.

Standard UNIX applications such as `newfs`, `fsck`, `mkfs`, and `mount`, which normally take a disk device or raw disk device as a parameter, also accept the SDD device as a parameter. Similarly, entries in files such as `vfstab` and `dfstab` (in the format of `cntndnsn`) can be replaced by entries for the corresponding SDD `vpathNs` devices. Make sure that the devices that are replaced are replaced with the corresponding SDD device. Issue the **`showvpath`** command to list all SDD devices and their underlying disks.

To use the SDD driver for an existing logical volume, you must remove the existing logical volume and volume group and recreate it using the SDD device.

**Attention:** Do not use the SDD for critical file systems needed at startup, such as `/(root)`, `/stand`, `/usr`, `/tmp` or `/var`. Doing so may render your system unusable if SDD is ever uninstalled (for example, as part of an upgrade).

### Creating new logical volumes

The task of creating a new logical volume to use SDD consists of the following subtasks.

**Note:** You must have super-user privileges to perform the following subtasks.

1. Determining the major number of the logical volume device
2. Creating a device node for the logical volume device
3. Creating a physical volume
4. Creating a volume group
5. Creating a logical volume

6. Creating a file system on the volume group
7. Mounting the logical volume.

To create a new logical volume that uses SDD, you first need to determine the major number of the logical volume device.

**Determining the major number of the logical volume device:** Type the following command to determine the major number:

```
# lsdev | grep lv
```

A message similar to the following is displayed:

```
64          64          lv          lvm
```

The first number in the message is the major number of the character device, which is the number you want to use.

**Creating a device node for the logical volume device:** Creating a device node actually consists of:

1. Creating a subdirectory in the /dev directory for the volume group
2. Changing to the /dev directory
3. Creating a device node for the logical volume device

If you do not have any other logical volume devices, you can use a minor number of 0x010000. In this example, assume that you have no other logical volume devices. A message similar to the following is displayed:

```
# mknod group c 64 0x010000
```

Create a physical volume, by performing the procedure in “Creating a physical volume” on page 96.

**Creating a directory in /dev for the volume group:** Type the following command to create a subdirectory in the /dev directory for the volume group:

```
# mkdir /dev/vgibm
```

In this example, vgibm is the name of the directory.

Next, change to the directory that you just created.

**Changing to the /dev directory:** Type the following command to change to the /dev directory:

```
# cd /dev/vgibm
```

Next, recreate a device node for the logical volume device.

**Recreating the physical volume:** Type the following command to recreate the physical volume:

```
# pvcreate /dev/rdisk/vpath0
```

A message similar to the following is displayed:

```
Physical volume "/dev/rdisk/vpath0" has been successfully created.
```

In this example, the SDD device associated with the underlying disk is vpath0. Verify the underlying disk by typing the following **showvpath** command:

```
# /opt/IBMdpo/bin/showvpath
```

A message similar to the following is displayed:

```
vpath0:  
/dev/dsk/c3t4d0
```

Next, create the physical volume.

**Creating a physical volume:** Type the following command to create a physical volume:

```
# pvcreate /dev/rdisk/vpath0
```

Now create the volume group.

**Creating a volume group:** Type the following command to create a volume group:

```
# vgcreate /dev/vgibm /dev/dsk/vpath0
```

Now create the logical volume.

**Creating a logical volume:** Type the following command to create logical volume lv01 :

```
# lvcreate -L 100 -n lv01 vgibm
```

The -L 100 portion of the command makes a 100-MB volume group; you can make it larger if you want to. Now you are ready to create a file system on the volume group.

**Creating a file system on the volume group:** Type the following command to create a file system on the volume group:

```
# newfs -F hfs /dev/vgibm/rlv01
```

Finally, mount the logical volume. This example assumes that you have a mount point called /mnt.

**Mounting the logical volume:** Type the following command to mount the logical volume lv01:

```
# mount /dev/vgibm/lv01 /mnt
```

**Attention:** In some cases it may be necessary to use standard HP recovery procedures to fix a volume group that has become damaged or corrupted. For information about using recovery procedures, such as, vgscan, vgextend, vpcchange, or vgreduce, see the *HP-UX Reference Volume 2* at the following Web site:

docs.hp.com

## Removing logical volumes

Perform the following procedures to remove logical volumes.

**Removing the existing logical volume:** Before the logical volume is removed, it must be unmounted. For example, type the following command to unmount logical volume lv01:

```
# umount /dev/vgibm/lvol1
```

Next, remove the logical volume.

For example, type the following command to remove logical volume lvol1:

```
# lvremove /dev/vgibm/lvol1
```

A message similar to the following is displayed:

```
The logical volume "/dev/vgibm/lvol1" is not empty;
do you really want to delete the logical volume (y/n)
```

Type `y` and press Enter. A message similar to the following is displayed:

```
Logical volume "/dev/vgibm/lvol1" has been successfully removed.
Volume Group configuration for /dev/vgibm has been saved in
/etc/lvmconf/vgibm.conf
```

When prompted to delete the logical volume, type `y`.

Next, remove the volume group.

**Removing the existing volume group:** Type the following command to remove the volume group `vgibm`:

```
# vgremove /dev/vgibm
```

A message similar to the following is displayed:

```
Volume group "/dev/vgibm" has been successfully removed.
```

Now recreate the logical volume.

## Recreating the existing logical volumes

The task of converting an existing logical volume to use SDD consists of the following subtasks:

1. Determining the size of the logical volume
2. Recreating the physical volume
3. Recreating the volume group
4. Recreating the logical volume
5. Setting the correct timeout value for the logical volume manager

**Note:** You must have super-user privileges to perform these subtasks.

As an example, suppose you have a logical volume called `lvol1` under a volume group `vgibm`, which is currently using the disk directly, (for example, through path `/dev` path `/dev/dsk/c3t4d0`). You would like to convert logical volume `lvol1` to use SDD. To recreate the logical volume, you first need to determine the size of the logical volume.

**Determining the size of the logical volume:** Type the following command to determine the size of the logical volume:

```
# lvsdisplay | grep LV Size
```

A message similar to the following is displayed:

```
LV Size (Mbytes) 100
```

In this case, the logical volume size is 100 MB. Next, recreate the physical volume.

**Recreating the physical volume:** Type the following command to recreate the physical volume:

```
# pvcreate /dev/rdisk/vpath0
```

A message similar to the following is displayed:

```
Physical volume "/dev/rdisk/vpath0" has been successfully created.
```

In this example, the SDD device associated with the underlying disk is vpath0. Verify the underlying disk by typing the following command:

```
# /opt/IBMdpo/bin/showvpath
```

A message similar to the following is displayed:

```
vpath0:  
/dev/dsk/c3t4d0
```

Next, recreate the volume group.

**Recreating the volume group:** Type the following command to recreate the volume group:

```
# vgcreate /dev/vgibm /dev/dsk/vpath0
```

A message similar to the following is displayed:

```
Increased the number of physical extents per physical volume to 2187.  
Volume group "/dev/vgibm" has been successfully created.  
Volume Group configuration for /dev/vgibm has been saved in  
/etc/lvmconf/vgibm.conf
```

Now recreate the logical volume.

**Recreating the logical volume:** Recreating the logical volume consists of a number of smaller steps:

1. Recreating the physical volume
2. Recreating the volume group
3. Recreating the logical volume
4. Setting the proper timeout value for the logical volume manager

**Attention:** The recreated logical volume should be the same size as the original volume; otherwise, the recreated volume cannot store the data that was on the original.

Type the following command to recreate the logical volume:

```
# lvcreate -L 100 -n lvoll vgibm
```

A message similar to the following is displayed:



```
Logical volume "/dev/vgibm/lvol1" has been successfully created with
character device "/dev/vgibm/rlvol1".
Logical volume "/dev/vgibm/lvol1" has been successfully extended.
Volume Group configuration for /dev/vgibm has been saved in
/etc/lvmconf/vgibm.conf
```

The `-L 100` parameter comes from the size of the original logical volume, which is determined by using the `lvdisplay` command. In this example, the original logical volume was 100 MB in size.

**Setting the correct timeout value for the logical volume manager:**

**Attention:** The timeout values for the logical volume manager must be set correctly for SDD to operate properly. This is particularly true if you are going to be using concurrent microcode download.

If you are going to be using concurrent microcode download with single-path SCSI, perform the following steps to set the correct timeout value for the logical volume manager:

1. Ensure that the timeout value for an SDD logical volume is set to the default. Type `lvdisplay /dev/vgibm/lvol1` and press Enter. If the timeout value is not default, type `lvchange -t 0 /dev/vgibm/lvol1` and press Enter to change it. (In this example, `vgibm` is the name of the logical volume group that was previously configured to use SDD; in your environment the name may be different.)
2. Change the timeout value for an SDD physical volume to 240. Type `pvchange -t 240 /dev/dsk/vpathn` and press Enter. (*n* refers to the vpath number.) If you are not sure about the vpath number, type `/opt/IBMdpo/bin/showvpath` and press Enter to obtain this information.

If you are going to be using concurrent microcode download with multipath SCSI, perform the following steps to set the proper timeout value for the logical volume manager:

1. Ensure that the timeout value for an SDD logical volume is set to the default. Type `lvdisplay /dev/vgibm/lvol1` and press Enter. If the timeout value is not default, type `lvchange -t 0 /dev/vgibm/lvol1` and press Enter to change it. (In this example, `vgibm` is the name of logical volume group that was previously configured to use SDD; in your environment the name may be different.)
2. Change the timeout value for an SDD physical volume to 240. Type `pvchange -t 240 /dev/dsk/vpathn` and press Enter. (*n* refers to the vpath number.) If you are not sure about the vpath number, type `/opt/IBMdpo/bin/showvpath` and press Enter to obtain this information.
3. The recreated logical volume must be mounted before it can be accessed.

**Attention:** In some cases it may be necessary to use standard HP recovery procedures to fix a volume group that has become damaged or corrupted. For information about using recovery procedures, such as, `vgscan`, `vgextend`, `pvchange`, or `vgreduce`, see the *HP-UX Reference Volume 2* at the following Web site:

[docs.hp.com](http://docs.hp.com)

## Installing SDD on a Network File System file server

The procedures in this section show how to install SDD for use with an exported file system (Network File System file server).

## Setting up Network File System for the first time

Perform the following steps if you are installing exported file systems on SDD devices for the first time:

1. If you have not already done so, install SDD using the procedure in “Installing the Subsystem Device Driver” on page 89.
2. Determine which SDD (vpathN) volumes you will use as file system devices.
3. Create file systems on the selected SDD devices using the appropriate utilities for the type of file system that you will use. If you are using the standard HP-UX UFS file system, type the following command:

```
# newfs /dev/rdsk/vpathN
```

In this example, *N* is the SDD device instance of the selected volume. Create mount points for the new file systems.

4. Install the file systems into the directory `/etc/fstab`. Click **yes** in the **mount at boot** field.
5. Install the file system mount points into the `/etc/exports` directory for export.
6. Restart the system.

## Installing SDD on a system that already has the Network File System file server

Perform the following steps if you have the Network File System file server already configured to:

- Export file systems that reside on a multiport subsystem, and
  - Use SDD partitions instead of sdisk partitions to access them
1. List the mount points for all currently exported file systems by looking in the `/etc/exports` directory.
  2. Match the mount points found in step 1 with sdisk device link names (files named `/dev/(r)dsk/cntndn`) by looking in the `/etc/fstab` directory.
  3. Match the sdisk device link names found in step 2 with SDD device link names (files named `/dev/(r)dsk/vpathN`) by issuing the **showvpath** command.
  4. Make a backup copy of the current `/etc/fstab` file.
  5. Edit the `/etc/fstab` file, replacing each instance of an sdisk device link named `/dev/(r)dsk/cntndn` with the corresponding SDD device link.
  6. Restart the system.
  7. Verify that each exported file system:
    - Passes the start time **fsck pass**
    - Mounts properly
    - Is exported and available to NFS clients

If there is a problem with any exported file system after completing step 7, restore the original `/etc/fstab` file and restart to restore Network File System service. Then review your steps and try again.

## Oracle

You must have super-user privileges to perform the following procedures. You also need to have Oracle documentation on hand. These procedures were tested with Oracle 8.0.5 Enterprise server with the 8.0.5.1 patch set from Oracle.

## Installing an Oracle database for the first time

You can set up your Oracle database in one of two ways. You can set it up to use a file system or raw partitions. The procedure for installing your database differs depending on the choice you make.

### **Using a file system:**

1. If you have not already done so, install SDD using the procedure in “Installing the Subsystem Device Driver” on page 89.
2. Create and mount file systems on one or more SDD partitions. (Oracle recommends three mount points on different physical devices.)
3. Follow the *Oracle Installation Guide* for instructions on installing to a file system. (During the Oracle installation, you will be asked to name three mount points. Supply the mount points for the file systems you created on the SDD partitions.)

**Using raw partitions: Attention:** When using raw partitions, make sure that the ownership and permissions of the SDD devices are the same as the ownership and permissions of the raw devices they are replacing. Make sure that all the databases are closed before making changes.

In the following procedure you will be replacing the raw devices with the SDD devices.

1. If you have not already done so, install SDD using the procedure in “Installing the Subsystem Device Driver” on page 89.
2. Create the Oracle software owner user in the local server `/etc/passwd` file. You must also complete the following related activities:
  - a. Complete the rest of the Oracle preinstallation tasks described in the *Oracle8 Installation Guide*. Plan the installation of Oracle8 on a file system residing on an SDD partition.
  - b. Set up the Oracle user’s `ORACLE_BASE` and `ORACLE_HOME` environment variables to the directories of this file system.
  - c. Create two more SDD-resident file systems on two other SDD volumes. Each of the resulting three mount points should have a subdirectory named `oradata`. The subdirectory is used as a control file and redo log location for the installer’s default database (a sample database) as described in the *Oracle8 Installation Guide*. Oracle recommends using raw partitions for redo logs. To use SDD raw partitions as redo logs, create symbolic links from the three redo log locations to SDD raw device links (files named `/dev/rdsk/vpathNs`, where `N` is the SDD instance number, and `s` is the partition ID) that point to the slice.
3. Determine which SDD (`vpathN`) volumes you will use as Oracle8 database devices.
4. Partition the selected volumes using the HP-UX format utility. If SDD raw partitions are to be used by Oracle8 as database devices, be sure to leave disk cylinder 0 of the associated volume unused. This protects UNIX disk labels from corruption by Oracle8, as described in the *Oracle8 Installation Guide*.
5. Ensure that the Oracle software owner has read and write privileges to the selected SDD raw partition device files under the `/devices` directory.
6. Set up symbolic links from the `oradata` directory (under the first of the three mount points). Link the database files system `<db>.dbf`, `tempdb.dbf`, `rbsdb.dbf`, `toolsd.bdbf`, and `usersdb.dbf` to SDD raw device links (files named `/dev/rdsk/vpathNs`). Point to the partitions of the appropriate size, where `db` is the name of the database that you are creating. (The default is `test`.)

7. Install the Oracle8 server following the instructions in the *Oracle8 Installation Guide*. Be sure to be logged in as the Oracle software owner when you run the **orainst /m** command. Select the **Install New Product - Create Database Objects** option. Select **Raw Devices** for the storage type. Specify the raw device links set up in steps 2 on page 101 and 6 on page 101 for the redo logs and database files of the default database.
8. To set up other Oracle8 databases, you must set up control files, redo logs, and database files following the guidelines in the *Oracle8 Administrator's Reference*. Make sure any raw devices and file systems you set up reside on SDD volumes.
9. Launch the sqlplus utility.
10. Issue the **create database** SQL command, specifying the control, log, and system data files that you have set up.
11. Issue the **create tablespace** SQL command to set up each of the temp, rbs, tools, and users database files that you created.
12. Issue the **create rollback segment** SQL command to create the three redo log files that you set. For the syntax of these three **create** commands, see the *Oracle8 Server SQL Language Reference Manual*.

### Installing an SDD on a system that already has Oracle in place

The installation procedure for a new SDD installation differs depending on whether you are using a file system or raw partitions for your Oracle database.

**If using a file system:** Perform the following procedure if you are installing SDD for the first time on a system with an Oracle database that uses a file system:

1. Record the raw disk partitions being used (they are in the cntndnsn format) or the partitions where the Oracle file systems reside. You can get this information from the `/etc/vfstab` file if you know where the Oracle files are. Your database administrator can tell you where the Oracle files are, or you can check for directories with the name `oradata`.
2. Complete the basic installation steps in "Installing the Subsystem Device Driver" on page 89.
3. Change to the directory where you installed the SDD utilities. Issue the **showvpath** command.
4. Check the display to see whether you find a `cntndn` directory that is the same as the one where the Oracle files are.
5. Use the SDD partition identifiers instead of the original HP-UX identifiers when mounting the file systems.

If you originally used the following HP-UX identifiers:

```
mount /dev/dsk/clt3d2 /oracle/mp1
```

You now use the following SDD partition identifiers:

```
mount /dev/dsk/vpath2 /oracle/mp1
```

For example, assume that you found that `vpath2` was the SDD identifier.

Follow the instructions in the *Oracle Installation Guide* for setting ownership and permissions.

**If using raw partitions:** Perform the following procedure if you have Oracle8 already installed and want to reconfigure it to use SDD partitions instead of `sdisk` partitions (for example, partitions accessed through `/dev/rdisk/cntndn` files).

All Oracle8 control, log, and data files are accessed either directly from mounted file systems or using links from the oradata subdirectory of each Oracle mount point set up on the server. Therefore, the process of converting an Oracle installation from sdisk to SDD has two parts:

- Changing the Oracle physical devices for the mount points' in /etc/fstab from sdisk device partition links to the SDD device partition links that access the same physical partitions.
- Recreating links to raw sdisk device links to point to raw SDD device links that access the same physical partitions.

*Converting an Oracle installation from sdisk to SDD:* Perform the following conversion steps:

1. Back up your Oracle8 database files, control files, and redo logs.
2. Obtain the sdisk device names for the Oracle8 mounted file systems by looking up the Oracle8 mount points in /etc/fstab and extracting the corresponding sdisk device link name (for example, /dev/rdisk/c1t4d0).
3. Launch the sqlplus utility.
4. Type the command:  

```
select * from sys.dba_data_files;
```

Determine the underlying device where each data file resides, either by looking up mounted file systems in /etc/fstab or by extracting raw device link names directly from the **select** command output.

5. Fill in the following table, which is for planning purposes:

Oracle Device Link	File Attributes			SDD Device Link
	Owner	Group	Permissions	
/dev/rdisk/c1t1d0	oracle	dba	644	/dev/rdisk/vpath4

6. Fill in column 2 by issuing the command **ls -l** on each device link listed in column 1 and extracting the link source device file name.
7. Fill in the File Attributes columns by issuing the command **ls -l** on each Actual Device Node from column 2.
8. Install SDD following the instructions in the "Installing the Subsystem Device Driver" on page 89.
9. Fill in the Subsystem Device Driver Device Links column by matching each **cntndnsn** device link listed in the Oracle Device Link column with its associated **vpathN** device link name by typing the following command:  

```
/opt/IBMdpo/bin/showvpath
```
10. Fill in the Subsystem Device Driver Device Nodes column by issuing the command **ls -l** on each SDD Device Link and tracing back to the link source file.
11. Change the attributes of each node listed in the Subsystem Device Driver Device Nodes column to match the attributes listed to the left of it in the File Attributes column using the UNIX **chown**, **chgrp**, and **chmod** commands.
12. Make a copy of the existing /etc/fstab file. Edit the /etc/fstab file, changing each Oracle device link to its corresponding SDD device link.
13. For each link found in an oradata directory, recreate the link using the appropriate SDD device link as the source file instead of the associated sdisk device link listed in the Oracle Device Link column.

14. Restart the server.
15. Verify that all file system and database consistency checks complete successfully.

---

## Chapter 6. SDD for a Sun host system

This chapter provides procedures for you to install, configure, remove, and use the SDD on a Sun host system that is attached to an ESS. For updated and additional information not included in this manual, see the README file on the compact disc or visit the SDD Web site:

[www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates](http://www.ibm.com/storage/support/techsup/swtechsup.nsf/support/sddupdates)

---

### Verifying the hardware and software requirements

You must meet the following minimum hardware and software requirements to install the SDD on your host system:

- A Sparc system running Solaris 2.6, Solaris 7, or Solaris 8
- A multiport storage subsystem; for example, multi-active redundant RAID control-unit image (such as is available in the ESS)
- One or more pairs of SCSI or fibre-channel host adapters
- Subsystem LUNs that have been created and confirmed for multiport access. Each LUN should have up to eight sdisk instances, with one for each path on the server.
- A SCSI cable to connect each SCSI host adapter to a storage system control-unit image port

- A fiber-optic cable to connect each fibre-channel adapter to an ESS port

To install SDD and use the input-output (I/O) load-balancing and failover features, you need a minimum of two SCSI or fibre-channel adapters.

A host system with a single fibre adapter that connects through a switch to multiple ESS ports is considered a multiple fibre-channel connection.

For information on the SCSI or fibre-channel adapters that can be used on your Sun host system go to the following Web site:

[www.storage.ibm.com/hardsoft/products/ess/supserver.htm](http://www.storage.ibm.com/hardsoft/products/ess/supserver.htm)

SDD supports the following environments:

- 32-bit applications on Solaris 2.6.
- 32-bit and 64-bit applications on Solaris 7 and Solaris 8.

SDD does not support the following environments:

- A host system with a single-path fibre connection to an ESS
- A host system with SCSI connections and a single-path fibre connection to an ESS
- A host system with both a SCSI and fibre-channel connection to a shared LUN
- A system start from an SDD pseudo device
- A system paging file on a SDD pseudo device
- Root (/), /var, /usr, /opt, /tmp and swap partitions

### Understanding how SDD works on a Sun host

SDD resides above the Sun SCSI disk driver (sd) in the protocol stack. There can be a maximum of eight sd devices underneath each SDD device in the protocol stack. Each sd device represents a different path to the physical device. There can be up to eight sd devices that represent up to eight different paths to the physical device.

SDD devices behave exactly like sd devices. Any operation on an sd device can be performed on the SDD device, including commands such as **mount**, **open**, **close**, **umount**, **dd**, **newfs**, or **fsck**. For example, with SDD you enter **mount /dev/dsk/vpath0c /mnt1** instead of the Solaris **mount /dev/dsk/c1t2d0s2 /mnt1** command.

SDD acts as a pass-through agent. I/Os sent to the device driver are passed to an sdisk driver after path selection. When an active path experiences a failure (such as a cable or control-unit image failure), the device driver dynamically switches to another path. The device driver dynamically balances the load based on the workload of the adapter.

SDD also supports one SCSI adapter on the host system. With single-path access, concurrent download of licensed internal code is supported. However, the load-balancing and failover features are not available.

---

## Preparing for SDD installation

Before you install SDD, you must configure the ESS to your host system and required fibre-channel adapters are attached.

## Configuring the ESS

Before you install SDD, configure your ESS for single-port or multiport access for each LUN. SDD requires a minimum of two independent paths that share the same logical unit to use the load-balancing and failover features.

For information about configuring your ESS, see *IBM Enterprise Storage Server Introduction and Planning Guide*.

## Planning for installation

Before you install SDD on your Sun host, you need to understand what kind of software is running on it. The way you install SDD depends on the kind of software you are running. Basically, there are three types of software that communicate directly to raw or block disk device interfaces such as sd and SDD:

- UNIX file systems, where there is no logical volume manager present.
- Logical volume managers (LVMs), such as Sun's Solstice Disk Suite. LVMs allow the system manager to logically integrate, for example, several different physical volumes to create the image of a single large volume.
- Major application packages, such as certain database managers (DBMS).

There are three possible scenarios for installing SDD. The scenario you choose depends on the kind of software you have installed:

### Scenario 1

Your system has no volume manager, DBMS, or software applications (other than UNIX) that communicate directly to the Solaris disk device layer

### Scenario 2

Your system already has a volume manager, software application, or DBMS, such as Oracle, that communicates directly with the Solaris disk device drivers

### Scenario 3

Your system already has SDD and you want to upgrade the software



Table 23 further describes the various installation scenarios and how you should proceed.

Table 23. SDD installation scenarios

Installation scenario	Description	How to proceed
Scenario 1	<ul style="list-style-type: none"> <li>SDD is not installed.</li> <li>No volume managers are installed.</li> <li>No software application or DBMS are installed that communicates directly to the sd interface.</li> </ul>	Go to: <ol style="list-style-type: none"> <li>“Installing the Subsystem Device Driver” on page 108</li> <li>“Standard UNIX applications” on page 113</li> </ol>
Scenario 2	<ul style="list-style-type: none"> <li>SDD is not installed.</li> <li>An existing volume manager, software application, or DBMS is installed that communicates directly to the sd interface.</li> </ul>	Go to: <ol style="list-style-type: none"> <li>“Installing the Subsystem Device Driver” on page 108</li> <li>“Using applications with SDD” on page 113</li> </ol>
Scenario 3	SDD is installed.	Go to: “Upgrading the Subsystem Device Driver” on page 111

Table 24 lists the installation package file names that come with SDD.

Table 24. SDD package file names

Package file names	Description
sun32bit/IBMdpo	Solaris 2.6, Solaris 7, Solaris 8
sun64bit/IBMdpo	Solaris 7
sun64bit/IBMdpo	Solaris 8

For SDD to operate properly, ensure that the Solaris patches in Table 25 are installed on your operating system.

Table 25. Solaris patches necessary for proper operation of SDD

Patch name	Solaris 2.6	Solaris 7
glm	105580-15	106925-04
isp	105600-19	106924-06
sd & ssd	105356-16	107458-10

**Attention:** Analyze and study your operating and application environment to ensure there are no conflicts with these patches prior to their installation.

Go to the following Web site for the latest information about Solaris patches:

[sunsolve.Sun.COM](http://sunsolve.Sun.COM)

---

## Installing the Subsystem Device Driver

Before you install SDD, make sure that you have root access to your Sun host system and that all the required hardware and software is ready.

Perform the following steps to install SDD on your Sun host system:

1. Make sure that the SDD compact disc (CD) is available.
  2. Insert the CD into your CD-ROM drive.
  3. Change to the installation directory:
4. Issue the **pkgadd** command, and point the **-d** option of the **pkgadd** command to the directory containing IBMdpo. For example,

```
# cd /cdrom/cdrom0/sun32bit or  
# cd /cdrom/cdrom0/sun64bit
```

```
pkgadd -d /cdrom/cdrom0/sun32bit IBMdpo or  
pkgadd -d /cdrom/cdrom0/sun64bit IBMdpo
```

5. A message similar to the following is displayed:

```
Processing package instance <IBMdpo> from <var/spool/pkg>  
  
IBM DPO driver  
(sparc) 1  
## Processing package information.  
## Processing system information.  
## Verifying disk space requirements.  
## Checking for conflicts with packages already installed.  
## Checking for setuid/setgid programs.  
  
This package contains scripts which will be executed with super-user  
permission during the process of installing this package.  
  
Do you want to continue with the installation of <IBMdpo> [y,n,?]
```

6. Type **y** and press Enter to proceed.
7. A message similar to the following is displayed:

```

Installing IBM DPO driver as <IBMdpo>

## Installing part 1 of 1.
/etc/defvpath
/etc/rc2.d/S00vpath-config
/etc/rcS.d/S20vpath-config
/kernel/drv/vpathdd
/kernel/drv/vpathdd.conf
/opt/IBMdpo/cfgvpath
/opt/IBMdpo/datapath
/opt/IBMdpo/devlink.vpath.tab
/opt/IBMdpo/etc.system
/opt/IBMdpo/pathtest
/opt/IBMdpo/showvpath
/usr/sbin/vpathmkdev
[ verifying class <none> ]
## Executing postinstall script.

DPO: Configuring 24 devices (3 disks * 8 slices)

Installation of <IBMdpo> was successful.

The following packages are available:
1 IBMcli ibm2105cli
   (sparc) 1.1.0.0
2 IBMdpo IBM DPO driver Version: May-10-2000 16:51
   (sparc) 1
Select package(s) you wish to process (or 'all' to process
all packages). (default: all) [?,??,q]:

```

8. Type `q` and press Enter to proceed. A message similar to the following is displayed:

```

*** IMPORTANT NOTICE ***
This machine must now be rebooted in order to ensure
sane operation. Execute
    shutdown -y -i6 -g0
and wait for the "Console Login:" prompt.

DPO is now installed. Proceed to Post-Installation.

```

To verify that SDD has been successfully installed, issue the **datapath query device** command. If the command executes, SDD is installed.

The following procedure explains how to uninstall an SDD. You must uninstall the current level of SDD before upgrading to a newer level.

**Attention:** Do not restart between the uninstallation and the reinstallation of SDD.

Perform the following steps to uninstall SDD:

1. Restart or umount all SDD file systems.
2. If you are using SDD with a database, such as Oracle, edit the appropriate database configuration files (database partition) to remove all the SDD devices.
3. If you are using a database, restart the database.
4. Type `# pkgrm IBMdpo` and press Enter.

**Attention:** A number of different installed packages is displayed. Make sure you specify the correct package to uninstall.

A message similar to the following is displayed:

```
The following packages are available:
1 IBMcli ibm2105cli
  (sparc) 1.1.0.0
2 IBMdpo IBM DPO driver Version: May-10-2000 16:51
  (sparc) 1
```

5. Type **y** and press **Enter**. A message similar to the following is displayed:

```
## Removing installed package instance <IBMdpo>

This package contains scripts that will be executed with super-user
permission during the process of removing this package.

Do you want to continue with the removal of this package [y,n,?,q] y
```

6. Type **y** and press **Enter**. A message similar to the following is displayed:

```
## Verifying package dependencies.
## Processing package information.
## Executing preremove script.
Device busy
Cannot unload module: vpathdd
Will be unloaded upon reboot.
## Removing pathnames in class <none>
/usr/sbin/vpathmkdev
/opt/IBMdpo
/kernel/drv/vpathdd.conf
/kernel/drv/vpathdd
/etc/rcS.d/S20vpath-config
/etc/rc2.d/S00vpath-config
/etc/defvpath
## Updating system information.

Removal of <IBMdpo> was successful.
```

**Attention:** Do not restart at this time.

When SDD has been successfully uninstalled, the first part of the procedure for upgrading the SDD is complete. To complete the upgrade, you now need to reinstall SDD. See “Installing the Subsystem Device Driver” on page 108 for detailed procedures.

## Post-installation

After the installation is complete, manually unmount the compact disc. Issue the **umount /cdrom** command from the root directory. Go to the CD-ROM drive and press the Eject button.

After SDD is installed, your system must be restarted to ensure proper operation. Type the command:

```
# shutdown -i6 -g0 -y
```

SDD devices are found in the `/dev/rdisk` and `/dev/dsk` directories. The device is named according to the SDD instance number. A device with an instance number of 0 would be: `/dev/rdisk/vpath0a` where *a* denotes the slice. Therefore, `/dev/rdisk/vpath0c` would be instance zero and slice 2.

After SDD is installed, the device driver resides above the Sun SCSI disk driver (`sd`) in the protocol stack. In other words, SDD now communicates to the Solaris device layer. The SDD software installation procedure installs a number of SDD components and updates some system files. Those components and files are listed in the following tables.

Table 26. SDD components installed for Sun host systems

File	Location	Description
vpathdd	/kernel/drv	Device driver
vpathdd.conf	/kernel/drv	SDD config file
Executables	/opt/IBMdpo/bin	Configuration and status tools
S20vpath-config	/etc/rcS.d	Boot initialization script (See Note.)
<b>Note:</b> This script must come before other LVM initialization scripts, such as Veritas initialization scripts.		

Table 27. System files updated for Sun host systems

File	Location	Description
/etc/system	/etc	Forces the loading of SDD
/etc/devlink.tab	/etc	Tells the system how to name SDD devices in /dev

Table 28. SDD commands and their descriptions for Sun host systems

Command	Description
cfgvpath	Configures vpath devices
showvpath	Lists all SDD devices and their underlying disks
vpathmkdev	Create SDD devices for /dev/dsk entries
datapath	SDD driver console command tool

If you are not using a volume manager, software application, or DBMS that communicates directly to the sd interface, then the installation procedure is nearly complete. If you have a volume manager, software application, or DBMS installed that communicates directly to the sd interface, such as Oracle, go to “Using applications with SDD” on page 113 and read the information specific to the application you are using.

## Upgrading the Subsystem Device Driver

Upgrading SDD consists of uninstalling and reinstalling the IBMdpo package. If you are upgrading SDD, go to 109 and then go to “Installing the Subsystem Device Driver” on page 108.

The following procedure explains how to remove the SDD. You must uninstall the current level of SDD before upgrading to a newer level.

Complete the following procedure to uninstall SDD:

1. Restart or unmount all SDD file systems.
2. If you are using SDD with a database, such as Oracle, edit the appropriate database configuration files (database partition) to remove all the SDD devices.
3. Run the **sam** program.
  - > sam
4. Click **Software Management**.
5. Click **Remove Software**.

6. Click **Remove Local Host Software**.
7. Click the **IBMdpo\_tag** selection.
  - a. Click **Actions** from the Bar menu, and then select **Mark for Remove**.
  - b. Click **Actions** from the Bar menu, and then select **Remove (analysis)**. A Remove Analysis window opens and shows the status of Ready.
  - c. Click **OK** to proceed. A Confirmation window opens and indicates that the uninstallation will begin.
  - d. Type Yes. The analysis phase starts.
  - e. After the analysis phase has finished, another Confirmation window opens indicating that the system will be restarted after the uninstallation is complete. Type Yes and press Enter. The uninstallation of IBMdpo begins.
  - f. An Uninstall window opens showing the progress of the IBMdpo software uninstallation. This is what the panel looks like:

```

Target      : XXXXX
Status      : Executing unconfigure
Percent Complete : 17%
Kbytes Removed : 340 of 2000
Time Left (minutes) : 5
Removing Software : IBMdpo_tag,.....
  
```

The **Done** option is not available when the installation is in progress. It becomes available after the installation process completes.

8. Click **Done**. A Note window opens informing you that the local system will restart with the newly installed software.
9. Click **OK** to proceed. The following message is displayed on the machine console before it restarts:

```

* A reboot of this system is being invoked. Please wait.

*** FINAL System shutdown message (XXXXX) ***
System going down IMMEDIATELY
  
```

**Note:** When SDD has been successfully uninstalled, the first part of the procedure for upgrading the SDD is complete. To complete an upgrade, you need to reinstall SDD. See the installation procedure in “Installing the Subsystem Device Driver” on page 89.

## Changing an SDD hardware configuration

When adding or removing multiport SCSI devices from your system, you must reconfigure SDD to recognize the new devices. Perform the following steps to reconfigure SDD:

1. Shut down the system. Type `shutdown -i0 -g0 -y` and press Enter.
2. Perform a configuration restart. From the OK prompt, type `boot -r` and press Enter. This uses the current SDD entries during restart, not the new entries. The restart forces the new disks to be recognized.
3. Run the SDD configuration utility to make the changes to the directory `/opt/IBMdpo/bin`. Type `cfgvpath -c` and press Enter.
4. Shut down the system. Type `shutdown -i6 -g0 -y` and press Enter.
5. After the restart, change to the `/opt/IBMdpo/bin` directory by typing:
 

```
cd /opt/IBMdpo/bin
```
6. Type `drvconfig` and press Enter to reconfigure all the drives.

7. Type `vpathmkdev` and press Enter to create all the vpath devices.

---

## Using applications with SDD

If your system already has a volume manager, software application, or DBMS installed that communicates directly with the Solaris disk device drivers, you need to insert the new SDD device layer between the program and the Solaris disk device layer. You also need to customize the volume manager, software application, or DBMS in order to have it communicate with the SDD devices instead of the Solaris devices.

In addition, many software applications and DBMS need to control certain device attributes such as ownership and permissions. Therefore, you must ensure that the new SDD devices that these software applications or DBMSs access have the same attributes as the Solaris `sd` devices that they replace. You need to customize the software application or DBMS to accomplish this.

This section describes how to use the following applications with SDD:

- Standard UNIX applications
- Network File System file systems
- Oracle
- Veritas Volume Manager

### Standard UNIX applications

If you have not already done so, install SDD using the procedure in “Installing the Subsystem Device Driver” on page 108. When this is done, the device driver resides above the Solaris SCSI disk driver (`sd`) in the protocol stack. In other words, SDD now communicates to the Solaris device layer.

Standard UNIX applications, such as `newfs`, `fsck`, `mkfs`, and `mount`, that normally take a disk device or raw disk device as a parameter, also accept the SDD device as a parameter. Similarly, entries in files such as `vfstab` and `dfstab` (in the format of `cntndnsn`) can be replaced by entries for the corresponding SDD `vpathNs` devices. Make sure that the devices that are replaced are replaced with the corresponding SDD device. Issue the `showvpath` command to list all SDD devices and their underlying disks.

### Installing SDD on a Network File System file server

The procedures in this section show how to install SDD for use with an exported file system (Network File System file server).

#### Setting up the Network File System for the first time

Perform the following steps if you are installing exported file systems on SDD devices for the first time:

1. If you have not already done so, install SDD using the procedure in “Installing the Subsystem Device Driver” on page 108.
2. Determine which SDD (`vpathN`) volumes you will use as file system devices.
3. Partition the selected volumes using the Solaris format utility.
4. Create file systems on the selected SDD devices using the appropriate utilities for the type of file system that you will use. If you are using the standard Solaris UFS file system, type the following command:

```
# newfs /dev/rdisk/vpathNs
```

In this example, *N* is the SDD device instance of the selected volume. Create mount points for the new file systems.

5. Install the file systems into the `/etc/fstab` directory. Click yes in the **mount at boot** field.
6. Install the file system mount points into the directory `/etc/exports` for export.
7. Restart the system.

### **Installing SDD on a system that already has the Network File System file server**

Perform the following steps if you have the Network File System file server already configured to:

- Export file systems that reside on a multiport subsystem
  - To use SDD partitions instead of sd partitions to access them
1. List the mount points for all currently exported file systems by looking in the `/etc/exports` directory.
  2. Match the mount points found in step 1 with `sdisk` device link names (files named `/dev/(r)dsk/cntndn`) by looking in the `/etc/fstab` directory.
  3. Match the `sd` device link names found in step 2 with SDD device link names (files named `/dev/(r)dsk/vpathN`) by issuing the **showvpath** command.
  4. Make a backup copy of the current `/etc/fstab` file.
  5. Edit the `/etc/fstab` file, replacing each instance of an `sd` device link named `/dev/(r)dsk/cntndn` with the corresponding SDD device link.
  6. Restart the system
  7. Verify that each exported file system passes:
    - The start time **fsck pass**
    - Mounts properly
    - Is exported and available to NFS clients

If there is a problem with any exported file system after completing step 7, restore the original `/etc/fstab` file and restart to restore Network File System service. Then review your steps and try again.

## **Oracle**

You must have super-user privileges, to perform the following procedures. You also need to have Oracle documentation on hand. These procedures were tested with Oracle 8.0.5 Enterprise server with the 8.0.5.1 patch set from Oracle.

### **Installing an Oracle database for the first time**

You can set up your Oracle database in one of two ways. You can set it up to use a file system or raw partitions. The procedure for installing your database differs depending on the choice you make.

#### ***Using a file system:***

1. If you have not already done so, install SDD using the procedure in “Installing the Subsystem Device Driver” on page 108.
2. Create and mount file systems on one or more SDD partitions. (Oracle recommends three mount points on different physical devices.)
3. Follow the *Oracle Installation Guide* for instructions on installing to a file system. (During the Oracle installation, you will be asked to name three mount points. Supply the mount points for the file systems you created on the SDD partitions.)



**Using raw partitions: Attention:** If using raw partitions make sure all the databases are closed before going further. Make sure that the ownership and permissions of the SDD devices are the same as the ownership and permissions of the raw devices they are replacing. Do not use disk cylinder 0 (sector 0), which is the disk label. Using it corrupts the disk. For example, slice 2 on Sun is the whole disk. If you use this device without repartitioning it to start at sector 1, the disk label is corrupted.

In the following procedure you will be replacing the raw devices with the SDD devices.

1. If you have not already done so, install SDD using the procedure outlined in "Installing the Subsystem Device Driver" on page 108.
2. Create the Oracle software owner user in the local server `/etc/passwd` file. You must also complete the following related activities:
  - a. Complete the rest of the Oracle preinstallation tasks described in the *Oracle8 Installation Guide*. Plan to install Oracle8 on a file system that resides on an SDD partition.
  - b. Set up the Oracle user's `ORACLE_BASE` and `ORACLE_HOME` environment variables to be directories of this file system.
  - c. Create two more SDD-resident file systems on two other SDD volumes. Each of the resulting three mount points should have a subdirectory named `oradata`. The subdirectory is used as a control file and redo log location for the installer's default database (a sample database) as described in the *Installation Guide*. Oracle recommends using raw partitions for redo logs. To use SDD raw partitions as redo logs, create symbolic links from the three redo log locations to SDD raw device links (files named `/dev/rdisk/vpathNs`, where N is the SDD instance number, and s is the partition ID) that point to the slice.
3. Determine which SDD (`vpathN`) volumes you will use as Oracle8 database devices.
4. Partition the selected volumes using the Solaris format utility. If SDD raw partitions are to be used by Oracle8 as database devices, be sure to leave sector 0/disk cylinder 0 of the associated volume unused. This protects UNIX disk labels from corruption by Oracle8.
5. Ensure that the Oracle software owner has read and write privileges to the selected SDD raw partition device files under the `/devices/pseudo` directory.
6. Set up symbolic links in the `oradata` directory under the first of the three mount points. See step 2 on page 115. Link the database files to SDD raw device links (files named `/dev/rdisk/vpathNs`) that point to partitions of the appropriate size.
7. Install the Oracle8 server following the instructions in the *Oracle Installation Guide*. Be sure to be logged in as the Oracle software owner when you run the `oraInst /m` command. Select the **Install New Product - Create Database Objects** option. Select **Raw Devices** for the storage type. Specify the raw device links set up in step 2 for the redo logs. Specify the raw device links set up in step 3 for the database files of the default database.
8. To set up other Oracle8 databases, you must set up control files, redo logs, and database files following the guidelines in the *Oracle8 Administrator's Reference*. Make sure any raw devices and file systems you set up reside on SDD volumes.
9. Launch the `sqlplus` utility.
10. Issue the **create database** SQL command, specifying the control, log, and system data files that you have set up.

11. Issue the **create tablespace** SQL command to set up each of the temp, rbs, tools, and users database files that you created.
12. Issue the **create rollback segment** SQL command to create the three redo log files that you set. For the syntax of these three **create** commands, see the *Oracle8 Server SQL Language Reference Manual*.

### Installing an SDD on a system that already has Oracle in place

The installation procedure for a new SDD installation differs depending on whether you are using a file system or raw partitions for your Oracle database.

**If using a file system:** Perform the following procedure if you are installing SDD for the first time on a system with an Oracle database that uses a file system:

1. Record the raw disk partitions being used (they are in the cntndnsn format) or the partitions where the Oracle file systems reside. You can get this information from the `/etc/vfstab` file if you know where the Oracle files are. Your database administrator can tell you where the Oracle files are, or you can check for directories with the name `oradata`.
2. Complete the basic installation steps in “Installing the Subsystem Device Driver” on page 108.
3. Change to the directory where you installed the SDD utilities. Issue the **showvpath** command.
4. Check the display to see whether you find a `cntndn` directory that is the same as the one where the Oracle files are. For example, if the Oracle files are on `c1t8d0s4`, look for `c1t8d0s2`. If you find it, you will know that `/dev/dsk/vpath0c` is the same as `/dev/dsk/ct18d2s2`. (SDD partition identifiers end in an alphabetical character from a -g rather than `s0`, `s1`, `s2`, etc.) Write this down. A message similar to the following is displayed:

```
vpath0c
  c1t8d0s2  /devices/pci@1f,0/pci@1/scsi@2/sd@1,0:c,raw
  c2t8d0s2  /devices/pci@1f,0/pci@1/scsi@2,1/sd@1,0:c,raw
```

5. Use the SDD partition identifiers instead of the original Solaris identifiers when mounting the file systems.

If you originally used the following Sun identifiers:

```
mount /dev/dsk/c1t3d2s4 /oracle/mp1
```

you now use the following SDD partition identifiers:

```
mount /dev/dsk/vpath2e /oracle/mp1
```

For example, assume you found that `vpath2c` was the SDD identifier.

Follow the instructions in *Oracle Installation Guide* for setting ownership and permissions.

**If using raw partitions:** Perform the following procedure if you have Oracle8 already installed and want to reconfigure it to use SDD partitions instead of `sd` partitions (for example, partitions accessed through `/dev/rdisk/cntndn` files).

If the Oracle8 installation is accessing Veritas logical volumes, go to “Veritas Volume Manager” on page 118 for information about installing SDD with that application.

All Oracle8 control, log, and data files are accessed either directly from mounted file systems, or through links from the oradata subdirectory of each Oracle mount point set up on the server. Therefore, the process of converting an Oracle installation from sd to SDD is changing the Oracle mount points' physical devices in /etc/fstab from sd device partition links to the SDD device partition links that access the same physical partitions, and then recreating any links to raw sd device links to point to raw SDD device links that access the same physical partitions.

*Converting an Oracle installation from sd to SDD partitions:* Perform the following steps to convert an Oracle installation from sd to SDD partitions:

1. Back up your Oracle8 database files, control files, and redo logs.
2. Obtain the sd device names for the Oracle8 mounted file systems by looking up the Oracle8 mount points in /etc/vfstab and extracting the corresponding sd device link name (for example, /dev/rdisk/c1t4d0s4).

3. Launch the sqlplus utility.

4. Type the command:

```
select * from sys.dba_data_files;
```

The output lists the locations of all data files in use by Oracle. Determine the underlying device that each data file resides on, either by looking up mounted file systems in the /etc/vfstab file or by extracting raw device link names directly from the **select** command output.

5. Issue the **ls -l** command on each device link found in step 4 and extract the link source device file name. For example, if you type the command:

```
# ls -l /dev/rdisk/c1t1d0s4
```

A message similar to the following is displayed:

```
/dev/rdisk/c1t1d0s4 /devices/pci@1f,0/pci@1/scsi@2/sd@1,0:e
```

6. Write down the file ownership and permissions by issuing the **ls -lL** command on either the files in /dev/ or /devices (it yields the same result). For example, if you type the command:

```
# ls -lL /dev/rdisk/c1t1d0s4
```

A message similar to the following is displayed:

```
crw-r--r-- oracle dba 32,252 Nov 16 11:49 /dev/rdisk/c1t1d0s4
```

7. Complete the basic installation steps in "Installing the Subsystem Device Driver" on page 108.
8. Match each cntndns device with its associated vpathNs device link name by issuing the **showvpath** command. Remember that vpathNs partition names use the letters a - h in the s position to indicate slices 0 - 7 in the corresponding cntndns slice names.
9. Issue the **ls -l** command on each SDD device link.
10. Write down the SDD device nodes for each SDD device link by tracing back to the link source file.
11. Change the attributes of each SDD device to match the attributes of the corresponding disk device using the **chgrp** and **chmod** commands.
12. Make a copy of the existing /etc/vfstab file for recovery purposes. Edit the /etc/vfstab file, changing each Oracle device link to its corresponding SDD device link.

13. For each link found in an oradata directory, recreate the link using the appropriate SDD device link as the source file instead of the associated sd device link. As you perform this step, generate a reversing shell script that can restore all the original links in case of error.
14. Restart the server.
15. Verify that all file system and database consistency checks complete successfully.

## Veritas Volume Manager

For these procedures, you should have a copy of the *Veritas Volume Manager System Administrator's Guide* and the *Veritas Volume Manager Command Line Interface for Solaris* book. These publications can be found at the following Web site:

[www.sun.com/products-n-solutions/hardware/docs/Software/Storage\\_Software/VERITAS\\_Volume\\_Manager/index.html](http://www.sun.com/products-n-solutions/hardware/docs/Software/Storage_Software/VERITAS_Volume_Manager/index.html)

These procedures were tested using Veritas 3.0.1. The Sun patches 105223 and 105357 must be installed with Veritas (this is a Veritas requirement).

You must have super-user privileges to perform these procedures.

### Installing Veritas Volume Manager for the first time

Perform the instructions in this section if you are installing Veritas on the multiport subsystem server for the first time. Installing Veritas for the first time on a SDD system consists of the following tasks:

1. Installing SDD using the procedure in "Installing the Subsystem Device Driver" on page 108, if you have not already done so
2. Adding a Solaris hard disk device to the Veritas root disk group (rootdg)
3. Adding an SDD device to Veritas
4. Creating a new disk group from an SDD device
5. Creating a new volume from an SDD device

#### ***Adding a Solaris hard disk device to the Veritas root disk group (rootdg):***

During the installation, Veritas requires that at least one disk device be added to the Veritas root disk group (rootdg). This device must be a standard Solaris hard disk device and not an SDD device. It is important that the last disk in the rootdg be a regular disk and not an SDD device. Therefore, it is recommended that you use a different disk group for your SDD disks.

SDD disks may only be added to a Veritas disk group as a whole, for example, any previous partitioning is ignored. The c partition (the whole disk) is used. For example, the SDD device name for the disk in the /dev/dsk and /dev/rdisk directories would be vpath0c. Veritas always looks in these directories by default, so only the device name is needed, for example, vpath0c, when issuing Veritas commands.

Partitioning of the given disk once it has been added to a Veritas disk group is achieved by dividing the Veritas disk into Veritas subdisks.

***Adding an SDD device to Veritas:*** The following is an example of a command that adds an SDD device to Veritas:

```
vxdisk -f init vpath0c
```

After running this command, the Veritas graphical user interface tool (VMSA) can be used to create a new disk group and a new volume from an SDD device.

**Note:** VMSA and the command-line interface are the only supported methods of creating new disks or volumes with Veritas.

**Creating a new disk group from an SDD device:** The following command creates a new disk group from the SDD physical device. In this example, the new disk group is called `ibmdg` and the disk is `vpath0c`.

```
vx dg init ibmdg vpath0c
```

You can add an SDD device to an existing disk group using the **`vx dgadd`** command.

**Creating a new volume from an SDD device:** The following command allows the maximum size of the disk `vpath0c` in blocks:

```
/usr/sbin/vxassist -g ibmdg -p maxsize [vpath0c]
```

Write down the output of the last command and use it in the next command, which creates a volume called `ibmv` within the disk group called `ibmdg`.

The command to create a volume is:

```
/usr/sbin/vxassist -g ibmdg make ibmv 17846272 layout=nostripe
```

You can change the size of the volume and use less than the maximum number of blocks.

## Installing SDD on a system that already has Veritas Volume Manager in place

This section describes the Veritas command-line instructions needed to reconfigure a Veritas volume for use as an SDD disk device. This reconfiguration process consists of the following tasks:

- Adding SDD devices to the disk group that corresponds to the existing sd disks
- Setting the size of an SDD device to that of the original disk
- Setting the size of the original device to zero

At the conclusion, you will have a disk group that contains twice the number of devices as the original disk group. The new SDD devices in the disk group will be the same size as the original sd disks. The Solaris operating system will use the SDD devices and not the original sd disk.

Versions of Veritas that support multipathing (dpm) must be disabled. See *Veritas Volume Manager Release Notes* for instructions about disabling multipathing. Some versions of Veritas do not support the disabling of multipathing (dpm). In that case, you must first upgrade to a version of Veritas that supports disabling before proceeding. See the Veritas Volume Manager documentation for further details.

The following procedure assumes that you have:

1. Configured Veritas volumes to use Solaris disk device drivers for accessing the multiport subsystem drives.
2. Created SDD devices that refer to the same multiport subsystem drive.

These instructions help you replace all `sd` references to the original hard disks that occur in the Veritas volume configuration with references to the SDD devices. The example provided shows the general method for replacing the `sd` device with the

corresponding SDD device in an existing Veritas volume. At least one device in the rootdg disk group must be a non-SDD disk; do not attempt to change all the disks in rootdg to SDD devices.

The example uses the following identifiers:

**ibmv** The Veritas volume.

**ibmv-01**

The plex associated with the ibmv volume.

**disk01-01**

Veritas VM disk containing the original Sun hard disk device.

**vpath0c**

The SDD device that refers to the same hard disk that disk01-01 does.

**c1t1d0s2**

The sd disk associated with vpath0c and disk01-01.

**disk02**

Veritas VM disk containing the vpath0c device.

**rootdg**

The name of the Veritas disk group to which ibmv belongs.

A simplifying assumption is that the original volume, ibmv, contains exactly one subdisk. However, the method outlined here should be easy to adapt to other cases.

Before proceeding,

1. Record the multiport subsystem device links (/dev/(r)dsk/cntndnsn) being used as Veritas volume device files.
2. Determine the corresponding SDD device link (/dev/(r)dsk/vpathNs) using the **showvpath** command.
3. Record this information.

***Reconfiguring a Veritas Volume to use an SDD disk device:***

1. If you have not already done so, install SDD using the procedure in “Installing the Subsystem Device Driver” on page 108.
2. Type the following command to display information about the disk that is used in the volume ibmv.

```
vxdisk list c1t1d0
```

A message similar to the following is displayed:

```
public: slice=4 offset=0 len=17846310
private: slice=3 offset=1 len=2189
```

From this information, calculate the parameters privlen (length of the private region) and puboffset (offset of the public region). In this case, privlen=2189, and puboffset=2190 because puboffset is one block more than the length of privlen.

3. Type the following command to initialize the SDD device for use by Veritas as a simple disk, using the privlen and puboffset values from step 2.

```
vxdisk -f init vpath0c puboffset=2190 privlen=2189
```

4. Type the following command to add the SDD device to the disk group:

```
vxvg -g rootdg adddisk disk02=vpath0c
```

5. Type the following commands to ensure that the file systems that are part of this volume are not mounted and to stop the volume:

```
umount /ibmvfs  
vxvol -g rootdg stop ibmv
```

6. Type the following command to get the volume length (in sectors). This information is used in later steps. For this example, a volume length of 17846310 is assumed:

```
vxprint ibmv
```

7. Type the following commands to disassociate the plex and not delete it:

```
vxplex -g rootdg dis ibmv-01  
vxvol -g rootdg set len=0 vol01
```

**Note:** The plex should remain to serve as backup should backing out of the SDD installation be necessary.

8. Type the following command to create a subdisk from the SDD VM disk. Use the length (len) from step 6.

```
vxmake -g rootdg sd disk02-01 disk02,0,17846310
```

9. Type the following command to create a new plex called ibmv-02 that contains the disk02-01 subdisk:

```
vxmake -g rootdg plex ibmv-02 sd=disk02-01
```

10. Type the following commands to attach the plex to the volume. Use the length (len) from step 6.

```
vxplex -g rootdg att ibmv ibmv-02  
vxvol set len=17846310 ibmv
```

11. Type the following command to make the volume active:

```
vxvol -g rootdg init active ibmv
```

When a disk is initialized for use by Veritas, it is repartitioned as a sliced disk containing a private region at slice 3 and a public region at slice 4. The length and offsets of these regions can be displayed using the **vxdisk list cntndn** command. When using an sd device as an SDD device, you must initialize the SDD disk as a simple disk. This simple disk uses only a single slice (slice 2). The private region starts at block 1 after the disk VTOC region, which is situated at block 0. The length of the private region varies with the type of disk used, with the public region following the private region.

12. After verifying that everything is working correctly, you can delete the original disk.

## Solstice DiskSuite

For these procedures, you need access to the Solaris answerbook facility. These procedures were tested using Solstice DiskSuite 4.2 with the patch 106627-04 (DiskSuite patch) installed. You should have a copy of the *DiskSuite Administration Guide* available to complete these procedures. You must have super-user privileges to perform these procedures.

### Installing Solstice DiskSuite for the first time

Perform the following steps if you are installing Solstice DiskSuite on the multiport subsystem server for the first time. Perform the following steps to install the Solstice DiskSuite for the first time on an SDD system:

1. Install SDD using the procedure in "Installing the Subsystem Device Driver" on page 108, if you have not already done so.

2. Configure the Sparc server to recognize all devices over all paths using the **boot -r** command.
3. Install the Solstice DiskSuite packages and the answerbook. Do not restart yet.

**Note:** Do not install the DiskSuite Tool (metatool).

4. Determine which vpath devices you will use to create Disk Suite metadevices. Partition these devices by selecting them in the Solaris format utility. The devices appear as vpathNs, where *N* is the vpath driver instance number. Use the partition submenu, just as you would for an sd device link of the form, cntndn. If you want to know which cntndn links correspond to a particular vpath device, type the **showvpath** command and press Enter. Reserve at least three partitions of three cylinders each for use as DiskSuite Replica database locations.

**Note:** You do not need to partition any sd (cntndn) devices.

5. Set up the replica databases on a partition of its own. This partition needs to be at least three partitions of three cylinders. Do not use a partition that includes Sector 0 for this database replica partition. Perform the following instructions for setting up replica databases on the vpathNs partitions, where *N* is the vpath device instance number and *s* is the letter denoting the three-cylinder partition, or slice, of the device that you wish to use as a replica. Remember that partitions a - h of a vpath device correspond to slices 0 - 7 of the underlying multiport subsystem device.
6. Follow the instructions in the *DiskSuite Administration Guide* to build the types of metadevices you need, using the **metainit** command and the /dev/(r)dsk/vpathNs device link names, wherever the instructions specify /dev/(r)dsk/cntndnsn device link names.
7. Insert the setup of all vpathNs devices used by DiskSuite into the /etc/opt/SUNWmd/md.tab file.

## Installing SDD on a system that already has Solaris DiskSuite in place

Perform the following steps if Solaris DiskSuite is already installed:

1. Back up all data.
2. Back up the current Solstice configuration by making a copy of the /etc/opt/SUNWmd/md.tab file, and recording the output of the **metastat** and **metadb -i** commands. Make sure all sd device links in use by DiskSuite are entered in md.tab, and that they all come up properly after a restart.
3. Install SDD using the procedure in “Installing the Subsystem Device Driver” on page 108, if you have not already done so. After the installation completes, type the **shutdown -i6 -y -g0** command and press Enter. This verifies the vpath installation.

**Note:** Do not do a reconfiguration restart.

4. Using a plain sheet of paper, make a two-column list matching up the /dev/(r)dsk/cntndnsn device links found in step 2 with the corresponding /dev/(r)dsk/vpathNs device links using the **showvpath** command.
5. Delete each replica database currently configured with a /dev/(r)dsk/cntndnsn device by using the **metadb -d -f <device>** command. Replace the replica database with the corresponding /dev/(r)dsk/vpathNs device found in step 2 by using the **metadb -a <device>** command.
6. Create a new md.tab file, inserting the corresponding vpathNs device link name in place of each cntndnsn device link name. Do not do this for start



device partitions (vpath does not currently support these). When you are confident that the new file is correct, install it in the /etc/opt/SUNWmd directory.

7. Restart the server, or proceed to the next step if you wish to avoid restarting your system.

To back out vpath in case of any problems following step 7, reverse the procedures in step 6, reinstall the original md.tab into /etc/opt/SUNWmd, issue the **pkgrm IBMdpo** command, and restart.

8. Stop all applications using DiskSuite, including file systems.
9. Type the following commands for each existing metadevice:

```
metaclear <device>
metainit -a
```

10. Restart your applications.

### Setting up UFS logging on a new system

For these procedures, you need access to the Solaris answerbook facility. You must have super-user privileges to perform these procedures.

Perform the following steps if you are installing a new UFS logging file system on vpath devices:

1. Install SDD using the procedure in “Installing the Subsystem Device Driver” on page 108, if you have not already done so.
2. Determine which vpath (vpathNs) volumes you will use as file system devices. Partition the selected vpath volumes using the Solaris format utility. Be sure to create partitions for UFS logging devices as well as for UFS master devices.
3. Create file systems on the selected vpath UFS master device partitions using the **newfs** command.
4. Install Solstice DiskSuite if you have not already done so.
5. Create the metatrans device using metainit. For example, assume /dev/dsk/vpath0d is your UFS master device used in step 3, /dev/dsk/vpath0e is its corresponding log device, and d0 is the trans device you want to create for UFS logging. Type `metainit d0 -t vpath0d vpath0e` and press Enter.
6. Create mount points for each UFS logging file system you have created using steps 3 and 5.
7. Install the file systems into the /etc/vfstab directory, specifying /dev/md/(r)dsk/d <metadevice number> for the raw and block devices. Set the **mount at boot** field to yes.
8. Restart your system.

### Installing vpath on a system that already has UFS logging in place

Perform the following steps if you already have UFS logging file systems residing on a multiport subsystem and if you wish to use vpath partitions instead of sd partitions to access them.

1. Make a list of the DiskSuite metatrans devices for all existing UFS logging file systems by looking in the /etc/vfstab directory. Make sure that all configured metatrans devices are correctly set up in the /etc/opt/SUNWmd/md.tab file. If the devices are not set up now, set them up before continuing. Save a copy of the md tab file.
2. Match the device names found in step 1 with sd device link names (files named /dev/(r)dsk/cntndnsn) using the **metastat** command.
3. Install SDD using the procedure in “Installing the Subsystem Device Driver” on page 108, if you have not already done so.

4. Match the sd device link names found in step 2 with vpath device link names (files named /dev/(r)dsk/vpathNs) by executing the **/opt/IBMdpo/bin/showvpath** command.
5. Unmount all current UFS logging file systems known to reside on the multiport subsystem through the **umount** command.
6. Type **metaclear -a** and press Enter.
7. Create new metatrans devices from the vpathNs partitions found in step 4 corresponding to the sd device links found in step 2. Remember that vpath partitions a - h correspond to sd slices 0 - 7. Use the **metainit d <metadevice number> -t <"vpathNs" - master device> <"vpathNs" - logging device>** command. Be sure to use the same metadevice numbering as was originally used with the sd partitions. Edit the /etc/opt/SUNWmd/md.tab file to change each metatrans device entry to use vpathNs devices.
8. Restart the system.

**Note:** If there is a problem with a metatrans device after steps 7 and 8, restore the original /etc/opt/SUNWmd/md.tab file and restart the system. Review your steps and try again.

---

## Chapter 7. Using the datapath commands

SDD provides commands that you can use to display the status of adapters that are used to access managed devices, or to display the status of devices that the device driver manages. You can also set individual path conditions either to online or offline, or you can set all paths that are connected to an adapter or bus either to online or offline. This chapter includes descriptions of these commands. Table 29 provides an alphabetical list of these commands, a brief description, and where to go in this chapter for more information.

*Table 29. Commands*

<b>Command</b>	<b>Description</b>	<b>Page</b>
datapath query adapter	Displays information about adapters	126
datapath query adaptstats	Displays performance information for all SCSI and FCS adapters that are attached to SDD devices	127
datapath query device	Displays information about devices	128
datapath query devstats	Displays performance information for a single SDD device or all SDD devices	130
datapath set adapter	Sets all device paths that are attached to an adapter to online or offline	132
datapath set device	Sets the path of a device to online or offline	133

---

## datapath query adapter command

The **datapath query adapter** command displays information about a single adapter or all adapters.

### Syntax

▶—datapath query adapter—*adapter number*—▶

### Parameters

*adapter number*

The adapter number for which you want information displayed. If you do not enter an adapter number, information about all adapters is displayed.

### Examples

If you type the datapath query adapter command, the following output is displayed:

```
Active Adapters :4
Adpt#   Adapter Name  State   Mode   Select  Errors  Paths  Active
0       scsi3          NORMAL ACTIVE  129062051  0       64     0
1       scsi2          NORMAL ACTIVE  88765386  303     64     0
2       fscsi2        NORMAL ACTIVE  407075697  5427   1024   0
3       fscsi0        NORMAL ACTIVE  341204788  63835  256    0
```

The terms used in the output are defined as follows:

**Adpt #**

The number of the adapter.

**Adapter Name**

The name of the adapter.

**State** The condition of the named adapter. It can be either:

**Normal**

Adapter is in use.

**Degraded**

One or more paths are not functioning.

**Failed** The adapter is no longer being used by SDD.

**Mode** The mode of the named adapter, which is either Active or Offline.

**Select** The number of times this adapter was selected for input or output.

**Errors** The number of errors on all paths that are attached to this adapter.

**Paths** The number of paths that are attached to this adapter.

**Note:** In the Windows NT host system, this is the number of physical and logical devices that are attached to this adapter.

**Active** The number of functional paths that are attached to this adapter. The number of functional paths is equal to the number of paths minus any that are identified as failed or offline.

---

## datapath query adaptstats command

The **datapath query adaptstats** command displays performance information for all SCSI and FCS adapters that are attached to SDD devices. If you do not enter a device number, information about all devices is displayed.

### Syntax

```
▶▶—datapath query adaptstats—adapter number————▶▶
```

### Parameters

*adapter number*

The adapter number for which you want information displayed. If you do not enter an adapter number, information about all adapters is displayed.

### Examples

If you type the `datapath query adaptstats 0` command, the following output is displayed:

```
Adapter #: 0
=====
                Total Read  Total Write  Active Read  Active Write  Maximum
I/O:                1442      41295166         0           2           75
SECTOR:              156209      750217654         0           32          2098

/*-----*/
```

The terms used in the output are defined as follows:

#### Total Read

- I/O: total number of completed Read requests
- SECTOR: total number of sectors that have been read

#### Total Write

- I/O: total number of completed Write requests
- SECTOR: total number of sectors that have been written

#### Active Read

- I/O: total number of Read requests in process
- SECTOR: total number of sectors to read in process

#### Active Write

- I/O: total number of Write requests in process
- SECTOR: total number of sectors to write in process

#### Maximum

- I/O: the maximum number of queued I/O requests
- SECTOR: the maximum number of queued sectors to Read/Write

---

## datapath query device command

The **datapath query device** command displays information about a single device or all devices. If you do not enter a device number, information about all devices is displayed.

### Syntax

▶—datapath query device—*device number*————▶

### Parameters

#### *device number*

The device number refers to the device *index* number, rather than the SDD device number.

### Examples

If you type the datapath query device 35 command, the following output is displayed:

```
DEV#: 35  DEVICE NAME: vpath0  TYPE: 2105E20  SERIAL: 60012028
=====
Path#      Adapter/Hard Disk  State  Mode  Select  Errors
  0          scsi6/hdisk58  OPEN  NORMAL  7861147  0
  1          scsi5/hdisk36  OPEN  NORMAL  7762671  0
```

**Note:** Usually, the *device number* and the device *index* number are the same. However, if the devices are configured out of order, the two numbers are not always consistent. To find the corresponding index number for a specific device, you should always run the **datapath query device** command first.

The terms used in the output are defined as follows:

**Dev#** The number of this device.

**Name** The name of this device.

**Type** The device product ID from inquiry data.

**Serial** The logical unit number (LUN) for this device.

**Path** The path number.

#### **Adapter**

The name of the adapter that the path is attached to.

#### **Hard Disk**

The name of the logical device that the path is bound to.

**State** The condition of the named device:

**Open** Path is in use.

**Close** Path is not being used.

**Dead** Path is no longer being used. It was either removed by SDD due to errors or manually removed using the **datapath set device M path N offline** or **datapath set adapter N offline** command.

#### **Invalid**

Path verification failed. The path was not opened.

**Mode** The mode of the named device. It is either Normal or Offline.

**Select** The number of times this path was selected for input or output.

**Errors** The number of errors on a path that is attached to this device.

---

## datapath query devstats command

The **datapath query devstats** command displays performance information for a single SDD device or all SDD devices. If you do not enter a device number, information about all devices is displayed.

## Syntax

▶▶—datapath query devstats—*device number*————▶▶

## Parameters

*device number*

The device number refers to the device *index* number, rather than the SDD device number.

## Examples

If you type the `datapath query devstats 0` command, the following output is displayed:

```
Device #: 0
=====
                Total Read  Total Write  Active Read  Active Write  Maximum
I/O:              387      24502563         0           0           62
SECTOR:           9738      448308668         0           0          2098

Transfer Size:    <= 512      <= 4k      <= 16K      <= 64K      > 64K
                  4355850      1024164      19121140      1665        130

/*-----*/
```

The terms used in the output are defined as follows:

### Total Read

- I/O: total number of completed Read requests
- SECTOR: total number of sectors that have been read

### Total Write

- I/O: total number of completed Write requests
- SECTOR: total number of sectors that have been written

### Active Read

- I/O: total number of Read requests in process
- SECTOR: total number of sectors to read in process

### Active Write

- I/O: total number of Write requests in process
- SECTOR: total number of sectors to write in process

### Maximum

- I/O: the maximum number of queued I/O requests
- SECTOR: the maximum number of queued sectors to Read/Write

### Transfer size

- <= 512: the number of I/O requests received, whose transfer size is 512 bytes or less



- $\leq 4k$ : the number of I/O requests received, whose transfer size is 4 KB or less (where KB equals 1024 bytes)
- $\leq 16K$ : the number of I/O requests received, whose transfer size is 16 KB or less (where KB equals 1024 bytes)
- $\leq 64K$ : the number of I/O requests received, whose transfer size is 64 KB or less (where KB equals 1024 bytes)
- $> 64K$ : the number of I/O requests received, whose transfer size is greater than 64 KB (where KB equals 1024 bytes)

---

## datapath set adapter command

The **datapath set adapter** command sets all device paths attached to an adapter either to online or offline. If all paths are attached to a single fibre-channel adapter, that connects to multiple ESS ports through a switch, the **set adapter 0 offline** command fails; all the paths are not set offline. The **datapath set adapter offline** command fails if there is any device having the last path attached to this adapter.

**Attention:** The **datapath set adapter offline** command will not remove the last path to a device. This command can be issued even when the device are closed.

## Syntax

```
▶▶—datapath set adapter—adapter number—online  
offline—▶▶
```

## Parameters

*adapter number*

The adapter number that you want to change.

*online*

Sets the adapter online.

*offline*

Sets the adapter offline.

## Examples

If you type the `datapath set adapter 0 offline` command, adapter 0 changes to Offline mode and its state changes to failed; while all paths attached to adapter 0 change to Offline mode and their states change to Dead, if they were in the Open state.

---

## datapath set device command

The **datapath set device** command sets the path of a device either to online or offline. You cannot remove the last path to a device from service. This prevents a data access failure from occurring. The **datapath set device** command can be issued even when the device is closed.

### Syntax

```
▶▶—datapath set device—device number path number [ online | offline ] ▶▶
```

### Parameters

*device number*

The device index number that you want to change.

*path number*

The path number that you want to change.

*online*

Sets the path online.

*offline*

Removes the path from service.

### Examples

If you type the `datapath set device 0 path 0 offline` command, path 0 for device 0 changes to Offline mode.



---

# Statement of Limited Warranty

---

## Part 1 – General Terms

International Business Machines Corporation  
Armonk, New York, 10504

*This Statement of Limited Warranty includes Part 1 - General Terms and Part 2 - Country or region-unique Terms. The terms of Part 2 may replace or modify those of Part 1. The warranties provided by IBM in this Statement of Limited Warranty apply only to Machines you purchase for your use, and not for resale, from IBM or your reseller. The term "Machine" means an IBM machine, its features, conversions, upgrades, elements, or accessories, or any combination of them. The term "Machine" does not include any software programs, whether pre-loaded with the Machine, installed subsequently or otherwise. Unless IBM specifies otherwise, the following warranties apply only in the country or region where you acquire the Machine. Nothing in this Statement of Warranty affects any statutory rights of consumers that cannot be waived or limited by contract. If you have any questions, contact IBM or your reseller.*

Unless IBM specifies otherwise, the following warranties apply only in the country or region where you acquire the Machine. If you have any questions, contact IBM or your reseller.

**Machine:** IBM 2105 (Models E10, E20, F10, and F20) TotalStorage Enterprise Storage Server (ESS)

**Warranty Period:** Three Years \*

*\*Contact your place of purchase for warranty service information. Some IBM Machines are eligible for On-site warranty service depending on the country or region where service is performed.*

## The IBM Warranty for Machines

IBM warrants that each Machine 1) is free from defects in materials and workmanship and 2) conforms to IBM's Official Published Specifications ("Specifications"). The warranty period for a Machine is a specified, fixed period commencing on its Date of Installation. The date on your sales receipt is the Date of Installation, unless IBM or your reseller informs you otherwise.

During the warranty period IBM or your reseller, if approved by IBM to provide warranty service, will provide repair and exchange service for the Machine, without charge, under the type of service designated for the Machine and will manage and install engineering changes that apply to the Machine.

If a Machine does not function as warranted during the warranty period, and IBM or your reseller are unable to either 1) make it do so or 2) replace it with one that is at least functionally equivalent, you may return it to your place of purchase and your money will be refunded. The replacement may not be new, but will be in good working order.

## Extent of Warranty

The warranty does not cover the repair or exchange of a Machine resulting from misuse, accident, modification, unsuitable physical or operating environment,

improper maintenance by you, or failure caused by a product for which IBM is not responsible. The warranty is voided by removal or alteration of Machine or parts identification labels.

**THESE WARRANTIES ARE YOUR EXCLUSIVE WARRANTIES AND REPLACE ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THESE WARRANTIES GIVE YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF EXPRESS OR IMPLIED WARRANTIES, SO THE ABOVE EXCLUSION OR LIMITATION MAY NOT APPLY TO YOU. IN THAT EVENT, SUCH WARRANTIES ARE LIMITED IN DURATION TO THE WARRANTY PERIOD. NO WARRANTIES APPLY AFTER THAT PERIOD.**

## Items Not Covered by Warranty

IBM does not warrant uninterrupted or error-free operation of a Machine.

Unless specified otherwise, IBM provides non-IBM machines **WITHOUT WARRANTIES OF ANY KIND.**

Any technical or other support provided for a Machine under warranty, such as assistance via telephone with "how-to" questions and those regarding Machine setup and installation, will be provided **WITHOUT WARRANTIES OF ANY KIND.**

## Warranty Service

To obtain warranty service for the Machine, contact your reseller or IBM. In the United States, call IBM at **1-800-IBM-SERV (426-7378)**. In Canada, call IBM at **1-800-465-6666**. You may be required to present proof of purchase.

IBM or your reseller provides certain types of repair and exchange service, either at your location or at a service center, to keep Machines in, or restore them to, conformance with their Specifications. IBM or your reseller will inform you of the available types of service for a Machine based on its country or region of installation. IBM may repair the failing Machine or exchange it at its discretion.

When warranty service involves the exchange of a Machine or part, the item IBM or your reseller replaces becomes its property and the replacement becomes yours. You represent that all removed items are genuine and unaltered. The replacement may not be new, but will be in good working order and at least functionally equivalent to the item replaced. The replacement assumes the warranty service status of the replaced item.

Any feature, conversion, or upgrade IBM or your reseller services must be installed on a Machine which is 1) for certain Machines, the designated, serial-numbered Machine and 2) at an engineering-change level compatible with the feature, conversion, or upgrade. Many features, conversions, or upgrades involve the removal of parts and their return to IBM. A part that replaces a removed part will assume the warranty service status of the removed part.

Before IBM or your reseller exchanges a Machine or part, you agree to remove all features, parts, options, alterations, and attachments not under warranty service.

You also agree to

1. ensure that the Machine is free of any legal obligations or restrictions that prevent its exchange.
2. obtain authorization from the owner to have IBM or your reseller service a Machine that you do not own; and
3. where applicable, before service is provided
  - a. follow the problem determination, problem analysis, and service request procedures that IBM or your reseller provides,
  - b. secure all programs, data, and funds contained in a Machine,
  - c. provide IBM or your reseller with sufficient, free, and safe access to your facilities to permit them to fulfill their obligations, and
  - d. inform IBM or your reseller of changes in a Machine's location.

IBM is responsible for loss of, or damage to, your Machine while it is 1) in IBM's possession or 2) in transit in those cases where IBM is responsible for the transportation charges.

Neither IBM nor your reseller is responsible for any of your confidential, proprietary or personal information contained in a Machine which you return to IBM or your reseller for any reason. You should remove all such information from the Machine prior to its return.

## Production Status

Each IBM Machine is manufactured from new parts, or new and used parts. In some cases, the Machine may not be new and may have been previously installed. Regardless of the Machine's production status, IBM's appropriate warranty terms apply.

## Limitation of Liability

Circumstances may arise where, because of a default on IBM's part or other liability, you are entitled to recover damages from IBM. In each such instance, regardless of the basis on which you are entitled to claim damages from IBM (including fundamental breach, negligence, misrepresentation, or other contract or tort claim), IBM is liable for no more than

1. damages for bodily injury (including death) and damage to real property and tangible personal property; and
2. the amount of any other actual direct damages, up to the greater of U.S. \$100,000 (or equivalent in local currency) or the charges (if recurring, 12 months' charges apply) for the Machine that is the subject of the claim.

This limit also applies to IBM's suppliers and your reseller. It is the maximum for which IBM, its suppliers, and your reseller are collectively responsible.

**UNDER NO CIRCUMSTANCES IS IBM LIABLE FOR ANY OF THE FOLLOWING: 1) THIRD-PARTY CLAIMS AGAINST YOU FOR DAMAGES (OTHER THAN THOSE UNDER THE FIRST ITEM LISTED ABOVE); 2) LOSS OF, OR DAMAGE TO, YOUR RECORDS OR DATA; OR 3) SPECIAL, INCIDENTAL, OR INDIRECT DAMAGES OR FOR ANY ECONOMIC CONSEQUENTIAL DAMAGES (INCLUDING LOST PROFITS OR SAVINGS), EVEN IF IBM, ITS SUPPLIERS OR YOUR RESELLER IS INFORMED OF THEIR POSSIBILITY. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.**

---

## Part 2 - Country or region-unique Terms

### ASIA PACIFIC

**AUSTRALIA: The IBM Warranty for Machines:** The following paragraph is added to this Section: The warranties specified in this Section are in addition to any rights you may have under the Trade Practices Act 1974 or other legislation and are only limited to the extent permitted by the applicable legislation.

**Extent of Warranty:** The following replaces the first and second sentences of this Section: The warranty does not cover the repair or exchange of a Machine resulting from misuse, accident, modification, unsuitable physical or operating environment, operation in other than the Specified Operating Environment, improper maintenance by you, or failure caused by a product for which IBM is not responsible.

**Limitation of Liability:** The following is added to this Section: Where IBM is in breach of a condition or warranty implied by the Trade Practices Act 1974, IBM's liability is limited to the repair or replacement of the goods or the supply of equivalent goods. Where that condition or warranty relates to right to sell, quiet possession or clear title, or the goods are of a kind ordinarily acquired for personal, domestic or household use or consumption, then none of the limitations in this paragraph apply.

**PEOPLE'S REPUBLIC OF CHINA: Governing Law:** The following is added to this Statement: The laws of the State of New York govern this Statement.

**INDIA: Limitation of Liability:** The following replaces items 1 and 2 of this Section: 1. liability for bodily injury (including death) or damage to real property and tangible personal property will be limited to that caused by IBM's negligence; 2. as to any other actual damage arising in any situation involving nonperformance by IBM pursuant to, or in any way related to the subject of this Statement of Limited Warranty, IBM's liability will be limited to the charge paid by you for the individual Machine that is the subject of the claim.

**NEW ZEALAND: The IBM Warranty for Machines:** The following paragraph is added to this Section: The warranties specified in this Section are in addition to any rights you may have under the Consumer Guarantees Act 1993 or other legislation which cannot be excluded or limited. The Consumer Guarantees Act 1993 will not apply in respect of any goods which IBM provides, if you require the goods for the purposes of a business as defined in that Act.

**Limitation of Liability:** The following is added to this Section: Where Machines are not acquired for the purposes of a business as defined in the Consumer Guarantees Act 1993, the limitations in this Section are subject to the limitations in that Act.

### EUROPE, MIDDLE EAST, AFRICA (EMEA)

**The following terms apply to all EMEA countries or regions.**

The terms of this Statement of Limited Warranty apply to Machines purchased from an IBM reseller. If you purchased this Machine from IBM, the terms and conditions of the applicable IBM agreement prevail over this warranty statement.

#### Warranty Service



If you purchased an IBM Machine in Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland or United Kingdom, you may obtain warranty service for that Machine in any of those countries or regions from either (1) an IBM reseller approved to perform warranty service or (2) from IBM.

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 or regions from either (1) an IBM reseller approved to perform warranty service or (2) from IBM.

The applicable laws, Country or region-unique terms and competent court for this Statement are those of the country or region 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 or region 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.



---

## Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

*IBM Director of Licensing  
IBM Corporation  
North Castle Drive  
Armonk, NY 10504-1785  
U.S.A*

**The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:**

INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATIONS "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publications. IBM may make improvements and/or changes in the product(s) and/or program(s) described in this publication at any time without notice.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

---

## Trademarks

The following terms are trademarks of the International Business Machines Corporation in the United States, other countries, or both:

AIX  
AS/400

DFSMS/MVS  
ES/9000  
ESCON  
FICON  
FlashCopy  
HACMP/6000  
IBM  
Enterprise Storage Server  
IBM TotalStorage  
eServer  
MVS/ESA  
Netfinity  
NetVista  
NUMA-Q  
Operating System/400  
OS/390  
OS/400  
RS/6000  
S/390  
Seascope  
SNAPSHOT  
SP  
StorWatch  
System/360  
System/370  
System/390  
TotalStorage  
Versatile Storage Server  
VM/ESA  
VSE/ESA

Microsoft and Windows NT are trademarks of Microsoft Corporation in the United States, other countries, or both.

Java and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

Linux is a trademark of Linus Torvalds and others.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Other company, product, and service names may be trademarks or service marks of others.

---

## Electronic emission notices

This section contains the electronic emission notices or statements for the United States and other countries.

## Federal Communications Commission (FCC) statement

This equipment has been tested and complies with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate

radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors, or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the users authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device might not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

## **Industry Canada compliance statement**

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conform à la norme NMB-003 du Canada.

## **European community compliance statement**

This product is in conformity with the protection requirements of EC Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a nonrecommended modification of the product, including the fitting of non-IBM option cards.

### **Germany only Zulassungsbescheinigung laut Gesetz ueber die elektromagnetische Vertraeglichkeit von Geraeten (EMVG) vom 30. August 1995.**

Dieses Geraet ist berechtigt, in Uebereinstimmung mit dem deutschen EMVG das EG-Konformitaetszeichen - CE - zu fuehren.

Der Aussteller der Konformitaetserklaeung ist die IBM Deutschland.

Informationen in Hinsicht EMVG Paragraph 3 Abs. (2) 2:

Das Geraet erfuehlt die Schutzanforderungen nach EN 50082-1 und EN 55022 Klasse A.

EN 55022 Klasse A Geraete beduerfen folgender Hinweise:

Nach dem EMVG:

"Geraete duerfen an Orten, fuer die sie nicht ausreichend entstoert sind, nur mit besonderer Genehmigung des Bundesministeriums fuer Post und Telekommunikation oder des Bundesamtes fuer Post und Telekommunikation betrieben werden. Die Genehmigung wird erteilt, wenn keine elektromagnetischen Stoerungen zu erwarten sind." (Auszug aus dem EMVG, Paragraph 3, Abs.4)

Dieses Genehmigungsverfahren ist nach Paragraph 9 EMVG in Verbindung mit der entsprechenden Kostenverordnung (Amtsblatt 14/93) kostenpflichtig.

Nach der EN 55022:

"Dies ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funkstörungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Massnahmen durchzuführen und dafür aufzukommen."

Anmerkung:

Um die Einhaltung des EMVG sicherzustellen, sind die Geräte wie in den Handbüchern angegeben zu installieren und zu betreiben.

## Japanese Voluntary Control Council for Interference (VCCI) class A statement

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

## Korean government Ministry of Communication (MOC) statement

Please note that this device has been approved for business purpose with regard to electromagnetic interference. If you find this is not suitable for your use, you may exchange it for a nonbusiness purpose one.

## Taiwan class A compliance statement

**警告使用者:**

這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

---

## IBM agreement for licensed internal code

### Read Before Using

IMPORTANT

YOU ACCEPT THE TERMS OF THIS IBM LICENSE AGREEMENT FOR MACHINE CODE BY YOUR USE OF THE HARDWARE PRODUCT OR MACHINE CODE. PLEASE READ THE AGREEMENT CONTAINED IN THIS BOOK BEFORE USING THE HARDWARE PRODUCT. SEE "IBM agreement for licensed internal code".



You accept the terms of this Agreement<sup>1</sup> by your initial use of a machine that contains IBM Licensed Internal Code (called "Code"). These terms apply to Code used by certain machines IBM or your reseller specifies (called "Specific Machines"). International Business Machines Corporation or one of its subsidiaries ("IBM") owns copyrights in Code or has the right to license Code. IBM or a third party owns all copies of Code, including all copies made from them.

If you are the rightful possessor of a Specific Machine, IBM grants you a license to use the Code (or any replacement IBM provides) on, or in conjunction with, only the Specific Machine for which the Code is provided. IBM licenses the Code to only one rightful possessor at a time.

Under each license, IBM authorizes you to do only the following:

1. execute the Code to enable the Specific Machine to function according to its Official Published Specifications (called "Specifications");
2. make a backup or archival copy of the Code (unless IBM makes one available for your use), provided you reproduce the copyright notice and any other legend of ownership on the copy. You may use the copy only to replace the original, when necessary; and
3. execute and display the Code as necessary to maintain the Specific Machine.

You agree to acquire any replacement for, or additional copy of, Code directly from IBM in accordance with IBM's standard policies and practices. You also agree to use that Code under these terms.

You may transfer possession of the Code to another party only with the transfer of the Specific Machine. If you do so, you must 1) destroy all your copies of the Code that were not provided by IBM, 2) either give the other party all your IBM-provided copies of the Code or destroy them, and 3) notify the other party of these terms. IBM licenses the other party when it accepts these terms. These terms apply to all Code you acquire from any source.

Your license terminates when you no longer rightfully possess the Specific Machine.

## **Actions you must not take**

You agree to use the Code only as authorized above. You must not do, for example, any of the following:

1. Otherwise copy, display, transfer, adapt, modify, or distribute the Code (electronically or otherwise), except as IBM may authorize in the Specific Machine's Specifications or in writing to you;
2. Reverse assemble, reverse compile, or otherwise translate the Code unless expressly permitted by applicable law without the possibility of contractual waiver;
3. Sublicense or assign the license for the Code; or
4. Lease the Code or any copy of it.

---

1. Form Z125-4144



---

## Glossary

This glossary includes terms for the IBM TotalStorage 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), 11 West 42nd Street, New York, New York 10036. Definitions derived from this book have 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 derived from this book have the symbol (I) after the definition. Definitions taken from draft international standards, committee drafts, and working papers being developed by ISO/IEC JTC1/SC1 have the symbol (T) after the definition, indicating that final agreement has not been reached among the participating National Bodies of SC1.

This glossary uses the following cross-reference form:

- See** This refers the reader to one of three kinds of related information:
- A related term
  - A term that is the expanded form of an abbreviation or acronym
  - A synonym or more preferred term

## A

**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.

**access-any mode.** One of the two access modes that can be set for the ESS during initial configuration. It enables all fibre-channel-attached host systems with no defined access profile to access all logical volumes on the ESS. With a profile defined in ESS Specialist for a particular host, that host has access only to volumes that are assigned to the WWPN for that host. See *pseudo-host* and *worldwide port name*.

**active Copy Services server.** The Copy Services server that manages the Copy Services domain. Either the primary or the backup Copy Services server can be the active Copy Services server. The backup Copy Services server is available to become the active Copy Services server if the primary Copy Services server fails. See *backup Copy Services server* and *primary Copy Services server*.

**alert.** A message or log that a storage facility generates as the result of error event collection and analysis. An alert indicates that a service action is required.

**allegiance.** In Enterprise Systems Architecture/390, a relationship that is created between a device and one or more channel paths during the processing of certain conditions. See *implicit allegiance*, *contingent allegiance*, and *reserved allegiance*.

**allocated storage.** On an ESS, the space allocated to volumes, but not yet assigned. See *assigned storage*.

**American National Standards Institute (ANSI).** An organization of producers, consumers, and general interest groups that establishes the procedures by which accredited organizations create and maintain voluntary industry standards in the United States. (A)

**Anonymous.** The label in ESS Specialist on an icon representing all connections using fibre-channel adapters between the ESS and hosts that are not completely defined to the ESS. See *anonymous host*, *pseudo-host*, and *access-any mode*.

**anonymous host.** Synonym for “pseudo-host” (in contrast to the Anonymous label that appears on some pseudo-host icons. See *Anonymous* and *pseudo-host*).

**ANSI.** See *American National Standards Institute*.

**APAR.** See *authorized program analysis report*.

**arbitrated loop.** For fibre-channel connections, a topology that enables the interconnection of a set of nodes. See *point-to-point connection* and *switched fabric*.

**array.** An ordered collection, or group, of physical devices (disk drive modules) that are used to define logical volumes or devices. More specifically, regarding the ESS, an array is a group of disks designated by the user to be managed by the RAID-5 technique. See *redundant array of inexpensive disks*.

**ASCII.** American Standard Code for Information Interchange. An ANSI standard (X3.4–1977) for assignment of 7-bit numeric codes (plus 1 bit for parity) to represent alphabetic and numeric characters and

common symbols. Some organizations, including IBM, have used the parity bit to expand the basic code set.

**assigned storage.** On an ESS, 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. See *data availability*.

## B

**backup Copy Services server.** One of two Copy Services servers in a Copy Services domain. The other Copy Services server is the primary Copy Services server. The backup Copy Services server is available to become the active Copy Services server if the primary Copy Services server fails. A Copy Services server is software that runs in one of the two clusters of an ESS, and manages data-copy operations for that Copy Services server group. See *primary Copy Services server* and *active Copy Services server*.

**bay.** Physical space on an ESS used for installing SCSI, ESCON, and fibre-channel host adapter cards. The ESS has four bays, two in each cluster. See *service boundary*.

**bit.** (1) A binary digit. (2) The storage medium required to store a single binary digit. (3) Either of the digits 0 or 1 when used in the binary numeration system. (T) See *byte*.

**block.** A group of consecutive bytes used as the basic storage unit in fixed-block architecture (FBA). All blocks on the storage device are the same size (fixed size). See *fixed-block architecture* and *data record*.

**byte.** (1) A group of eight adjacent binary digits that represent one EBCDIC character. (2) The storage medium required to store eight bits. See *bit*.

## C

**cache.** A buffer storage that contains frequently accessed instructions and data, thereby reducing 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 hit.** An event that occurs when a read operation is sent to the cluster, and the requested data is found in cache. The opposite of *cache miss*.

**cache memory.** Memory, typically 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. In addition to residing in cache memory, the same data also resides on the storage devices in the storage facility.

**cache miss.** An event that occurs when a read operation is sent to the cluster, but the data is not found in cache. The opposite of *cache hit*.

**call home.** A communication link established between the ESS and a service provider. The ESS can use this link to place a call to IBM or to another service provider when it requires service. With access to the machine, service personnel can perform service tasks, such as viewing error logs and problem logs or initiating trace and dump retrievals. See *heartbeat* and *remote technical assistance information network*.

**cascading.** (1) Connecting network controllers to each other in a succession of levels, to concentrate many more lines than a single level permits. (2) In high-availability cluster multiprocessing (HACMP), cascading pertains to a cluster configuration in which the cluster node with the highest priority for a particular resource acquires the resource if the primary node fails. The cluster node relinquishes the resource to the primary node upon reintegration of the primary node into the cluster.

**catcher.** A server that service personnel use to collect and retain status data that an ESS sends to it.

**CCR.** See *channel-command retry*.

**CCW.** See *channel command word*.

**CD-ROM.** See *compact disc, read-only memory*.

**CEC.** See *computer-electronic complex*.

**channel.** In Enterprise Systems Architecture/390, the part of a channel subsystem that manages a single I/O interface between a channel subsystem and a set of control units.

**channel command retry (CCR).** In Enterprise Systems Architecture/390, the protocol used between a channel and a control unit that enables the control unit to request that the channel reissue the current command.

**channel command word (CCW).** In Enterprise Systems Architecture/390, a data structure that specifies an I/O operation to the channel subsystem.

**channel path.** In Enterprise Systems Architecture/390, the interconnection between a channel and its associated control units.

**channel subsystem.** In Enterprise Systems Architecture/390, the part of a host computer that manages I/O communication between the program and any attached control units.

**channel-subsystem image.** In Enterprise Systems Architecture/390, the logical functions that a system requires to perform the function of a channel subsystem. With ESCON multiple image facility (EMIF), one channel subsystem image exists in the channel subsystem for each logical partition (LPAR). Each image appears to be an independent channel subsystem program, but all images share a common set of hardware facilities.

**CKD.** See *count key data*.

**CLI.** See *command-line interface*.

**cluster.** (1) A partition in the ESS capable of performing all ESS functions. With two clusters in the ESS, any operational cluster can take over the processing of a failing cluster. (2) On an AIX platform, 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 (CLI).** (1) An interface provided by an operating system that defines a set of commands and enables a user (or a script-like language) to issue these commands by typing text in response to the command prompt (for example, DOS commands, UNIX shell commands). (2) An optional ESS software that enables a user to issue commands to and retrieve information from the Copy Services server.

**compact disc, read-only memory (CD-ROM).** 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 that reduces 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.** A facility on a storage server that enables a program to make a backup of a data set while the logical volume remains available for subsequent processing. The data in the backup copy is frozen at the point in time that the server responds to the request.

**concurrent installation of licensed internal code.** Process of installing licensed internal code on 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 (a logical volume, for example) that contains the contents of the entire data entity at a single instant in time.

**console.** A user interface to a server, such as can be provided by a personal computer. See *IBM TotalStorage ESS Master Console*.

**contingent allegiance.** In Enterprise Systems Architecture/390, a relationship that is created in a control unit between a device and a channel when unit-check status is accepted by the channel. The allegiance causes the control unit to guarantee access; the control unit does not present the busy status to the device. This enables the channel to retrieve sense data that is associated with the unit-check status on the channel path associated with the allegiance.

**control unit (CU).** (1) A device that coordinates and controls the operation of one or more input/output devices, and synchronizes the operation of such devices with the operation of the system as a whole. (2) In Enterprise Systems Architecture/390, a storage server with ESCON, FICON, or OEMI interfaces. The control unit adapts a native device interface to an I/O interface supported by an ESA/390 host system. On an ESS, the control unit would be the parts of the storage server that support the attachment of emulated CKD devices over ESCON, FICON, or OEMI interfaces. See *cluster*.

**control-unit image.** In Enterprise Systems Architecture/390, a logical subsystem that is accessed through an ESCON or FICON I/O interface. One or more control-unit images exist in each control unit. Each image appears as an independent control unit, but all control-unit images share a common set of hardware facilities. The ESS can emulate 3990-3, TPF, 3990-6, or 2105 control units.

**control-unit initiated reconfiguration (CUIR).** A software mechanism used by the ESS to request that an operating system verify that one or more subsystem resources can be taken off-line for service. The ESS can use this process to automatically vary channel paths offline and online to facilitate bay service or concurrent code installation. Depending on the operating system, support for this process may be model-dependent, may depend on the IBM Subsystem Device Driver, or may not exist.

**Coordinated Universal Time (UTC).** The international standard of time that is kept by atomic clocks around the world.

**Copy Services client.** Software that runs on each ESS cluster in the Copy Services server group and that performs the following functions:

- Communicates configuration, status, and connectivity information to the Copy Services server.
- Performs data-copy functions on behalf of the Copy Services server.

**Copy Services server group.** A collection of user-designated ESS clusters participating in Copy Services functions managed by a designated active Copy Services server. A Copy Services server group is also called a Copy Services domain.

**count field.** The first field of a count key data (CKD) record. This eight-byte field contains a four-byte track address (CCHH). It defines the cylinder and head that are associated with the track, and a one-byte record number (R) that identifies the record on the track. It defines a one-byte key length that specifies the length of the record's key field (0 means no key field). It defines a two-byte data length that specifies the length of the record's data field (0 means no data field). Only the end-of-file record has a data length of zero.

**count key data (CKD).** In Enterprise Systems Architecture/390, a data-record format employing self-defining record formats in which each record is represented by up to three fields—a *count* area identifying the record and specifying its format, an optional *key* area that can be used to identify the data area contents; and an optional *data* area that typically would contain the user data for the record. For CKD records on the ESS, the logical volume size is defined in terms of the device emulation mode (3390 or 3380 track format). The count field is always 8 bytes long and contains the lengths of the key and data fields, the key field has a length of 0 to 255 bytes, and the data field has a length of 0 to 65 535 or the maximum that will fit on the track. Typically, customer data appears in the data field. The use of the key field is dependent on the software managing the storage. See *data record*.

**CPC.** See *cluster processor complex*.

**CRC.** See *cyclic redundancy check*.

**CU.** See *control unit*.

**CUIR.** See *control-unit initiated reconfiguration*.

**customer console.** See *console* and *IBM TotalStorage ESS Master Console*.

**CUT.** See *Coordinated Universal Time*.

**cyclic redundancy check (CRC).** A redundancy check in which the check key is generated by a cyclic algorithm. (T)

**cylinder.** A unit of storage on a CKD device. A cylinder has a fixed number of tracks.

## D

**DA.** See *device adapter* and *SSA adapter*.

**daisy chain.** See *serial connection*.

**DASD.** See *direct access storage device*.

**DASD fast write (DFW).** Caching of active write data by a storage server by journaling the data in nonvolatile storage, avoiding exposure to data loss.

**data availability.** The degree to which data is available when needed, typically measured as a percentage of time that the system would be capable of responding to any data request (for example, 99.999% available).

**data compression.** A technique or algorithm used to encode data such that the encoded result can be stored in less space than the original data. The original data can be recovered from the encoded result through a reverse technique or reverse algorithm. See *compression*.

**Data Facility Storage Management Subsystem.** An operating environment that helps automate and centralize the management of storage. To manage storage, DFSMS provides the storage administrator with control over data class, storage class, management class, storage group, and automatic class selection routine definitions.

**data field.** The optional third field of a count key data (CKD) record. The count field specifies the length of the data field. The data field contains data that the program writes.

**data record.** The basic unit of S/390 and zSeries storage on an ESS, also known as a count-key-data (CKD) record. Data records are stored on a track. The records are sequentially numbered starting with 0. The first record, R0, is typically called the track descriptor record and contains data normally used by the operating system to manage the track. See *count-key-data* and *fixed-block architecture*.

**data sharing.** The ability of homogeneous or divergent host systems to concurrently utilize data that they store on one or more storage devices. The storage facility enables configured storage to be accessible to any, or all, attached host systems. To use this capability, the host program must be designed to support data that it is sharing.

**DDM.** See *disk drive module*.

**DDM group.** See *disk 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.** To remove 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 might 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 can be demoted.

**destaging.** (1) Movement of data from an online or higher priority to an offline or lower (2) priority device. The ESS stages incoming data into cache and then destages it to disk.

**device.** In Enterprise Systems Architecture/390, a disk drive.

**device adapter (DA).** A physical component of the ESS that provides communication between the clusters and the storage devices. The ESS has eight device adapters that it deploys in pairs, one from each cluster. DA pairing enables the ESS to access any disk drive from either of two paths, providing fault tolerance and enhanced availability.

**device address.** In Enterprise Systems Architecture/390, the field of an ESCON or FICON 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.** In Enterprise Systems Architecture/390, a four-hexadecimal-character identifier, for example 13A0, that the systems administrator associates with a device to facilitate communication between the program and the host operator. The device number is associated with a subchannel.

**device sparing.** A subsystem function that automatically copies data from a failing DDM to a spare DDM. The subsystem maintains data access during the process.

**direct access storage device (DASD).** (1) A mass storage medium on which a computer stores data. (2) A disk device.

**disk drive.** Standard term for a disk-based nonvolatile storage medium. The ESS uses hard disk drives as the primary nonvolatile storage media to store host data.

**disk drive module (DDM).** A field replaceable unit that consists of a single disk drive and its associated packaging.

**disk drive module group.** In the ESS, a group of eight disk drive modules (DDMs) contained in an 8-pack and installed as a unit.

**disk group.** In the ESS, a collection of seven or eight disk drives in the same SSA loop and set up by the ESS to be available to be assigned as a RAID-5 rank. You can format a disk group as CKD or FB, and as RAID or non-RAID, or leave it unassigned.

**DNS.** See *domain name system*.

**domain.** (1) That part of a computer network in which the data processing resources are under common control. (2) In TCP/IP, the naming system used in hierarchical networks. (3) A Copy Services server group, in other words, the set of clusters designated by the user to be managed by a particular Copy Services server.

**domain name system (DNS).** In TCP/IP, the server program that supplies name-to-address translation by mapping domain names to internet addresses. The address of a DNS server is the internet address of the server that hosts the DNS software for the network.

**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. See *disk drive module*. (2) The mechanism used to seek, read, and write information on a storage medium.

**duplex.** (1) Regarding ESS Copy Services, the state of a volume pair after PPRC has completed the copy operation and the volume pair is synchronized. (2) In general, pertaining to a communication mode in which data can be sent and received at the same time.

**dynamic sparing.** The ability of a storage server to move data from a failing disk drive module (DDM) to a spare DDM while maintaining storage functions.

## E

**E10.** The forerunner of the F10 model of the ESS. See *F10*.

**E20.** The forerunner of the F20 model of the ESS. See *F20*.

**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 control unit, disk drives, and power source.

**end of file.** A coded character recorded on a data medium to indicate the end of the medium. On a 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 Storage Server.** See *IBM TotalStorage Enterprise Storage Server*.

**Enterprise Systems Architecture/390® (ESA/390) and z/Architecture.** IBM architectures for mainframe computers and peripherals. Processor systems that follow the ESA/390 architecture include the ES/9000® family, while the IBM @server zSeries server uses the z/Architecture.

**Enterprise Systems Connection (ESCON).** (1) An ESA/390 and zSeries 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 System Connection*.

**ESCON channel.** An S/390 or zSeries channel that supports ESCON protocols.

**ESCON director (ESCD).** An I/O interface switch that provides for the interconnection of multiple ESCON interfaces in a distributed-star topology.

**ESCON host systems.** S/390 or zSeries hosts that attach to the ESS with an ESCON adapter. Such host systems run on MVS, VM, VSE, or TPF operating systems.

**ESCON multiple image facility (EMIF).** In Enterprise Systems Architecture/390, a function that enables

LPARs to share an ESCON channel path by providing each LPAR with its own channel-subsystem image.

**EsconNet.** In ESS Specialist, the label on a pseudo-host icon representing a host connection that uses the ESCON protocol and that is not completely defined on the ESS. See *pseudo-host* and *access-any mode*.

**ESD.** See *electrostatic discharge*.

**eserver.** See *IBM @server*.

**ESS.** See *IBM TotalStorage Enterprise Storage Server*.

**ESS Expert.** See *IBM StorWatch Enterprise Storage Server Expert*.

**ESS Specialist.** See *IBM TotalStorage Enterprise Storage Server Specialist*.

**ESS Copy Services.** See *IBM TotalStorage Enterprise Storage Server Copy Services*.

**ESS Master Console.** See *IBM TotalStorage ESS Master Console*.

**ESSNet.** See *IBM TotalStorage Enterprise Storage Server Network*.

**Expert.** See *IBM StorWatch Enterprise Storage Server Expert*.

**extended binary-coded decimal interchange code (EBCDIC).** A coding scheme developed by IBM used to represent various alphabetic, numeric, and special symbols with a coded character set of 256 eight-bit codes.

**extended count key data (ECKD).** An extension of the CKD architecture.

**Extended Remote Copy (XRC).** A function of a storage server 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.

**extent.** A continuous space on a disk that is occupied by or reserved for a particular data set, data space, or file. The unit of increment is a track. See *multiple allegiance* and *parallel access volumes*.

## F

**F10.** A model of the ESS featuring a single-phase power supply. It has fewer expansion capabilities than the Model F20.

**F20.** A model of the ESS featuring a three-phase power supply. It has more expansion capabilities than



the Model F10, including the ability to support a separate expansion enclosure.

**fabric.** In fibre-channel technology, a routing structure, such as a switch, receives addressed information and routes to the appropriate destination. A fabric can consist of more than one switch. When multiple fibre-channel switches are interconnected, they are said to be *cascaded*.

**failback.** Cluster recovery from failover following repair. See *failover*.

**failover.** On the ESS, the process of transferring all control of a storage facility to a single cluster when the other cluster in the storage facility fails.

**fast write.** A write operation at cache speed that does not require immediate transfer of data to a disk drive. The subsystem writes the data directly to cache, to nonvolatile storage, or to both. The data is then available for destaging. A fast-write operation reduces the time an application must wait for the I/O operation to complete.

**FBA.** See *fixed-block architecture*.

**FC-AL.** See *Fibre Channel-Arbitrated Loop*.

**FCP.** See *fibre-channel protocol*.

**FCS.** See *fibre-channel standard*.

**feature code.** A code that identifies a particular orderable option and that is used by service personnel to process hardware and software orders. Individual optional features are each identified by a unique feature code.

**fibre channel (FC).** A data-transmission architecture based on the ANSI fibre-channel standard, which supports full-duplex communication. The ESS supports data transmission over fiber-optic cable through its fibre-channel adapters. See *fibre-channel protocol* and *fibre-channel standard*.

**Fibre Channel-Arbitrated Loop (FC-AL).** An implementation of the fibre-channel standard that uses a ring topology for the communication fabric. Refer to American National Standards Institute (ANSI) X3T11/93-275. In this topology, two or more fibre-channel end points are interconnected through a looped interface. The ESS supports this topology.

**fibre-channel connection (FICON).** A fibre-channel communications protocol designed for IBM mainframe computers and peripherals.

**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 American National Standards Institute (ANSI) X3.230-199x.

**FICON.** See *fibre-channel connection*.

**FiconNet.** In ESS Specialist, the label on a pseudo-host icon representing a host connection that uses the FICON protocol and that is not completely defined on the ESS. See *pseudo-host* and *access-any mode*.

**field replaceable unit (FRU).** An assembly that is replaced in its entirety when any one of its components fails. In some cases, a field replaceable unit 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 who meet authorization criteria.

**first-in-first-out (FIFO).** A queuing technique in which the next item to be retrieved is the item that has been in the queue for the longest time. (A)

**fixed-block architecture (FBA).** An architecture for logical devices that specifies the format of and access mechanisms for the logical data units on the device. The logical data unit is a block. All blocks on the device are the same size (fixed size). The subsystem can access them independently.

**fixed-block device.** An architecture for logical devices that specifies the format of the logical data units on the device. The logical data unit is a block. All blocks on the device are the same size (fixed size); the subsystem can access them independently. This is the required format of the logical data units for host systems that attach with a Small Computer System Interface (SCSI) or fibre-channel interface. See *fibre-channel*, *Small Computer System Interface* and *SCSI-FCP*.

**FlashCopy.** An optional feature for the ESS that 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<sup>9</sup> bytes. A gigabyte of memory is 2<sup>30</sup> bytes.

**GDPS.** Geographically Dispersed Parallel Sysplex, an S/390 multi-site application availability solution.

**group.** See *disk drive module group* or *Copy Services server group*.

## H

**HA.** See *host adapter*.

**HACMP.** Software that provides host clustering, so that a failure of one host is recovered by moving jobs to other hosts within the cluster; named for high-availability cluster multiprocessing

**hard disk drive (HDD).** (1) A storage medium within a storage server used to maintain information that the storage server requires. (2) A mass storage medium for computers that is typically available as a fixed disk (such as the disks used in system units of personal computers or in drives that are external to a personal computer) or a removable cartridge.

**Hardware Service Manager (HSM).** An option selected from System Service Tools or Dedicated Service Tools on the AS/400 or iSeries host that enables the user to display and work with system hardware resources, and to debug input-output processors (IOP), input-output adapters (IOA), and devices.

**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.

**heartbeat.** A status report sent at regular intervals from the ESS. The service provider uses this report to monitor the health of the call home process. See *call home*, *heartbeat call home record*, and *remote technical assistance information network*.

**heartbeat call home record.** Machine operating and service information sent to a service machine. These records might include such information as feature code information and product logical configuration information.

**High Speed Link (HSL).** Bus technology for input-output tower attachment on iSeries host.

**home address.** A nine-byte field at the beginning of a track that contains information that identifies the physical track and its association with a cylinder.

**hop.** Interswitch connection. A hop count is the number of connections that a particular block of data traverses between source and destination. For example, data traveling from one hub over a wire to another hub traverses one hop.

**host adapter (HA).** A physical subunit of a storage server that provides the ability to attach to one or more host I/O interfaces. The Enterprise Storage Server has four HA bays, two in each cluster. Each bay supports up to four host adapters.

**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 computer system that is connected to the ESS. The ESS supports both mainframe (S/390 or zSeries) hosts as well as open-systems hosts. S/390 or zSeries hosts are connected to the ESS through ESCON or FICON interfaces. Open-systems hosts are connected to the ESS by SCSI or fibre-channel interfaces. (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.

**HSL.** See *High Speed Link*.

## I

**IBM @server.** The brand name for a series of server products that are optimized for e-commerce. The products include the iSeries, pSeries, xSeries, and zSeries.

**IBM product engineering (PE).** The third-level of IBM service support. Product engineering is composed of IBM engineers who have experience in supporting a product or who are knowledgeable about the product.

**IBM StorWatch Enterprise Storage Server Expert (ESS Expert).** The software that gathers performance data from the ESS and presents it through a Web browser.

**IBM TotalStorage Enterprise Storage Server (ESS).** A member of the Seascape<sup>®</sup> product family of storage servers and attached storage devices (disk drive modules). The ESS provides for high-performance, fault-tolerant storage and management of enterprise data, providing access through multiple concurrent operating systems and communication protocols. High performance is provided by four symmetric multiprocessors, integrated caching, RAID support for the disk drive modules, and disk access through a high-speed serial storage architecture (SSA) interface.

**IBM TotalStorage Enterprise Storage Server Specialist (ESS Specialist).** Software with a Web-browser interface for configuring the ESS.

**IBM TotalStorage Enterprise Storage Server Copy Services (ESS Copy Services).** Software with a Web-browser interface for configuring, managing, and monitoring the data-copy functions of FlashCopy and PPRC.

**IBM TotalStorage Enterprise Storage Server Network (ESSNet).** A private network providing Web browser access to the ESS. IBM installs the ESSNet software on an IBM workstation called the IBM TotalStorage ESS Master Console, supplied with the first ESS delivery.

**IBM TotalStorage ESS Master Console (ESS Master Console).** An IBM workstation (formerly named the ESSNet console and hereafter referred to simply as the ESS Master Console) that IBM installs to provide the ESSNet facility when they install your ESS. It includes a Web browser that provides links to the ESS user interface, including ESS Specialist and ESS Copy Services.

**ID.** See *identifier*.

**identifier (ID).** A unique name or address that identifies things such as programs, devices, or systems.

**IML.** See *initial microprogram load*.

**implicit allegiance.** In Enterprise Systems Architecture/390, a relationship that a control unit creates between a device and a channel path when the device accepts a read or write operation. The control unit guarantees access to the channel program over the set of channel paths that it associates with the allegiance.

**initial microprogram load (IML).** To load and initiate microcode or firmware that controls a hardware entity such as a processor or a storage server.

**initial program load (IPL).** To load and initiate the software, typically an operating system that controls a host computer.

**initiator.** A SCSI device that communicates with and controls one or more targets. An initiator is typically an I/O adapter on a host computer. A SCSI initiator is analogous to an S/390 channel. A SCSI logical unit is analogous to an S/390 device. See *target*.

**i-node.** The internal structure in an AIX operating system that describes the individual files in the operating system. It contains the code, type, location, and owner of a file.

**input/output (I/O).** Pertaining to (a) input, output, or both or (b) a device, process, or channel involved in data input, data output, or both.

**Internet Protocol (IP).** In the Internet suite of protocols, a protocol without connections that routes data through a network or interconnecting networks and acts as an intermediary between the higher protocol layers and the physical network. The upper layer supports one or more logical protocols (for example, a SCSI-command protocol and an ESA/390 command protocol). Refer to ANSI X3.230-199x. The IP acronym is the IP in TCP/IP. See *Transmission Control Protocol/Internet Protocol*.

**invalidate.** To remove a logical data unit from cache memory, because it cannot support continued access to the logical data unit on the device. This removal may be the result of a failure within the storage server or a storage device that is associated with the device.

**I/O.** See *input/output*.

**I/O adapter (IOA).** Input-output adapter on the PCI bus.

**I/O device.** An addressable read and write unit, such as a disk drive device, magnetic tape device, or printer.

**I/O interface.** An interface that enables a host to perform read and write operations with its associated peripheral devices.

**I/O Priority Queueing.** Facility provided by the Workload Manager of OS/390 and supported by the ESS that enables the systems administrator to set priorities for queueing I/Os from different system images. See *multiple allegiance* and *parallel access volume*.

**I/O processor (IOP).** Controls input-output adapters and other devices.

**IP.** See *Internet Protocol*.

**IPL.** See *initial program load*.

**iSeries.** An IBM @server product that emphasizes integration.

## J

**Java virtual machine (JVM).** A software implementation of a central processing unit (CPU) that runs compiled Java code (applets and applications).

**JVM.** See *Java virtual machine*.

## 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 and use the key field to identify or locate a given record. The subsystem does not use the key field.

**kilobyte (KB).** (1) For processor storage, real, and virtual storage, and channel volume,  $2^{10}$  or 1024 bytes. (2) For disk storage capacity and communications volume, 1000 bytes.

**Korn shell.** Interactive command interpreter and a command programming language.

**KPOH.** See *thousands of power-on hours*.

## L

**LAN.** See *local area network*.

**last-in first-out (LIFO).** A queuing technique in which the next item to be retrieved is the item most recently placed in the queue. (A)

**LBA.** See *logical block address*.

**LCU.** See *logical control unit*.

**least recently used (LRU).** (1) The algorithm used to identify and make available the cache space that contains the least-recently used data. (2) A policy for a caching algorithm that chooses to remove from cache the item that has the longest elapsed time since its last access.

**LED.** See *light-emitting diode*.

**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 or FICON interface, the portion of a source or destination address in a frame that ESCON or FICON uses to route a frame through an ESCON or FICON director. ESCON or FICON associates the link address with a specific switch port that is on the ESCON or FICON director. Equivalently, it associates the link address with the channel-subsystem or control unit link-level functions that are attached to the switch port.

**link-level facility.** The ESCON or FICON hardware and logical functions of a control unit or channel

subsystem that allow communication over an ESCON or FICON write interface and an ESCON or FICON read interface.

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

**local e-mail.** An e-mail configuration option for storage servers that are connected to a host-system network that does not have a domain name system (DNS) server.

**logical address.** On an ESCON or FICON interface, the portion of a source or destination address in a frame used to select a specific channel-subsystem or control-unit image.

**logical block address (LBA).** The address assigned by the ESS to a sector of a disk.

**logical control unit (LCU).** See *control-unit image*.

**logical data unit.** A unit of storage that is accessible on a given device.

**logical device.** The facilities of a storage server (such as the ESS) associated with the processing of I/O operations directed to a single host-accessible emulated I/O device. The associated storage is referred to as a logical volume. The logical device is mapped to one or more host-addressable units, such as a device on an S/390 I/O interface or a logical unit on a SCSI I/O interface, such that the host initiating I/O operations to the I/O-addressable unit interacts with the storage on the associated logical device.

**logical partition (LPAR).** 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 path.** For Copy Services, a relationship between a source logical subsystem and target logical subsystem that is created over a physical path through the interconnection fabric used for Copy Services functions.

**logical subsystem (LSS).** Pertaining to the ESS, a construct that consists of a group of up to 256 logical devices. An ESS can have up to 16 CKD-formatted logical subsystems (4096 CKD logical devices) and also up to 16 fixed-block (FB) logical subsystems (4096 FB logical devices). The logical subsystem facilitates configuration of the ESS and may have other implications relative to the operation of certain functions. There is a one-to-one mapping between a CKD logical subsystem and an S/390 control-unit image.

For S/390 or zSeries hosts, a logical subsystem represents a logical control unit (LCU). Each control-unit image is associated with only one logical subsystem. See *control-unit image*.

**logical unit.** The open-systems term for a logical disk drive.

**logical unit number (LUN).** A SCSI term for a unique number used on a SCSI bus to enable it to differentiate between up to eight separate devices, each of which is a logical unit.

**logical volume.** The storage medium associated with a logical disk drive. A logical volume typically resides on one or more storage devices. The ESS administrator defines this unit of storage. The logical volume, when residing on a RAID-5 array, is spread over 6 +P or 7 +P drives, where P is parity. A logical volume can also reside on a non-RAID storage device. See *count key data* and *fixed block address*.

**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).

**longitudinal redundancy check (LRC).** A method of error-checking during data transfer that involves checking parity on a row of binary digits that are members of a set that forms a matrix. Longitudinal redundancy check is also called a longitudinal parity check.

**longwave laser adapter.** A connector used between host and the ESS to support longwave fibre-channel communication.

**loop.** The physical connection between a pair of device adapters in the ESS. See *device adapter*.

**LPAR.** See *logical partition*.

**LRC.** See *longitudinal redundancy check*.

**LRU.** See *least recently used*.

**LSS.** See *logical subsystem*.

**LUN.** See *logical unit number*.

**LVM.** See *logical volume manager*.

## M

**machine level control (MLC).** A database that contains the EC level and configuration of products in the field.

**machine reported product data (MRPD).** Product data gathered by a machine and sent to a destination such as an IBM support server or RETAIN. These

records might include such information as feature code information and product logical configuration information.

**mainframe.** A computer, usually in a computer center, with extensive capabilities and resources to which other computers may be connected so that they can share facilities. (T)

**maintenance analysis procedure (MAP).** A hardware maintenance document that gives an IBM service representative a step-by-step procedure for tracing a symptom to the cause of a failure.

**management information base (MIB).** (1) A schema for defining a tree structure that identifies and defines certain objects that can be passed between units using an SNMP protocol. The objects passed typically contain certain information about the product such as the physical or logical characteristics of the product. (2) Shorthand for referring to the MIB-based record of a network device. Information about a managed device is defined and stored in the management information base (MIB) of the device. Each ESS has a MIB. SNMP-based network management software uses the record to identify the device. See *simple network management protocol*.

**MAP.** See *maintenance analysis procedure*.

**Master Console.** See *IBM TotalStorage ESS Master Console*.

**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<sup>20</sup> or 1 048 576 bytes. (2) For disk storage capacity and communications volume, 1 000 000 bytes.

**MES.** See *miscellaneous equipment specification*.

**MIB.** See *management information base*.

**Micro Channel architecture (MCA).** The rules that define how subsystems and adapters use the Micro Channel bus in a computer. The architecture defines the services that each subsystem can or must provide.

**Microsoft Internet Explorer (MSIE).** Web browser software manufactured by Microsoft.

**MIH.** See *missing-interrupt handler*.

**mirrored pair.** Two units that contain the same data. The system refers to them as one entity.

**mirroring.** In host systems, the process of writing the same data to two disk units within the same auxiliary storage pool at the same time.

**miscellaneous equipment specification (MES).** IBM field-installed change to a machine.

**missing-interrupt handler (MIH).** An MVS and MVS/XA facility that tracks I/O interrupts. MIH informs the operator and creates a record whenever an expected interrupt fails to occur before a specified elapsed time is exceeded.

**MLC.** See *machine level control*.

**mobile service terminal (MoST).** The mobile terminal used by service personnel.

**Model 100.** A 2105 Model 100, often simply referred to as a Mod 100, is an expansion enclosure for the ESS. See 2105 and

**MoST.** See *mobile service terminal*.

**MRPD.** See *machine reported product data*.

**MSIE.** See *Microsoft Internet Explorer*.

**MTBF.** See *mean time between failures*.

**multiple allegiance.** An ESS hardware function that is independent of software support. This function enables multiple system images to concurrently access the same logical volume on the ESS as long as the system images are accessing different extents. See *extent* and *parallel access volumes*.

**multiple virtual storage (MVS).** Implies MVS/390, MVS/XA, MVS/ESA, and the MVS element of the OS/390 operating system.

**MVS.** See *multiple virtual storage*.

## N

**Netfinity.** Obsolete brand name of an IBM Intel-processor-based server.

**Netscape Navigator.** Web browser software manufactured by Netscape.

**node.** The unit that is connected in a fibre-channel network. An ESS is a node in a fibre-channel network.

**non-RAID.** A disk drive set up independently of other disk drives and not set up as part of a disk drive module

group to store data using the redundant array of disks (RAID) data-striping methodology.

**nonremovable medium.** A recording medium that cannot be added to or removed from a storage device.

**nonretentive data.** Data that the control program can easily recreate in the event it is lost. The control program may cache nonretentive write data in volatile memory.

**nonvolatile storage (NVS).** (1) Typically refers to nonvolatile memory on a processor rather than to a nonvolatile disk 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

**octet.** In Internet Protocol (IP) addressing, one of the four parts of a 32-bit integer presented in dotted decimal notation. dotted decimal notation consists of four 8-bit numbers written in base 10. For example, 9.113.76.250 is an IP address containing the octets 9, 113, 76, and 250.

**OEMI.** See *original equipment manufacturer's information*.

**open system.** A system whose characteristics comply with standards made available throughout the industry and that therefore can be connected to other systems complying with the same standards. Applied to the ESS, such systems are those hosts that connect to the ESS through SCSI or SCSI-FCP adapters. See *Small Computer System Interface* and *SCSI-FCP*.

**organizationally unique identifier (OUI).** An IEEE-standards number that identifies an organization with a 24-bit globally unique assigned number referenced by various standards. OUI is used in the family of 802 LAN standards, such as Ethernet and Token Ring.

**original equipment manufacturer's information (OEMI).** A reference to an IBM guideline for a computer peripheral interface. The interface uses ESA/390 logical protocols over an I/O interface that configures attached units in a multidrop bus topology.

**OUI.** See *organizationally unique identifier*.

## P

**panel.** The formatted display of information that appears on a display screen.

**parallel access volume (PAV).** An advanced function of the ESS that enables OS/390 and z/OS systems to issue concurrent I/O requests against a CKD logical volume 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. PAV enables two or more concurrent writes to the same logical volume, as long as the writes are not to the same extents. See *extent*, *I/O Priority Queueing*, and *multiple allegiance*.

**parity.** A data checking scheme used in a computer system to ensure the integrity of the data. The RAID implementation uses parity to recreate data if a disk drive fails.

**path group.** The ESA/390 term for a set of channel paths that are defined to a control unit as being associated with a single logical partition (LPAR). The channel paths are in a group state and are online to the host. See *logical partition*.

**path group identifier.** The ESA/390 term for the identifier that uniquely identifies a given logical partition (LPAR). The path group identifier is used in communication between the LPAR program and a device. The identifier associates the path group with one or more channel paths, thereby defining these paths to the control unit as being associated with the same LPAR.

**PAV.** See *parallel access volume*.

**PCI.** See *peripheral component interconnect*.

**PE.** See *IBM product engineering*.

**Peer-to-Peer Remote Copy (PPRC).** A function of a storage server that maintains a consistent copy of a logical volume on the same storage server or on another storage server. All modifications that any attached host performs on the primary logical volume are also performed on the secondary logical volume.

**peripheral component interconnect (PCI).** An architecture for a system bus and associated protocols that supports attachments of adapter cards to a system backplane.

**physical path.** A single path through the I/O interconnection fabric that attaches two units. For Copy Services, this is the path from a host adapter on one ESS (through cabling and switches) to a host adapter on another ESS.

**point-to-point connection.** For fibre-channel connections, a topology that enables the direct interconnection of ports. See *arbitrated loop* and *switched fabric*.

**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.

**primary Copy Services server.** One of two Copy Services servers in a Copy Services domain. The primary Copy Services server is the active Copy Services server until it fails; it is then replaced by the backup Copy Services server. A Copy Services server is software that runs in one of the two clusters of an ESS and performs data-copy operations within that group. See *active Copy Services server* and *backup Copy Services server*.

**product engineering.** See *IBM product engineering*.

**program.** On a computer, a generic term for software that controls the operation of the computer. Typically, the program is a logical assemblage of software modules that perform multiple related tasks.

**program-controlled interruption.** An interruption that occurs when an I/O channel fetches a channel command word with the program-controlled interruption flag on.

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

**promote.** To add a logical data unit to cache memory.

**protected volume.** An AS/400 term for a disk storage device that is protected from data loss by RAID techniques. An AS/400 host does not mirror a volume configured as a protected volume, while it does mirror all volumes configured as unprotected volumes. The ESS, however, can be configured to indicate that an AS/400 volume is protected or unprotected and give it RAID protection in either case.

**pSeries.** An IBM @server product that emphasizes performance.

**pseudo-host.** A host connection that is not explicitly defined to the ESS and that has access to at least one volume that is configured on the ESS. The FiconNet pseudo-host icon represents the FICON protocol. The EsconNet pseudo-host icon represents the ESCON protocol. The pseudo-host icon labelled "Anonymous" represents hosts connected through the SCSI-FCP protocol. *Anonymous host* is a commonly used synonym for *pseudo-host*. The ESS adds a pseudo-host icon only when the ESS is set to access-any mode. See *access-any mode*.

**PTF.** See *program temporary fix*.

**PV Links.** Short for Physical Volume Links, an alternate pathing solution from Hewlett-Packard providing for multiple paths to a volume, as well as static load balancing.

## R

**rack.** See *enclosure*.

**RAID.** See *redundant array of inexpensive disks and array*. RAID also is expanded to redundant array of independent disks.

**RAID 5.** A type of RAID that optimizes cost-effective performance through data striping. RAID 5 provides fault tolerance for up to two failed disk drives by distributing parity across all of the drives in the array plus one parity disk drive. The ESS automatically reserves spare disk drives when it assigns arrays to a device adapter pair (DA pair). See *device adapter*.

**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.

**redundant array of inexpensive disks (RAID).** A methodology of grouping disk drives for managing disk storage to insulate data from a failing disk drive.

**remote technical assistance information network (RETAIN).** The initial service tracking system for IBM service support, which captures heartbeat and call-home records. See *support catcher* and *support catcher telephone number*.

**REQ/ACK.** See *request for acknowledgement and acknowledgement*.

**request for acknowledgement and acknowledgement (REQ/ACK).** A cycle of communication between two data transport devices for the purpose of verifying the connection, which starts with a request for acknowledgement from one of the devices and ends with an acknowledgement from the second device.

**reserved allegiance.** In Enterprise Systems Architecture/390, a relationship that is created in a control unit 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*.

**R0.** See *track-descriptor record*.

## S

**S/390 and zSeries.** IBM enterprise servers based on Enterprise Systems Architecture/390 (ESA/390) and z/Architecture, respectively. "S/390" is a shortened form of the original name "System/390".

**S/390 and zSeries storage.** Storage arrays and logical volumes that are defined in the ESS as connected to S/390 and zSeries servers. This term is synonymous with count-key-data (CKD) storage.

**SAID.** See *system adapter identification number*.

**SAM.** See *sequential access method*.

**SAN.** See *storage area network*.

**SBCON.** See *Single-Byte Command Code Sets Connection*.

**screen.** The physical surface of a display device upon which information is shown to users.

**SCSI.** See *Small Computer System Interface*.

**SCSI device.** A disk drive connected to a host through a an I/O interface using the SCSI protocol. A SCSI device is either an initiator or a target. See *initiator* and *Small Computer System Interface*.

**SCSI host systems.** Host systems that are attached 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 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.

**SCSI-FCP.** Short for SCSI-to-fibre-channel protocol, a protocol used to transport data between a SCSI adapter on an open-systems host and a fibre-channel adapter on an ESS. See *fibre-channel protocol* and *Small Computer System Interface*.

**Seascope architecture.** A storage system architecture developed by IBM for open-systems servers and S/390 and zSeries host systems. It provides storage solutions that integrate software, storage management, and technology for disk, tape, and optical storage.

**serial connection.** A method of device interconnection for determining interrupt priority by connecting the interrupt sources serially.

**self-timed interface (STI).** An interface that has one or more conductors that transmit information serially between two interconnected units without requiring any clock signals to recover the data. The interface performs clock recovery independently on each serial data stream



and uses information in the data stream to determine character boundaries and inter-conductor synchronization.

**sequential access.** A mode of accessing data on a medium in a manner that requires the storage device to access consecutive storage locations on the medium.

**sequential access method (SAM).** An access method for storing, deleting, or retrieving data in a continuous sequence based on the logical order of the records in the file.

**serial 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. See *SSA adapter*.

**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.** A category that identifies a group of components that are unavailable for use when one of the components of the group is being serviced. Service boundaries are provided on the ESS, for example, in each host bay and in each cluster.

**service information message (SIM).** A message sent by a storage server to service personnel through an S/390 operating system.

**service personnel.** A generalization referring to individuals or companies authorized to service the ESS. The terms “service provider”, “service representative”, and “IBM service support representative (SSR)” refer to types of service personnel. See *service support representative*.

**service processor.** A dedicated processing unit used to service a storage facility.

**service support representative (SSR).** Individuals or a company authorized to service the ESS. This term also refers to a service provider, a service representative, or an IBM service support representative (SSR). An IBM SSR installs the ESS.

**shared storage.** Storage within an ESS that is configured so that multiple homogeneous 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. The programs must be designed to handle the effects of concurrent access.

**shortwave laser adapter.** A connector used between host and ESS to support shortwave fibre-channel communication.

**SIM.** See *service-information message*.

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

**simplex volume.** A volume that is not part of a FlashCopy, XRC, or PPRC volume pair.

**Single-Byte Command Code Sets Connection (SBCCON).** The ANSI standard for the ESCON or FICON 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 initiators and targets in a multidrop 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 *symmetric multi-processor*.

**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 on the ESS that can replace a failed disk drive. A spare can be predesignated to allow automatic dynamic sparing. Any data preexisting on a disk drive that is invoked as a spare is destroyed by the dynamic sparing copy process.

**spatial reuse.** A feature of serial storage architecture that enables a device adapter loop to support many simultaneous read/write operations. See *serial storage architecture*.

**Specialist.** See *IBM TotalStorage Enterprise Storage Server Specialist*.

**SSA.** See *serial storage architecture*.

**SSA adapter.** A physical adapter based on serial storage architecture. SSA adapters connect disk drive modules to ESS clusters. See *serial storage architecture*.

**SSID.** See *subsystem identifier*.

**SSR.** See *service support representative*.

**stacked status.** In Enterprise Systems Architecture/390, 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.

**stage operation.** The operation of reading data from the physical disk drive into the cache.

**staging.** To move data from an offline or low-priority device back to an online or higher priority device, usually on demand of the system or on request of the user.

**STI.** See *self-timed interface*.

**storage area network.** A network that connects a company's heterogeneous storage resources.

**storage complex.** Multiple storage facilities.

**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 server 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 physical unit that manages attached storage devices and provides an interface between them and a host computer by providing the function of one or more logical subsystems. The storage server can provide functions that are not provided by the storage device. The storage server has one or more clusters.

**striping.** A technique that distributes data in bit, byte, multi-byte, 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.** A server to which a machine sends a trace or a dump package.

**support catcher telephone number.** The telephone number that connects the support catcher server to the ESS to receive a trace or dump package. See *support catcher*. See *remote technical assistance information network*.

**switched fabric.** One of three a fibre-channel connection topologies supported by the ESS. See *arbitrated loop* and *point-to-point*.

**symmetric multi-processor (SMP).** An implementation of a multi-processor computer consisting of several identical processors configured in a way that any subset of the set of processors is capable of

continuing the operation of the computer. The ESS contains four processors set up in SMP mode.

**synchronous write.** A write operation whose completion is indicated after the data has been stored on a storage device.

**System/390.** See *S/390*.

**system adapter identification number (SAID).**

**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

**TAP.** See *Telocator Alphanumeric Protocol*.

**target.** A SCSI device that acts as a slave to an initiator and consists of a set of one or more logical units, each with an assigned logical unit number (LUN). The logical units on the target are typically I/O devices. A SCSI target is analogous to an S/390 control unit. A SCSI initiator is analogous to an S/390 channel. A SCSI logical unit is analogous to an S/390 device. See *Small Computer System Interface*.

**TB.** See *terabyte*.

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

**Telocator Alphanumeric Protocol (TAP).** An industry standard protocol for the input of paging requests.

**terabyte (TB).** (1) Nominally, 1 000 000 000 000 bytes, which is accurate when speaking of bandwidth and disk storage capacity. (2) For ESS cache memory, processor storage, real and virtual storage, a terabyte refers to  $2^{40}$  or 1 099 511 627 776 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 that 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 IBM operating system, designed to support real-time, transaction-driven applications. The specialized architecture of TPF is intended to optimize system efficiency, reliability, and responsiveness for data communication and database processing. TPF provides real-time inquiry and updates to a large, centralized database, where message length is relatively short in both directions, and response time is generally less than three seconds. Formerly known as the Airline Control Program/Transaction Processing Facility (ACP/TPF).

**Transmission Control Protocol/Internet Protocol (TCP/IP).** (1) Together, the Transmission Control Protocol and the Internet Protocol provide 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. See *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 control unit. On ESCON or FICON interfaces, the unit address is the same as the device address. On OEMI interfaces, the unit address specifies a control unit and device pair on the interface.

**unprotected volume.** An AS/400 term that indicates that the AS/400 host recognizes the volume as an unprotected device, even though the storage resides on a RAID array and is therefore fault tolerant by definition. The data in an unprotected volume can be mirrored. Also referred to as an *unprotected device*.

**upper-layer protocol.** The layer of the Internet Protocol (IP) that supports one or more logical protocols (for example, a SCSI-command protocol and an ESA/390 command protocol). Refer to ANSI X3.230-199x.

**UTC.** See *Coordinated Universal Time*.

**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 Enterprise Systems Architecture/390, the information recorded on a single unit of recording medium. Indirectly, it can refer to the unit of recording medium itself. On a nonremovable-medium storage device, the term can also indirectly refer to the storage device associated with the volume. When multiple volumes are stored on a single storage medium transparently to the program, the volumes can be referred to as logical volumes.

**VPD.** See *vital product data*.

## W

**Web Copy Services.** See *IBM TotalStorage Enterprise Storage Server Copy Services*.

**worldwide node name (WWNN).** A unique 64-bit identifier for a host containing a fibre-channel port. See *worldwide port name*.

**worldwide port name (WWPN).** A unique 64-bit identifier associated with a fibre-channel adapter port. It is assigned in an implementation- and protocol-independent manner.

**write hit.** A write operation in which the requested data is in the cache.

**write penalty.** The performance impact of a classical RAID 5 write operation.

**WWPN.** See *worldwide port name*.

## X

**XRC.** See *Extended Remote Copy*.

**xSeries.** An IBM @server product that emphasizes architecture.

## Z

**zSeries.** An IBM @server product that emphasizes near-zero downtime.

**zSeries storage.** See *S/390 and zSeries storage*.

## Numerics

**2105.** The machine number for the IBM Enterprise Storage Server (ESS). 2105-100 is an ESS expansion enclosure typically referred to as the Model 100. See *IBM TotalStorage Enterprise Storage Server and Model 100*.

**3390.** The machine number of an IBM disk storage system. The ESS, when interfaced to IBM S/390 or zSeries hosts, is set up to appear as one or more 3390 devices, with a choice of 3390-2, 3390-3, or 3390-9 track formats.

**3990.** The machine number of an IBM control unit.

**7133.** The machine number of an IBM disk storage system. The Model D40 and 020 drawers of the 7133 can be installed in the 2105-100 expansion enclosure of the ESS.

**8-pack.** See *disk drive module group*.

---

# Index

## Special Characters

/opt/IBMdpo/bin/showvpath command 123  
/usr/lib/errstop command 27  
> errclear 0 command 27  
> errpt > file.save command 27

## A

about this book xi

accessing

AIX

- add a data path volume to a volume group SMIT panel 48
- add a volume group with data path devices SMIT panel 48
- add paths to available data path devices SMIT panel 47
- back up a volume group with data path devices SMIT panel 49
- configure a defined data path device SMIT panel 47
- define and configure all data path devices SMIT panel 47
- display data path device adapter status SMIT panel 46
- display data path device configuration SMIT panel 46
- display data path device status SMIT panel 46
- remake a volume group with data path devices SMIT panel 50
- remove a copy from a datapath logical volume SMIT panel 49
- remove a data path device SMIT panel 48

adapters

configuring

Windows 2000 78, 79

Windows NT 63

Emulex LP7000E 9

adding

devices in Sun host systems 118

paths

Windows 2000 host systems 80

Windows NT 64

storage for Windows NT host systems 68, 69

adding paths

AIX

host systems 21

to SDD devices volume group 20

from AIX 4.3.2 volume group 20

addpaths

utility programs, AIX 50

addpaths command 20, 43, 51

agreement for licensed internal code 146

AIX

accessing

- add a data path volume to a volume group SMIT panel 48

AIX (continued)

accessing (continued)

- add a volume group with data path devices SMIT panel 48

- add paths to available data path devices SMIT panel 47

- back up a volume group with data path devices SMIT panel 49

- configure a defined data path device SMIT panel 47

- define and configure all data path devices SMIT panel 47

- display data path device adapter status SMIT panel 46

- display data path device configuration SMIT panel 46

- display data path device status SMIT panel 46

- remake a volume group with data path devices SMIT panel 50

- remove a copy from a datapath logical volume SMIT panel 49

- removing a data path device SMIT panel 48

adding paths 20, 21

adding paths to SDD devices of a volume group 20

backing-up files belonging to an SDD volume group 44

changing the path-selection policy 19

configuring

- volume group for failover protection 36

configuring SDD 17

error log messages 58

- new and modified messages by SDD for HACMP 59

exporting

- volume group with SDD 39

extending

- an existing SDD volume group 44

importing

- volume group with SDD 37

installing SDD 13

migrating

- an existing non-SDD volume group to SDD vpath devices in concurrent mode 56

- non-SDD volume group to an ESS SDD multipath volume group in concurrent mode 54

nondisruptive installation 23

recovering

- from mixed volume groups 44

removing SDD from a host system 26

restoring files belonging to an SDD volume group 45

SDD utility programs 50

SDD-specific SMIT panels 45

the loss of a device path 41

unconfiguring SDD 18

upgrading 23

upgrading to SDD 1.3.1.3 25

- AIX (*continued*)
  - upgrading to SDD 1.3.1.3 through a nondisruptive installation 25
  - verifying SDD 18
  - verifying SDD installation 16, 24
- AIX 4.3.2 applications
  - 32-bit 9
  - 64-bit 9
- AIX 4.3.3 applications
  - 32-bit 9
  - 64-bit 9
- AIX 5.1.0 applications
  - 32-bit 9
  - 64-bit 9
- AIX 5.1.x
  - 32-bit 9
  - 64-bit 9
- AIX fibre-channel requirements 11
- AIX host system
  - commands 2
  - disk driver 1
  - protocol stack 1
- AIX levels
  - AIX 4.2.1
    - required PTFs 8
  - AIX 4.3.2
    - required PTFs 8
  - AIX 4.3.3
    - required maintenance level 8
- AIX trace 58

## B

- backing-up AIX files belonging to an SDD volume group 44
- BIOS, disabling 63, 79
- block disk device interfaces (SDD) 88, 106
- boot -r command 121
- bootinfo -K command 9

## C

- Canadian compliance statement 145
- cfallvpath command 23
- cfgmgr
  - run *n* times where *n* represents the number of paths per SDD device. 42
  - run for each installed SCSI or fibre adapter 42
- cfgmgr command 11, 21, 42
- changing
  - path-selection policy for AIX 19
  - SDD hardware configuration
    - HP host systems 93
    - Sun hosts 112
  - to the /dev directory
    - HP host systems 95
- chdev command 41, 42
- chgrp command 103, 117
- chmod command 103, 117
- chown command 103
- class A compliance statement, Taiwan 146

- command
  - /usr/lib/errstop 27
  - > errclear 0 27
  - > errpt > file.save 27
  - addpaths 20, 43, 51
  - bootinfo -K 9
  - cfallvpath 23
  - cfgmgr 11, 42
    - running *n* times for *n*-path configurations 21, 22, 42
    - running for each relevant SCSI or FCP adapter 21, 22
  - chdev 41, 42
  - datapath query adapter 126
  - datapath query adaptstats 127
  - datapath query device 36, 42, 128
  - datapath query devstats 130
  - datapath set adapter 132
  - datapath set device 133
  - datapath set device 0 path 0 offline 133
  - datapath set device N policy rr/fo/lb/df 20
  - dpovgfix 36, 51
  - dpovgfix vg-name 21, 22, 42
  - extendvg 44
  - extendvg4vp 44, 52
  - hd2vp and vp2hd 51
  - hd2vp vg\_name 26
  - hd2vp vg-name 23
  - installp 11
  - instfix -i | grep IY10201 11
  - instfix -i | grep IY10994 11
  - instfix -i | grep IY11245 11
  - instfix -i | grep IY13736 11
  - instfix -i | grep IY17902 11
  - instfix -i | grep IY18070 11
  - ls -al /unix 9
  - lscfg -vl fcsN 12
  - lsdev -Cc disk 12
  - lsdev -Cc disk | grep 2105 17
  - lspp -l ibmSdd\_421.rte 16
  - lspp -l ibmSdd\_432.rte 16
  - lspp -l ibmSdd\_433.rte 16
  - lspp -l ibmSdd\_510.rte 16
  - lspp -l ibmSdd\_510nchacmp.rte 16
  - lspv 21, 22, 25, 40
  - lsvg -p vg-name 37
  - lsvgfs 25
  - lsvgfs vg-name 22
  - lsvpcfg 21, 26, 35, 41, 51
  - mkdev -l vpathN 18
  - mksysb restore command 40
  - mkvg 37
  - mkvg4vp 37, 52
  - mount 22
  - odmget -q "name = ioaccess" CuAt 32
  - restvg 45
  - restvg4vp 45
  - rmdev 42, 43
  - rmdev -dl dpo -R 26
  - rmdev -dl fcsN -R 12
  - rmdev -l dpo -R 18, 22

- command (*continued*)
  - rmdev -l vpath N 22
  - savevg 45
  - savevg4vp 45
  - shutdown -rF 12
  - smitty 26
  - smitty deinstall 11
  - smitty device 26
  - umount 25
  - umount mounted-filesystem 22
  - using 125
  - varyoffvg 17, 25
  - varyoffvg vg-name 22
  - varyonvg vg\_name 26
  - varyonvg vg-name 23
- commands
  - /opt/IBMdpo/bin/showvpath 123
  - boot -r 121
  - chgrp 103, 117
  - chmod 103, 117
  - chown 103
  - datapath query
    - adapter 74, 86
    - device 64, 80, 86
  - datapath query device 91
  - datapath set adapter # offline 84
  - datapath set adapter offline 84
  - metadb -a <device> 122
  - metadb -d -f <device> 122
  - metadb -i 122
  - metainit 122
  - metainit d <metadevice number> -t <"vpathNs" - master device> <"vpathNs" - logging device> 124
  - metastat 122, 123
  - mount /dev/dsk/c1t2d0s2 /mnt1 105
  - mount /dev/dsk/clt2d0 /mnt1 87
  - mount /dev/dsk/vpath0 /mnt1 87
  - mount /dev/dsk/vpath0c /mnt1 105
  - newfs 123
  - orainst /m 102, 115
  - pkgrm IBMdpo 123
  - showvpath 96, 116, 117, 120, 122
  - shutdown -i6 -y -g0 122
  - umount 124
  - umount /cdrom 111
  - vxdisk list cntndn 121
- commands datapath set adapter # offline 73
- commands datapath set adapter offline 73
- communications statement 144
- compliance statement
  - German 145
  - radio frequency energy 144
  - Taiwan class A 146
- concurrent download of licensed internal code
  - AIX 27
  - SDD 4
- configuring
  - additional paths on a Windows NT host system 65
  - AIX
    - ESS 10
    - fibre-channel attached devices 10, 11

- configuring (*continued*)
  - AIX (*continued*)
    - volume group for failover protection 36
  - clusters with SDD
    - Windows 2000 host system 84
    - Windows NT host system 73
  - ESS
    - HP host systems 88
    - Sun host systems 106
    - Windows 2000 78
    - Windows NT 62
  - fibre-channel adapters
    - Windows 2000 host system 78
    - Windows NT host system 62
  - SCSI adapters
    - Windows 2000 host systems 79
    - Windows NT 63
  - SDD
    - Windows 2000 host system 80
    - Windows NT host system 64
    - SDD for AIX host 17
    - SDD on AIX 17
- configuring a vpath device to the Available condition 43
- configuring all vpath devices to the Available condition 43
- conversion script
  - vp2hd 18
- conversion scripts
  - hd2vp 50
  - vp2hd 21, 22, 50
- creating
  - device node for the logical volume device in an HP host systems 95
  - directory in /dev for the volume group in an HP host systems 95
  - filesystem on the volume group in an HP host systems 96
  - logical volume in an HP host systems 96
  - new disk group from an SDD device in a Sun host systems 119
  - new logical volumes in an HP host systems 94
  - new volume group from an SDD device in a Sun host systems 119
  - physical volume in an HP host systems 96
  - volume group in an HP host systems 96
- customizing
  - Network File System file server 99
  - Oracle 100, 114
  - standard UNIX applications 94, 113

## D

- Data Path Optimizer (DPO) 63
- database managers (DBMS) 106
- datapath
  - query
    - adapter command 74, 86
    - device command 64, 74, 86
    - query adapter command 126
    - query adaptstats command 127

- datapath (*continued*)
  - query device command 128
  - query devstats command 130
  - query set adapter command 132
  - set adapter # offline command 73, 84
  - set adapter offline command 73, 84
  - set device command 133
- datapath query device command 36, 42
- datapath set device 0 path 0 offline command 133
- datapath set device N policy rr/fo/lb/df command 20
- determining
  - AIX
    - Emulex adapter firmware level 12
    - major number of the logical volume device for an HP host systems 95
    - size of the logical volume for an HP host systems 97
- device driver 105
- displaying
  - AIX
    - ESS vpath device configuration 35
    - current version of SDD
      - Windows 2000 83
    - current version of the SDD
      - Windows NT 72
- documents, ordering xiii
- dpovgfix command 36, 51
- dpovgfix vg-name command 21, 22, 42
- dynamic I/O load-balancing 3

## E

- electronic emission notices 144
- Emulex adapter
  - Emulex LP7000E 9
  - firmware level 10, 12
  - upgrading firmware level to (sf320A9) 12
- enhanced data availability 3
- error log messages
  - AIX
    - new and modified messages by SDD for HACMP 59
    - VPATH\_DEVICE\_OFFLINE 58
    - VPATH\_DEVICE\_ONLINE 58
    - VPATH\_PATH\_OPEN 58
    - VPATH\_XBUF\_NOMEM 58
- error log messages for ibmSdd\_433.rte fileset for SDD
  - AIX
    - VPATH\_DEVICE\_OPEN 59
    - VPATH\_FAIL\_RELPRESERVE 59
    - VPATH\_OUT\_SERVICE 59
    - VPATH\_RESV\_CFLICT 59

## ESS

- AIX
  - displaying vpath device configuration 35
  - configuring for HP 88
  - configuring for Sun 106
  - configuring on
    - Windows 2000 78
  - configuring on Windows NT 62
  - publications xii

- ESS devices (hdisks) 52
- ESS LUNs 52
- European Community Compliance statement 145
- exporting a volume group with SDD, AIX 39
- extending an existing SDD volume group, AIX 44
- extendvg command 44
- extendvg4vp command 44, 52

## F

- failover 3
- failover protection, AIX
  - creating a volume group from a single-path vpath device 41
  - losing 40
  - manually deleted devices and running the configuration manager 42
  - providing load-balancing and failover protection 35
  - side effect of running the disk change method 41
  - the loss of a device path 41
    - when it doesn't exist 35
- Federal Communications Commission (FCC)
  - statement 144
- fibre-channel adapters
  - configuring for Windows 2000 78
  - supported
    - HP host systemss 87
    - Sun host systemss 105
    - Windows 2000 host systems 78
    - Windows NT host systems 62
  - supported on AIX host systems 9
- fibre-channel device drivers
  - configuring for AIX 11
  - devices.common.IBM.fc 11
  - devices.fcp.disk 11
  - devices.pci.df1000f7 11
  - installing for AIX 11
  - supported on AIX host systems 9
- fileset
  - AIX
    - dpo.ibmssd.rte.nnn 15
    - ibmSdd\_421.rte 7, 14, 16, 27, 54
    - ibmSdd\_432.rte 7, 13, 14, 16, 27, 28, 54
    - ibmSdd\_433.rte 7, 13, 14, 16, 18, 27, 28, 31, 32, 39, 54, 59
    - ibmSdd\_510.rte 7, 14, 16, 17, 27, 28
    - ibmSdd\_510nchacmp.rte 14, 27, 28

## G

- German compliance statement 145
- glossary 149

## H

- HACMP/6000
  - concurrent mode 28
  - hd2vp conversion script 32
  - node failover 33
  - nonconcurrent mode 28
  - persistent reserve 32



- HACMP/6000 (*continued*)
  - recovering paths 33
  - SDD fileset attributes 31
  - software support for concurrent mode 28
  - software support for nonconcurrent mode 30
  - special requirements 32
  - supported features 31
- hardware configuration
  - changing
    - HP host systems 93
    - Sun host systems 112
- hardware requirements
  - HP
    - host systems 87
    - Sun host systems 105
- hd2vp and vp2hd command 51
- hd2vp vg\_name command 26
- hd2vp vg-name command 23
- hdisk device
  - chdev 41
  - modify attributes 41
- High Availability Cluster Multi-Processing (HACMP) 27
- HP
  - SCSI disk driver (sdisk) 87
- HP host system
  - commands 2
  - disk driver 1
  - protocol stack 1
- HP host systems
  - changing
    - SDD hardware configuration 93
    - to the /dev directory 95
  - creating
    - a filesystem on the volume group 96
    - a logical volume 96
    - a volume group 96
    - device node for the logical volume device 95
    - directory in /dev for the volume group 95
    - new logical volumes 94
    - physical volume 96
  - determining
    - major number of the logical volume 95
    - size of the logical volume 97
  - installing Oracle 101
  - installing SDD 89
    - converting an Oracle installation from sdisk 103
    - on a Network File System file server 99
    - on a system that already has Network File System file server 100
    - on a system that already has Oracle 102
    - using a file system 102
    - using raw partitions 102
  - mounting the logical volume 96
  - recreating
    - existing logical volume 97
    - logical volume 98
    - physical volume 95, 98
    - volume group 98
  - removing
    - existing logical volume 96
    - existing volume group 97

- HP host systems (*continued*)
  - removing (*continued*)
    - logical volumes 96
  - SDD 87
  - setting the correct timeout value for the logical volume manager 99
  - setting up Network File System for the first time 100
  - setting up Oracle
    - using a file system 101
    - using raw partitions 101
  - standard UNIX applications 94
  - understanding how SDD works 87
  - upgrading SDD 88, 92
  - using applications with SDD 94
- HP-UX
  - disk device drivers 91, 94
  - LJFS file system 100
  - operating system 87
- HP-UX 11.0
  - 32-bit 87, 89
  - 64-bit 87, 89
- HP-UX 11i
  - 32-bit 87, 89
  - 64-bit 87, 89
- HP-UX commands 87

**I**

- IBM Subsystem Device Driver
  - Web site xviii
- ibm2105.rte 10
- ibm2105.rte ESS package 8
- ibmSdd\_433.rte fileset
  - for SDD 1.2.2.0
    - removing 32
  - for SDD 1.3.1.3. vpath devices
    - unconfiguring 32
- importing a volume group with SDD, AIX 37
- Industry Canada Compliance statement 145
- install package
  - AIX 14
- installing
  - additional paths on a Windows NT host system 65
  - AIX
    - fibre-channel device drivers 10, 11
    - planning 7
    - SDD 13
  - an Oracle installation from sdisk on an HP host systems 103
  - converting an Oracle installation from sdisk on a Sun host systems 117
- Oracle
  - HP host systems 101
  - Sun host systems 114
- SDD
  - HP host systems 87, 89
  - Sun host systems 105, 108
  - Windows 2000 host system 77, 79
  - Windows NT host system 61, 63

installing *(continued)*

- SDD on a Network File System file server on a Sun host systems 113
- SDD on a Network File System file server on an HP host systems 99
- SDD on a system that already has Network File System file server on a Sun host systems 114
- SDD on a system that already has Network File System file server on an HP host systems 100
- SDD on a system that already has Oracle on a Sun host systems 116
- SDD on a system that already has Oracle on an HP host systems 102
- SDD on a system that already has Solaris DiskSuite in place on a Sun host systems 122
- SDD on a system that already has Veritas Volume Manager in place on a Sun host systems 119
- Solstice DiskSuite for the first time on a Sun host systems 121
- using a file system on a Sun host systems 116
- using a file system on an HP host systems 102
- using raw partitions on a Sun host systems 116
- using raw partitions on an HP host systems 102
- Veritas Volume Manager on a Sun host systems 118
- vpath on a system that already has UFS logging in place on a Sun host systems 123

installp command 11

instfix -i | grep IY10201 command 11

instfix -i | grep IY10994 command 11

instfix -i | grep IY11245 command 11

instfix -i | grep IY13736 command 11

instfix -i | grep IY17902 command 11

instfix -i | grep IY18070 command 11

## J

Japanese Voluntary Control Council for Interference (VCCI) statement 146

## K

KB 130

Korean government Ministry of Communication (MOC) statement 146

## L

licensed internal code agreement 146

limited warranty statement 135

load-balancing, AIX 35

logical volume manager 106

losing failover protection, AIX 40

ls -al /unix command 9

lscfg -vl fcsN command 12

lsdev -Cc disk | grep 2105 command 17

lsdev -Cc disk command 12

lspp -l ibmSdd\_421.rte command 16

lspp -l ibmSdd\_432.rte command 16

lspp -l ibmSdd\_433.rte command 16

lspp -l ibmSdd\_510.rte command 16

lspp -l ibmSdd\_510nchacmp.rte command 16

lspv command 21, 22, 25, 40

lsvg -p vg-name command 37

lsvgfs command 25

lsvgfs vg-name command 22

lsvpcfg command 21, 26, 35, 41, 51

lsvpcfg utility programs, AIX 51

## M

manuals, ordering xiii

metadb -a <device> command 122

metadb -d -f <device> command 122

metadb -i command 122

metainit command 122

metainit d <metadevice number> -t <"vpathNs" - master device> <"vpathNs" - logging device> command 124

metastat command 122, 123

migrating

- AIX
  - an existing non-SDD volume group to SDD vpath devices in concurrent mode 56
  - non-SDD volume group to an ESS SDD multipath volume group in concurrent mode 54

mirroring logical volumes 55

mkdev -l vpathN command 18

mksysb restore command 40

mkvg command 37

mkvg4vp command 37, 52

modifying multipath storage configuration to the ESS, Windows NT host system 68

mount /dev/dsk/c1t2d0s2 /mnt1 command 105

mount /dev/dsk/clt2d0 /mnt1 command 87

mount /dev/dsk/vpath0 /mnt1 command 87

mount /dev/dsk/vpath0c /mnt1 command 105

mount command 22

mounting the logical volume, HP 96

## N

newfs command 123

non-supported environments

- AIX 7
- HP 87
- Sun 105
- Windows NT 61

nondisruptive installation

- AIX
  - SDD 1.3.1.3 23

notices

- electronic emission 144
- European community 145
- FCC statement 144
- German 145
- Industry Canada 145
- Japanese 146
- Korean 146
- licensed internal code 146
- notices statement 143
- Taiwan 146

## O

odmget -q "name = ioaccess" CuAt command 32  
oraInst /m command 102, 115  
ordering publications xiii

## P

path-failover protection system 3  
path-selection  
  algorithms 4  
path-selection policy  
  changing 20  
  default 20  
  failover only 20  
  load balancing 19  
  round robin 20  
Persistent Reserve command set 31  
pkgmgr IBMdpo command 123  
planning  
  AIX  
    Emulex adapter firmware level 12  
    ESS 10  
    fibre-channel attached devices 10, 11  
    fibre-channel device drivers 10, 11  
    preparing 10  
  AIX installation 7  
  ESS  
    HP host systems 88  
    Sun host systems 106  
    Windows 2000 host system 78  
    Windows NT host system 62  
  fibre-channel adapters  
    Windows 2000 host system 78  
    Windows NT host system 62  
  hardware and software requirements on a Sun host systems 105  
  hardware and software requirements on an HP host systems 87  
  hardware requirements, AIX  
    ESS 7  
    Fibre adapters and cables 7  
    Host system 7  
    SCSI adapters and cables 7  
  hardware requirements, Windows 2000  
    ESS 77  
  hardware requirements, Windows NT  
    ESS 61  
  host system requirements, AIX 7  
    ESS 8  
    Fibre 8  
    SCSI 8  
  host system requirements, Windows 2000  
    ESS 77  
  host system requirements, Windows NT  
    ESS 61  
  installation of SDD  
    HP host systems 88  
    Sun host systems 106  
  preparing  
    Sun host systems 106

## planning (continued)

  preparing for SDD installation on an HP host systems 88  
  SCSI adapters  
    Windows NT host systems 63  
  SDD  
    HP host systems 87  
    Sun host systems 105  
    Windows 2000 host system 78  
    Windows NT host system 61  
  software requirements  
    Windows 2000 operating system 77  
    Windows NT operating system 61  
  software requirements, AIX  
    AIX operating system 7  
    ibm2105.rte ESS package 7  
    SCSI and fibre-channel device drivers 7  
  Windows 2000  
    ESS 78  
post-installation of SDD  
  HP host systems 91  
  Sun host systems 110  
preparing  
  AIX  
    SDD installation 10  
  clusters with SDD  
    Windows 2000 host system 84  
  configure on AIX 17  
  SDD  
    HP host systems 88  
    Windows 2000 installation 78  
    Windows NT host system 62  
  SDD installation  
    Sun host systems 106  
providing  
  AIX  
    failover protection 35  
    load-balancing 35  
publications  
  ESS xii  
  library xii  
  ordering xiii  
  related xiv  
pvid 54  
PVID 40

## R

radio frequency energy compliance statement 144  
raw  
  device interface (sd) 106  
  device interface (sdisk) 88  
reconfiguring a Veritas Volume, Sun 120  
recovering from mixed volume groups 44  
recovering from mixed volume groups, AIX 44  
recovery procedures for HP 96, 99  
recreating  
  existing logical volume  
    on a HP host systems 97  
  physical volume  
    on an HP host systems 95

- recreating *(continued)*
  - the logical volume
    - on an HP host systems 98
  - the physical volume
    - on a HP host systems 98
  - the volume group
    - on an HP host systems 98
- related publications xiv
- removing
  - existing logical volume
    - on an HP host sytem 96
  - existing volume group
    - on an HP host systems 97
  - logical volumes
    - on an HP host systems 96
  - SDD
    - Windows 2000 host system 83
    - Windows NT host system 72
  - SDD from an AIX host 26
  - SDD from an AIX host system 26
- requirements
  - ESS
    - Windows 2000 host system 77
    - Windows NT 61
  - hardware and software on a Sun host systems 105
  - hardware and software, HP 87
  - hardware, AIX
    - ESS 7
    - Fibre adapters and cables 7
    - Host system 7
    - SCSI adapters and cables 7
  - hardware, Windows 2000
    - ESS 77
  - hardware, Windows NT
    - ESS 61
  - host system, AIX 7
    - ESS 8
    - Fibre 8
    - SCSI 8
  - software
    - Windows 2000 operating system 77
    - Windows NT operating system 61
  - software, AIX
    - AIX operating system 7
    - ibm2105.rte ESS package 7
    - SCSI and fibre-channel device drivers 7
- restoring
  - AIX
    - files belonging to an SDD volume group 45
- restvg command 45
- restvg4vp command 45
- reviewing the existing SDD configuration information,
  - Windows NT 64, 68
- rmdev -dl dpo -R command 26
- rmdev -dl fcsN -R command 12
- rmdev -l dpo -R command 18, 22
- rmdev -l vaph N command 22
- rmdev command 42, 43

## S

- SAN Data Gateway Web site xviii
- savevg command 45
- savevg4vp command 45
- SCSI adapter support
  - Windows NT host system 62
- SCSI adapter suuport
  - Windows 2000 host system 78
- SCSI adapters
  - supported on AIX host systems 8
- SCSI adapters support
  - HP host systemss 87
- SCSI adapters suuport
  - Sun host systemss 105
- SCSI-3 Persistent Reserve command set 31
- SDD
  - configuring for Windows 2000 80
  - displaying the current version on Windows 2000 83
  - how it works on an HP host system 87
  - how it works on Sun 105
  - installation scenarios 88
  - installing
    - HP host system 87
    - Sun host systemss 105
    - Windows 2000 host system 77, 79
    - Windows NT 61
  - installing on AIX 7
  - introducing 1
  - introduction 1
  - overview 1
  - post-installation of SDD
    - HP host systems 91
  - post-installation on Sun host systemss 110
  - removing SDD on Windows NT 72
  - uninstalling
    - HP host systems 92
  - uninstalling on Sun 111
  - upgrading
    - HP host systems 88
    - Windows 2000 82
  - using applications
    - with SDD on HP Network File System file server 99
    - with SDD on HP standard UNIX applications 94
    - with SDD on HP, Oracle 100
    - with SDD on Sun Network File System file Server 113
    - with SDD on Sun standard UNIX applications 113
    - with SDD on Sun, Oracle 114
    - with SDD on Sun, Veritas Volume Manager 118
  - verifying additional paths to SDD devices 66, 81
  - verifying configuration 18
  - Web site xi
- SDD configuration
  - checking 18
- SDD devices
  - reconfiguring 21, 22
- SDD utility programs, AIX 50
- SDD vpath devices 52
- server Web site xviii

- setting up
  - correct timeout value for the logical volume manager
    - on an HP host system 99
  - Network File System for the first time on a Sun host system 113
  - Network File System for the first time on an HP host system 100
  - Oracle using a file system
    - HP host system 101
    - Sun host system 114
  - Oracle using raw partitions
    - HP host system 101
    - Sun host system 115
  - UFS logging on a new system on a Sun host system 123
- showvpath command 96, 116, 117, 120, 122
- shutdown -i6 -y -g0 command 122
- shutdown -rF command 12
- sites, Web browser xviii
- SMIT
  - configuring
    - SDD for Windows 2000 host system 80
    - SDD for Windows NT host system 64
- smitty command 26
- smitty deinstall command 11
- smitty device command 26
- software requirements
  - for SDD on HP 87
  - for SDD on Sun 105
- Solaris
  - host system
    - upgrading Subsystem Device Driver on 106
  - operating system
    - upgrading SDD 105
  - sd devices 113
  - UFS file system 113
- Solaris commands 105
- statement
  - of compliance
    - Canada 145
    - European 145
    - Federal Communications Commission 144
    - Japan 146
    - Korean government Ministry of Communication (MOC) 146
    - Taiwan 146
- statement of limited warranty 135
- Subsystem Device Driver (SDD)
  - Web site xviii
- Subsystem device driver, see SDD. 121
- Sun disk device drivers 106
- Sun host system
  - commands 2
  - disk driver 1
  - protocol stack 1
- Sun host systems
  - adding
    - device to Veritas 118
    - Solaris hard disk device to the Veritas root disk group 118
  - changing SDD hardware configuration 112
- Sun host systems (*continued*)
  - creating
    - new disk group from an SDD device 119
    - new volume group from an SDD device 119
  - installing
    - Solstice DiskSuite for the first time 121
    - Veritas Volume Manager 118
    - vpath on a system that already has UFS logging in place 123
  - installing Oracle 114
  - installing SDD 108
    - converting an Oracle installation from sdisk 117
    - Network File System file server 113
    - system that already has Network File System file server 114
    - system that already has Oracle 116
    - system that already has Solaris DiskSuite in place 122
    - system that already has Veritas Volume Manager in place 119
    - using a file system 116
    - using raw partitions 116
  - Oracle 114
  - reconfiguring a Veritas Volume 120
  - SDD 105
  - SDD post-installation 110
  - setting up
    - Network File System for the first time 113
    - UFS logging on a new system 123
  - Solstice DiskSuite 121
  - standard UNIX applications 113
  - understanding how SDD works 105
  - upgrading SDD 111
  - using applications with SDD 113, 118
- Sun SCSI disk driver 105
- support for Windows 2000 83
- support for Windows NT 73
- synchronizing logical volumes 55
- System Management Interface Tool (SMIT) 13
  - definition 15
  - using for configuring 17
  - using to access the Add a Data Path Volume to a Volume Group panel on AIX host 48
  - using to access the Add a Volume Group with Data Path Devices panel on AIX host 48
  - using to access the Back Up a Volume Group with Data Path Devices on AIX host 49
  - using to access the Configure a Defined Data Path Device panel on AIX host 47
  - using to access the Define and Configure All Data Path Devices panel on AIX host 47
  - using to access the Display Data Path Device Configuration panel on AIX host 46
  - using to access the Display Data Path Device Status panel on AIX host 46
  - using to access the Remake a Volume Group with Data Path Devices on AIX host 50
  - using to access the Remove a copy from a datapath Logical Volume panel on AIX host 49
  - using to access the Remove a Data Path Device panel on AIX host 48

- System Management Interface Tool (SMIT) *(continued)*
  - using to backup a volume group with Subsystem Device Driver on AIX host 44, 49
  - using to create a volume group with Subsystem Device Driver on AIX host 36
  - using to display the ESS vpath device configuration on AIX host 35
  - using to export a volume group with SDD on AIX host 39
  - using to extend an existing Subsystem Device Driver volume group on AIX host 44
  - using to import a volume group with SDD on AIX host 37
  - using to remove SDD from AIX host 26
  - using to restore a volume group with SDD on AIX host 50
  - using to restore a volume group with Subsystem Device Driver on AIX host 45
  - using to unconfigure Subsystem Device Driver devices on AIX host 18
  - using to verify SDD configuration on AIX host 18

## T

- Taiwan class A compliance statement 146
- trademarks 143

## U

- umount
  - /cdrom command 111
  - command 124
- umount command 25
- umount mounted-filesystem command 22
- unconfiguring a SDD device to Defined condition 43
- unconfiguring all SDD devices to Defined condition 43
- unconfiguring SDD on AIX 18
- understanding
  - how SDD works for HP host systems 87
  - how SDD works for Sun host systems 105
- upgrading
  - AIX
    - Emulex adapter firmware level 12
    - SDD 1.3.1.3 25
    - SDD 1.3.1.3 through a nondisruptive installation 25
  - SDD
    - for AIX 4.2.1 23
    - for AIX 4.3.2 23
    - for AIX 4.3.3 23
    - for AIX 5.1.0 23
    - HP host system 92
    - Sun host system 111
    - Windows 2000 host system 82
    - Windows NT host system 68
- using
  - HP applications with SDD 94
  - Sun applications with SDD 113
- using command 125
- using ESS devices directly, AIX 52
- using ESS devices through AIX LVM 53

- using the datapath commands 125
- using the trace function, AIX 58
- utility programs, AIX
  - addpaths 50
  - dpovgfix 51
  - extendvg4vp 52
  - hd2vp and vp2hd 51
  - lsvpcfg 51
  - mkvg4vp 52
  - using ESS devices directly 52
  - using ESS devices through AIX LVM 53
  - using the trace function 58

## V

- varyoffvg command 17, 25
- varyoffvg vg-name command 22
- varyonvg vg\_name command 26
- varyonvg vg-name command 23
- verifying
  - additional paths are installed correctly
    - Windows 2000 host system 81
    - Windows NT host system 66
  - AIX
    - configuring SDD 18
    - SDD installation 16, 24
- Veritas Volume Manager
  - Command Line Interface for Solaris Web site 118
  - System Administrator's Guide Web site 118
- volume group
  - mixed
    - how to fix problem 42
  - mixed volume groups
    - dpovgfix vg-name 42
- volume groups on AIX 37
- vxdisk list cntndn command 121

## W

- warranty
  - limited 135
- Web site
  - AIX APARs, maintenance level fixes and microcode updates 8
  - Copy Services xviii
  - ESS publications xviii
  - host systems supported by the ESS xviii
  - IBM storage servers xviii
  - IBM Subsystem Device Driver xviii
  - information on the fibre-channel adapters that can be used on your AIX host 9
  - information on the SCSI adapters that can attach to your AIX host 8
  - SAN Data Gateway xviii
  - SDD xi
- Web sites
  - HP documentation 96, 99
  - information about
    - SCSI adapters that can attach to your Windows 2000 host system 78

- Web sites *(continued)*
  - information about *(continued)*
    - SCSI adapters that can attach to your Windows NT host system 62
- Windows 2000 host system
  - adding
    - paths to SDD devices 80
  - clustering special considerations 84
  - configuring
    - cluster with SDD 84
    - ESS 78
    - fibre-channel adapters 78
    - SCSI adapters 79
    - SDD 80
  - disk driver 1
  - displaying the current version of the SDD 83
  - installing SDD 79
  - path reclamation 84
  - preparing to configure a cluster with SDD 84
  - protocol stack 1
  - removing SDD 83
  - SDD 77
  - support for clustering 83
  - upgrading SDD 82
  - verifying
    - additional paths to SDD devices 81
- Windows NT
  - adding
    - paths to SDD devices 64
- Windows NT host system
  - adding
    - multipath storage configuration to the ESS 68
    - new storage to existing configuration 69
  - clustering special considerations 73
  - configuring
    - additional paths 65
    - clusters with SDD 73
    - SDD 64
  - disk driver 1
  - displaying the current version of the SDD 72
  - installing
    - additional paths 65
    - SDD 63
  - modifying multipath storage configuration to the ESS 68
  - path reclamation 73
  - protocol stack 1
  - removing SDD 72
  - reviewing existing SDD configuration
    - information 64, 68
  - SDD 61
  - support for clustering 73
  - upgrading
    - SDD 68
  - verifying
    - additional paths to SDD devices 66
    - new storage is installed correctly 70





# Readers' Comments — We'd Like to Hear from You

IBM TotalStorage™ Enterprise Storage Server™  
Subsystem Device Driver User's Guide

Publication No. GC26-7442-01

Overall, how satisfied are you with the information in this book?

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Overall satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How satisfied are you that the information in this book is:

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Accurate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easy to find	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easy to understand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Well organized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Applicable to your tasks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please tell us how we can improve this book:

Thank you for your responses. May we contact you?  Yes  No

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute your comments in any way it believes appropriate without incurring any obligation to you.

\_\_\_\_\_  
Name

\_\_\_\_\_  
Address

\_\_\_\_\_  
Company or Organization

\_\_\_\_\_  
Phone No.



Fold and Tape

Please do not staple

Fold and Tape



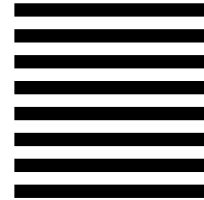
NO POSTAGE  
NECESSARY  
IF MAILED IN THE  
UNITED STATES

# BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 40 ARMONK, NEW YORK

POSTAGE WILL BE PAID BY ADDRESSEE

International Business Machines Corporation  
RCF Processing Department  
G26/050  
5600 Cottle Road  
San Jose, CA 95193-0001



Fold and Tape

Please do not staple

Fold and Tape





Printed in the United States of America  
on recycled paper containing 10%  
recovered post-consumer fiber.

GC26-7442-01



Spine information:



IBM TotalStorage<sup>™</sup> Enterprise  
Storage Server<sup>™</sup>

SDD User's Guide