

IBM System Storage

*Multipath Subsystem Device Driver
User's Guide*



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Note

Before using this information and the product it supports, read the information in "Notices" on page 213.

This edition applies to the following versions of IBM Multipath Subsystem Device Driver and to all subsequent releases and modifications until otherwise indicated in new editions:

- Subsystem Device Driver Version 1 Release 8 Modification 0 Level *x* for HP-UX
- Subsystem Device Driver Device Specific Module Version 2 Release 4 Modification 5 Level 0 for Windows
- Subsystem Device Driver Device Specific Module Version 2 Release 4 Modification 6 Level 0
- Subsystem Device Driver Device Specific Module Version 2 Release 4 Modification 7 Level 0 for Windows
- Subsystem Device Driver Device Specific Module Version 2 Release 4 Modification 7 Level 1 for Windows
- Subsystem Device Driver Device Specific Module Version 2 Release 4 Modification 8 Level 0 for Windows
- Subsystem Device Driver Device Specific Module Version 2 Release 5 Modification 0 Level 0 for Windows
- Subsystem Device Driver Device Specific Module Version 2 Release 5 Modification 1 Level 0 for Windows
- Subsystem Device Driver Device Specific Module Version 2 Release 5 Modification 2 Level 0 for Windows
- | • Subsystem Device Driver Device Specific Module Version 2 Release 5 Modification 3 Level 0 for Windows
- Subsystem Device Driver Path Control Module Version 3 Release 0 Modification *x* Level *x*
- Subsystem Device Driver Path Control Module Version 2 Release 6 Modification 6 Level 0
- Subsystem Device Driver Path Control Module Version 2 Release 6 Modification 7 Level 0
- Subsystem Device Driver Path Control Module Version 2 Release 6 Modification 8 Level 0
- Subsystem Device Driver Path Control Module Version 2 Release 6 Modification 9 Level 0
- Subsystem Device Driver Path Control Module Version 2 Release 7 Modification 0 Level 0
- Subsystem Device Driver Path Control Module Version 2 Release 7 Modification 1 Level 0
- Subsystem Device Driver Path Control Module Version 2 Release 7 Modification 1 Level 1
- | • Subsystem Device Driver Path Control Module Version 2 Release 7 Modification 1 Level 2

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About this guide

The IBM® System Storage® Multipath Subsystem Device Driver (SDD) supports a storage-redundant configuration environment for a host system that is attached to storage devices. It provides enhanced data availability, dynamic input/output (I/O) load balancing across multiple paths, and automatic path-failover protection for the HP-UX host system only. See <http://www-01.ibm.com/support/docview.wss?uid=ssg1S1005428> for details about discontinued support of some of the SDD Drivers.

The IBM System Storage Multipath Subsystem Device Driver Path Control Module (SDDPCM) provides AIX® Multipath I/O (MPIO) support. It is a loadable module. During the configuration of supported storage devices, SDDPCM is loaded and becomes part of the AIX MPIO Fibre Channel protocol device driver. The AIX MPIO-capable device driver with the SDDPCM module provides the same functions that SDD provides.

The IBM System Storage Multipath Subsystem Device Driver Device Specific Module (SDDDSM) provides multipath I/O support for Windows platforms based on the MPIO technology provided by Microsoft.

Who should use this guide

This guide is intended for users who will install and configure IBM System Storage Multipath Subsystem Device Driver (SDD), IBM System Storage Multipath Subsystem Device Driver Path Control Module (SDDPCM), or IBM System Storage Multipath Subsystem Device Driver Device Specific Module (SDDDSM). The installer of SDD, SDDPCM, or SDDDSM should be:

- Familiar with the operating systems on which the driver will be installed
- Familiar with the storage systems on which the driver will be operated
- Familiar with the applications used with the driver
- Aware of the procedures in this document
- Aware of related installation and service publications

Summary of changes

This guide contains information that was published in the *IBM System Storage Multipath Subsystem Device Driver User's Guide* and technical updates in that information. All changes to this guide are marked with a vertical bar (|) in the left margin.

Note: For the more recent updates that are not included in this guide, go to the SDD website at: www-947.ibm.com/support/entry/portal/product/system_storage/storage_software/other_software_products/system_storage_multipath_subsystem_device_driver?productContext=-1564959213

Updated information

This edition of the guide includes information about the following updates:

- New features added with SDDDSM release 2.4.8.0. For more information, see “SDDDSM release 2.4.8.0 features” on page 153.

- New features added with SDDPCM release 2.6.9.0. For more information, see “SDDPCM release 2.6.9.0 features” on page 91.

Command syntax conventions

This section describes the notational conventions that this book uses.

Highlighting conventions

The following typefaces are used to show emphasis:

boldface

Text in **boldface** represents menu items and command names.

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

monospace

Text in monospace identifies the commands that you type, samples of command output, examples of program code or messages from the system, and configuration state of the paths or volumes (such as Dead, Active, Open, Closed, Online, Offline, Invalid, Available, Defined).

Special characters conventions

The following special character conventions are used in this book:

*** asterisks**

Asterisks (*) are used as wildcard symbols to search for the beginning or remaining characters of the installation package name.

For example, the asterisks in the beginning and at the end of Sdd characters in the **ls1pp -l *Sdd*** command are used as wildcard symbols to search for the characters `ibm...` and `...rte`.

... ellipsis

Ellipsis indicates that more commands are in the next command line.

< > Indicate optional parameters.

Related information

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

- The publications for the IBM System Storage DS8000[®] library
- The publications for the IBM System Storage DS6000[™] library
- The publications for the IBM System Storage DS5000 and DS Storage Manager library
- The publications for the IBM System Storage DS4000[®] library
- The publications for the IBM System Storage SAN Volume Controller library
- The publications for the IBM Tivoli[®] Storage Productivity Center and IBM Tivoli Storage Productivity Center for Replication libraries
- The publications for the IBM TotalStorage Enterprise Storage Server[®] (ESS) library
- Other IBM publications that relate to the ESS
- Non-IBM publications that relate to the ESS

Note: IBM does not support ESS. For more information, contact the IBM Support team.

See “Ordering IBM publications” on page xvii for information about how to order publications. See “How to send your comments” on page xviii for information about how to send comments about the publications.

The ESS library

Note: IBM does not support ESS. For more information, contact the IBM Support team.

The following customer publications make up the ESS library. Unless otherwise noted, these publications are available in Adobe portable document format (PDF) on a compact disc (CD) that comes with the ESS. If you need additional copies of this CD, the order number is SK2T-8803.

See “IBM Publications Center” on page xvii for information about ordering these and other IBM publications.

Title	Description	Order number
IBM TotalStorage Enterprise Storage Server Copy Services Command-Line Interface Reference	This guide describes the commands that you can use from the ESS Copy Services command-line interface (CLI) for managing your ESS configuration and Copy Services relationships. The CLI application provides a set of commands that you can use to write customized scripts for a host system. The scripts initiate predefined tasks in an ESS Copy Services server application. You can use the CLI commands to indirectly control Peer-to-Peer Remote Copy (PPRC) and IBM FlashCopy® configuration tasks within an ESS Copy Services server group.	SC26-7494 (See Note.)
IBM TotalStorage Enterprise Storage Server Configuration Planner for Open-Systems Hosts	This guide provides guidelines and work sheets for planning the logical configuration of an ESS that attaches to open-systems hosts.	SC26-7477 (See Note.)
IBM TotalStorage Enterprise Storage Server Configuration Planner for S/390® and IBM eServer™ zSeries Hosts	This guide provides guidelines and work sheets for planning the logical configuration of an ESS that attaches to either the IBM S/390 or IBM eServer zSeries host system.	SC26-7476 (See Note.)
IBM TotalStorage Enterprise Storage Server Host Systems Attachment Guide	This guide provides guidelines for attaching the ESS to your host system and for migrating to fibre-channel attachment from either a Small Computer System Interface (SCSI) or from the IBM SAN Data Gateway.	SC26-7446 (See Note.)
IBM TotalStorage Enterprise Storage Server 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.	GC26-7444
IBM TotalStorage Storage Solutions Safety Notices	This publication provides translations of the danger notices and caution notices that IBM uses in ESS publications.	GC26-7229

Title	Description	Order number
IBM TotalStorage Enterprise Storage Server SCSI Command Reference	This publication describes the functions of the ESS. It provides reference information, such as channel commands, sense bytes, and error recovery procedures for UNIX, IBM Application System/400 (IBM AS/400), and IBM eServer iSeries 400 hosts.	SC26-7297
IBM TotalStorage Enterprise Storage Server Subsystem Device Driver User's Guide	This publication describes how to use the IBM TotalStorage ESS Subsystem Device Driver (SDD) on open-systems hosts to enhance performance and availability on the ESS. SDD creates redundant paths for shared LUNs. SDD permits applications to run without interruption when path errors occur. It balances the workload across paths, and it transparently integrates with applications.	SC26-7637
IBM TotalStorage Enterprise Storage Server User's Guide	This guide provides instructions for setting up and operating the ESS and for analyzing problems.	SC26-7445 (See Note.)
IBM TotalStorage Enterprise Storage Server Web Interface User's Guide	This guide provides instructions for using the two ESS Web interfaces: ESS Specialist and ESS Copy Services.	SC26-7448 (See Note.)
IBM TotalStorage Common Information Model Agent for the Enterprise Storage Server Installation and Configuration Guide	This guide introduces the common interface model (CIM) concept and provides instructions for installing and configuring the CIM agent. The CIM agent acts as an open-system standards interpreter, providing a way for other CIM-compliant storage resource management applications (IBM and non-IBM) to interoperate with each other.	GC35-0485
IBM TotalStorage Enterprise Storage Server Application Programming Interface Reference	This reference provides information about the ESS application programming interface (API).	GC35-0489
Note: No hardcopy book is produced for this publication.		

The DS8000 library

The following publications make up the IBM System Storage DS8000 library. These publications are available from www-05.ibm.com/e-business/linkweb/publications/servlet/pbi.wss.

Title	Order number
<i>IBM System Storage DS8000 Introduction and Planning Guide</i>	GC35-0515
<i>IBM System Storage DS[®] Command-Line Interface User's Guide for the DS6000 series and DS8000 series</i>	GC53-1127
<i>IBM System Storage DS8000 Host Systems Attachment Guide</i>	SC26-7917
<i>IBM System Storage DS Application Programming Interface 5.4.1 and 5.4.2 Installation and Reference</i>	GC35-0516

Title	Order number
<i>IBM CIM Agent for DS Open Application Programming Interface 5.5</i>	GC26-7929

The DS6000 library

The following publications make up the IBM System Storage DS6000 library. These publications are available from www-05.ibm.com/e-business/linkweb/publications/servlet/pbi.wss.

Title	Order number
<i>IBM System Storage DS6000 Installation, Troubleshooting, and Recovery Guide</i>	GC26-7925
<i>IBM System Storage DS6000 Introduction and Planning Guide</i>	GC26-7924
<i>IBM System Storage DS6000 Host System Attachment Guide</i>	GC26-7923
<i>IBM System Storage DS6000 Messages Reference</i>	GC26-7920
<i>IBM System Storage DS Command-Line Interface User's Guide for the DS6000 series and DS8000 series</i>	GC53-1127
<i>IBM System Storage DS6000 Quick Start Guide</i>	GC26-7921

The DS5000 and DS Storage Manager library

The following publications make up the IBM System Storage DS5000 and DS Storage Manager library. These publications are available from www-05.ibm.com/e-business/linkweb/publications/servlet/pbi.wss.

Title	Order number
<i>IBM System Storage DS Storage Manager Version 10.x Installation and Host Support Guide</i>	GC53-1135
<i>IBM System Storage DS Storage Manager Version 10.x Copy Services Guide</i>	GC53-1136
<i>IBM System Storage DS4000/DS5000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview</i>	GC53-1137
<i>IBM System Storage DS5100 and DS5300 Installation, User's and Maintenance Guide</i>	GC53-1140
<i>IBM System Storage EXP5000 Storage Expansion Enclosure Installation, User's, and Maintenance Guide</i>	GC53-1141
<i>IBM System Storage DS Storage Manager Command-Line Programming Guide</i>	GC52-1275
<i>IBM System Storage DS5000 Quick Start Guide: Quick Reference for the DS5100, DS5300 and EXP5000</i>	GC53-1134
<i>IBM TotalStorage DS4300 Fibre Channel Storage Subsystem Installation, User's, and Maintenance Guide</i>	GC26-7722

The DS4000 library

The following publications make up the IBM System Storage DS4000 library. These publications are available from www-05.ibm.com/e-business/linkweb/publications/servlet/pbi.wss.

Title	Order number
<i>IBM System Storage DS4000 Storage Manager Concepts Guide</i>	GC26-7734
<i>IBM System Storage DS4000 Storage Manager 10 Installation and Host Support Guide</i>	GA76-0422
<i>IBM System Storage DS4000 Storage Manager Copy Services Guide</i>	GC27-2172
<i>IBM System Storage DS4000 Storage Manager Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview</i>	GC26-7907
<i>IBM System Storage DS4000 Hard Drive and Storage Expansion Enclosure Installation and Migration Guide</i>	GC26-7849
<i>IBM System Storage DS3000/DS4000 Command-Line Programming Guide</i>	GC52-1275
<i>IBM System Storage DS4000 EXP420 Storage Expansion Unit Installation, User's and Maintenance Guide</i>	GC27-2050
<i>IBM System Storage DS4000 EXP810 Storage Expansion Enclosure Installation, User's and Maintenance Guide</i>	GC26-7798
<i>IBM TotalStorage DS4000 EXP700 and EXP710 Storage Expansion Enclosures Installation, User's, and Maintenance Guide</i>	GC26-7735
<i>IBM System Storage DS4200/DS4700 Quick Start Guide</i>	GC27-2147
<i>IBM System Storage DS4700 Installation, User's and Maintenance Guide</i>	GC26-7843
<i>IBM System Storage DS4800 Quick Start Guide</i>	GC27-2148
<i>IBM System Storage DS4800 Installation, User's and Maintenance Guide</i>	GC26-7845
<i>IBM System Storage DS4800 Controller Cache Upgrade Kit Instructions</i>	GC26-7774

The SAN Volume Controller library

The following publications make up the SAN Volume Controller library. Unless otherwise noted, these publications are available in Adobe PDF from the following website:

www-05.ibm.com/e-business/linkweb/publications/servlet/pbi.wss

Title	Order number
<i>IBM System Storage SAN Volume Controller Planning Guide</i>	GA32-0551
<i>IBM System Storage SAN Volume Controller Model 2145-8A4 Hardware Installation Guide</i>	GC27-2219

Title	Order number
<i>IBM System Storage SAN Volume Controller Model 2145-CF8 Hardware Installation Guide</i>	GC52-1356
<i>IBM System Storage SAN Volume Controller Software Installation and Configuration Guide</i>	SC23-6628
<i>IBM System Storage SAN Volume Controller Command-Line Interface User's Guide</i>	SC26-7903
<i>IBM System Storage SAN Volume Controller CIM Agent Developer's Guide</i>	SC23-6665
<i>IBM System Storage SAN Volume Controller Host Attachment Guide</i>	SC26-7905
<i>IBM System Storage SAN Volume Controller Troubleshooting Guide</i>	GC27-2227
<i>IBM System Storage SAN Volume Controller Hardware Maintenance Guide</i>	GC27-2226

The Tivoli Storage Productivity Center and Tivoli Storage Productivity Center for Replication libraries

The following publications make up the Tivoli Storage Productivity Center and Tivoli Storage Productivity Center for Replication libraries. These publications are available from the following website:

www-05.ibm.com/e-business/linkweb/publications/servlet/pbi.wss

Title	Order number
<i>IBM Tivoli Storage Productivity Center and IBM Tivoli Storage Productivity Center for Replication Installation and Configuration Guide</i>	SC27-2337
<i>IBM Tivoli Storage Productivity Center User's Guide</i>	SC27-2338
<i>IBM Tivoli Storage Productivity Center Messages</i>	SC27-2340
<i>IBM Tivoli Storage Productivity Center Command-Line Interface Reference</i>	SC27-2339
<i>IBM Tivoli Storage Productivity Center Problem Determination Guide</i>	GC27-2342
<i>IBM Tivoli Storage Productivity Center Workflow User's Guide</i>	SC27-2341

Ordering IBM publications

This section tells you how to order copies of IBM publications and how to set up a profile to receive notifications about new or changed publications.

IBM Publications Center

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

The IBM Publications Center offers customized search functions to help you find the publications that you need. Some publications are available for you to view or download at no 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 website:

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- Mail or fax your comments to:

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RCF Processing Department
Department 61C
9032 South Rita Road
Tucson, Arizona 85775-4401
U.S.A.

Chapter 1. Overview of the SDD

The IBM System Storage Multipath Subsystem Device Driver (SDD) supports a storage-redundant configuration environment for a host system that is attached to the following devices:

- IBM TotalStorage Enterprise Storage Server (ESS)
- IBM System Storage DS8000
- IBM System Storage DS6000
- IBM System Storage SAN Volume Controller
- IBM System Storage DS5000
- IBM System Storage DS4000
- IBM BladeCenter S SAS RAID Controller Module (RSSM)
- IBM System Storage DS3950

Important: ESS and RSSM are not supported by IBM. For any information about ESS or RSSM, contact the IBM Support team.

This guide uses the following terminology:

- The phrase *supported storage devices* refers to the following types of devices:
 - DS3950, DS4100 (AIX only), DS4200, DS4300, DS4500, DS4700, DS4800, DS5020, DS5100, DS5300, DS6000, and DS8000
 - SAN Volume Controller
 - ESS
 - RSSM
- The phrase *disk storage system* refers to ESS, DS8000, or DS6000 devices.
- The phrase *virtualization product* refers to the SAN Volume Controller. Table 1 indicates the products that different SDD platforms support.
- The phrase *DS4000* refers to DS4100 (AIX only), DS4200, DS4300, DS4500, DS4700, and DS4800 devices.
- The phrase *DS5000* refers to DS5100 and DS5300 devices.
- The phrase *RSSM* refers to IBM BladeCenter S SAS RAID Controller Module devices.
- The phrase *Open HyperSwap®* refers to Open HyperSwap replication.
- The phrase *Open HyperSwap device* refers to pair of volumes that are managed in a Tivoli Productivity Center for Replication copy set.
- The phrase *Open HyperSwap session* refers to a collection of Tivoli Productivity Center for Replication managed copy sets.

Table 1. SDD platforms on supported storage devices

Supported storage device								
Platform	ESS	DS8000	DS6000	DS5000	DS4000	DS3950	RSSM	SAN Volume Controller
AIX SDD	✓	✓	✓					✓
AIX SDDPCM	✓	✓	✓	✓	✓	✓	✓	✓

Table 1. SDD platforms on supported storage devices (continued)

Platform	Supported storage device							SAN Volume Controller
	ESS	DS8000	DS6000	DS5000	DS4000	DS3950	RSSM	
HP	✓	✓	✓	✓	✓	✓		✓
Linux	✓	✓	✓					✓
Novell	✓	✓	✓					
SUN	✓	✓	✓					✓
Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 SDDDSM	✓	✓	✓				✓	✓

The SDD supports a storage-redundant configuration environment for a host system that is attached to storage devices. It provides enhanced data availability, dynamic input/output (I/O) load-balancing across multiple paths, and automatic path failover protection.

This guide provides step-by-step procedures on how to install, configure, and use SDD features on the following host systems:

- IBM AIX (SDD and SDDPCM)
- HP-UX
- Supported Linux distributions, levels, and architectures. For up to date information about specific kernel levels supported in this release, see the Readme file on the CD-ROM or visit the SDD website:
www-947.ibm.com/support/entry/portal/product/system_storage/storage_software/other_software_products/system_storage_multipath_subsystem_device_driver?productContext=-1564959213
- Novell Netware (disk storage systems only)
- Sun Solaris
- Microsoft Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 SDDDSM

The SDD architecture

The SDD is a software solution to support the multipath configuration environments in supported storage devices. It resides in a host system with the native disk device driver and provides the following functions:

- Enhanced data availability
- Dynamic input/output (I/O) load-balancing across multiple paths
- Automatic path failover protection

- Concurrent download of licensed machine code

Table 2 shows the position of the SDD in the protocol stack. I/O operations that are sent to the SDD proceed to the host disk driver after path selection. When an active path experiences a failure (such as a cable or controller failure), the SDD dynamically switches to another path.

Table 2. SDD in the protocol stack

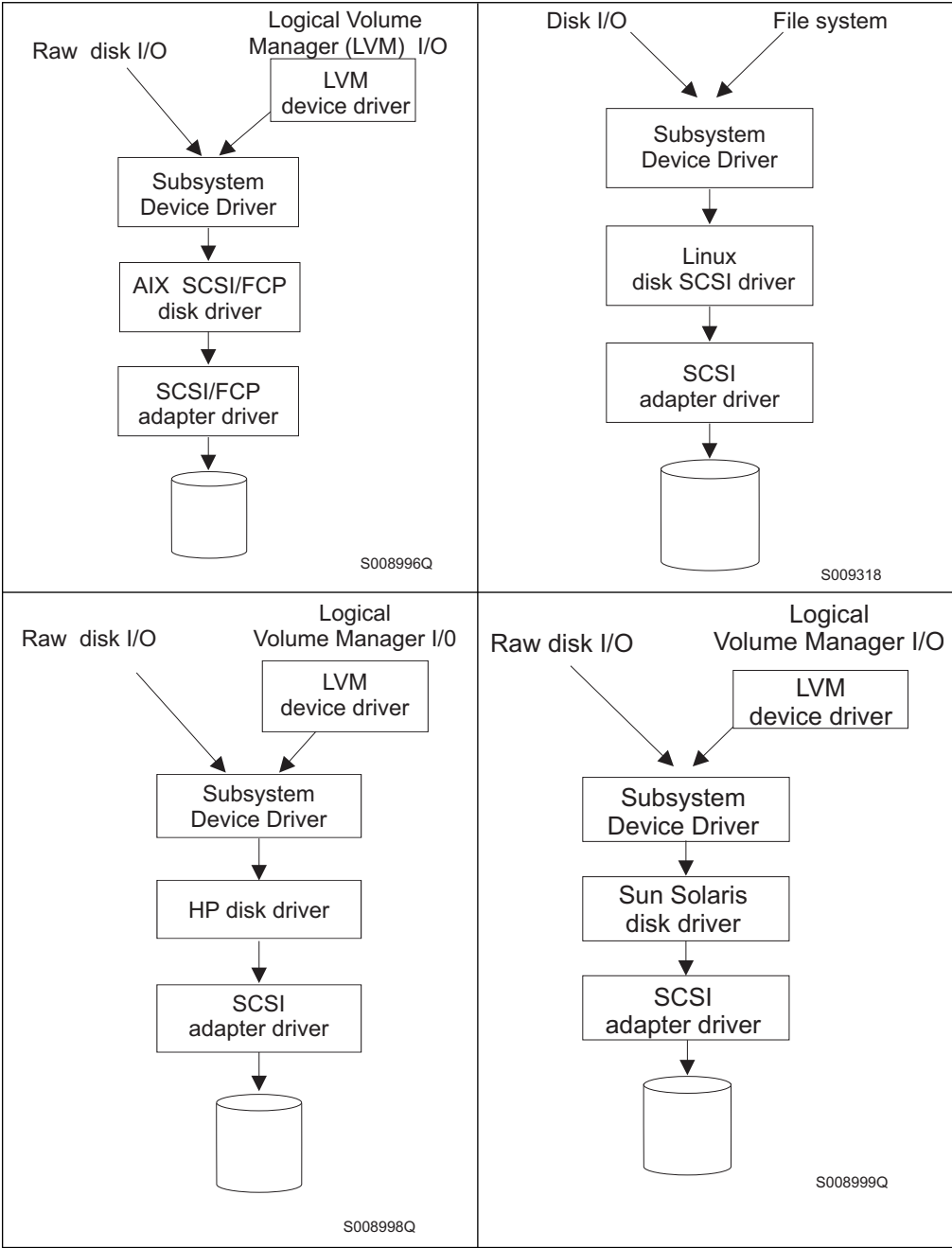
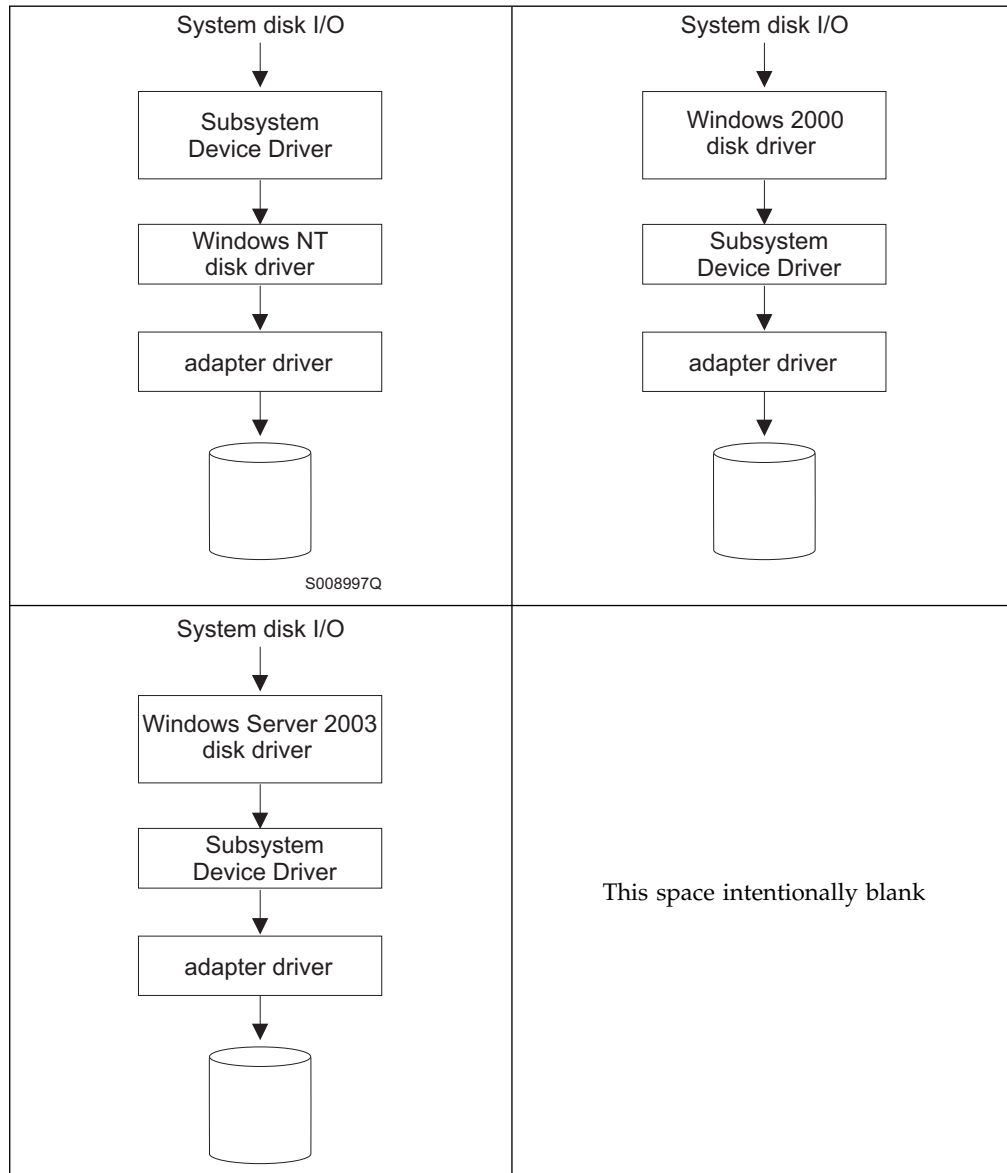


Table 2. SDD in the protocol stack (continued)



Each SDD vpath device represents a unique physical device on the storage server. Each physical device is presented to the operating system as an operating system disk device. There can be up to 32 operating system disk devices that represent up to 32 different paths to the same physical device.

The SDD vpath devices behave almost like native operating system disk devices. You can use most disk device operations of operating systems on the SDD vpath devices, including commands such as **open**, **close**, **dd**, or **fsck**.

Enhanced data availability

Figure 1 on page 5 shows a host system that is attached through small computer system interface (SCSI) or fibre-channel adapters to a disk storage system that has internal component redundancy and multipath configuration. The SDD, residing in the host system, uses this multipath configuration to enhance data availability. That is, when there is a path failure, the 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 disk storage system from disrupting data access.

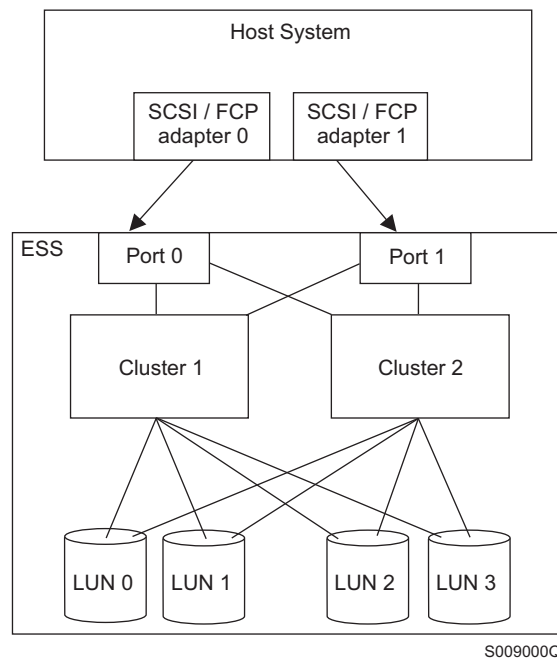


Figure 1. Multipath connections between a host system and the disk storage in a disk storage system

Figure 2 on page 6 shows a host system that is attached through fibre-channel adapters to a SAN Volume Controller that has internal components for redundancy and multipath configuration. The SDD, residing in the host system, uses this multipath configuration to enhance data availability. That is, when there is a path failure, the 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, fibre-channel cable, or host-interface adapter on the SAN Volume Controller from disrupting data access.

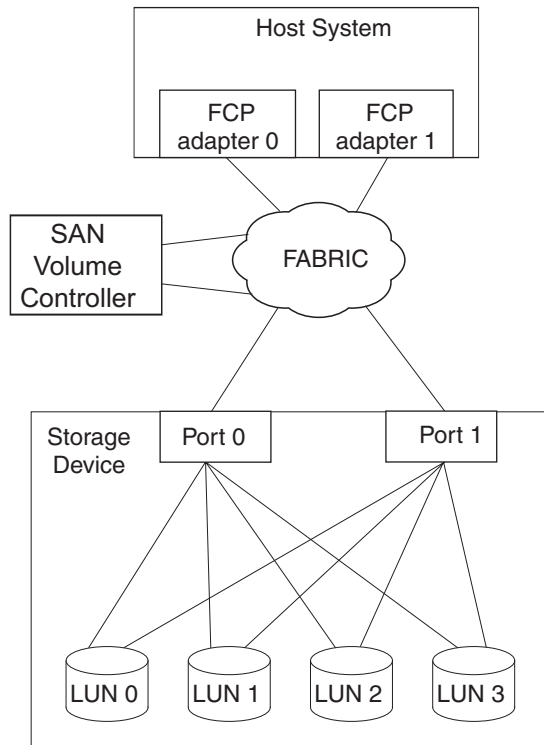


Figure 2. Multipath connections between a host system and the disk storage with the SAN Volume Controller

Note: SAN Volume Controller does not support parallel SCSI attachment.

Dynamic I/O load balancing

By distributing the I/O workload over multiple active paths, the SDD provides dynamic load balancing and eliminates dataflow bottlenecks. In the event of failure in one data path, the 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 feature minimizes any disruptions in I/O operations and recovers I/O operations from a failing data path. The SDD provides path-failover protection using the following process:

- Detects a path failure.
- Notifies the host system of the path failure.
- Selects and uses an alternate data path.

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

Some operating system drivers report each detected error in the system error log. With the SDD automatic path-failover feature, some reported errors are actually recovered from an alternative path.

Concurrent download of licensed machine code for disk storage systems

With the SDD multipath mode (configured with at least two paths per multipath device), you can concurrently download and install the licensed machine code (LMC) while applications continue to run. For certain disk storage system LMC, the disk storage system I/O bay or tower are quiesced and resumed. Its adapters might not respond for the duration of the service action, which could be 30 minutes or more.

Note: The SDD does not support single-path mode during the concurrent download of LMC. Also, the SDD does not support single-path mode during any disk storage system concurrent maintenance that impacts the path attachment, such as a disk storage system host-bay-adapter replacement.

Attention: Do not shut down the host or reconfigure the SDD during the concurrent download of licensed machine code or you might lose your initial SDD configuration.

For information about performing the concurrent download of LMC for ESS, see the microcode installation instructions for your specific type and model.

Concurrent download of licensed machine code for virtualization products

With the SDD multipath mode (configured with at least two paths per multipath device), you can concurrently download and install the licensed machine code while your applications continue to run.

At least one path must be configured through each node of a virtualization product group. That is, if only two paths exist, they must go to separate nodes for each I/O group. However, at least two paths to each node are recommended.

During the code upgrade, each node of an I/O group is upgraded sequentially. The node that is being upgraded is temporarily unavailable, and all I/O operations to that node fail. However, failed I/O operations are directed to the other node of the I/O group, and applications do not see any I/O failures.

Attention: Do not shut down the host or reconfigure the SDD during the concurrent download of licensed machine code or you might lose your initial SDD configuration.

For information about performing concurrent download of LMC for virtualization products, see the Configuration Guide for your specific type and model.

Concurrent download of licensed machine code for DS3950, DS4000 and DS5000

If you are using the SDD multipath mode, you can concurrently download and install the licensed machine code while your applications continue to run, as long as you configure redundant paths to each storage controller port in addition to the multiple host adapter ports.

Because switching a device to another controller is a time-consuming recovery action and affects I/O performance, you can use this redundancy to avoid an

unnecessary controller failover if a path fails. Therefore, configure a minimum of four paths for each LUN with two host adapter ports and two storage controller ports where each host adapter port has redundancy to each storage controller port and vice versa.

Attention: Do not shut down the host or reconfigure the SDD during the concurrent download of licensed machine code or you might lose your initial SDD configuration.

Concurrent download of licensed machine code for IBM BladeCenter S SAS RAID Controller Module (RSSM)

Note: IBM does not support RSSM. For more information, contact the IBM Support team.

With the SDD multipath mode (configured with two paths per multipath device), you can concurrently download and install the licensed machine code while your applications continue to run.

During the code upgrade, each RSSM node is upgraded sequentially. The node that is being upgraded is temporarily unavailable, and all I/O operations to that node fail. However, failed I/O operations are directed to the other RSSM node, and applications do not see any I/O failures.

Attention: Do not shut down the host or reconfigure the SDD during the concurrent download of licensed machine code or you might lose your initial SDD configuration.

Active/Passive dual array controller path-selection algorithm for DS3950, DS4000 and DS5000 products

The DS4000 and DS5000 products are dual array controller disk subsystems. Each LUN is assigned to one controller, which is considered the owner, or the active controller, of a particular LUN. The other controller is considered as an alternate, or passive, controller. Thus, the SDD distinguishes the following paths to the DS4000 and DS5000 product LUN:

- Paths on the ownership (active) controller
- Paths on the alternate (passive) controller

With this type of active/passive dual-controller subsystem device, I/O can be sent only to the ownership controller. When the SDD selects paths for I/O, it selects paths that are connected only to the ownership controller. If there is no path on the ownership controller that can be used, SDD changes the LUN controller ownership to an alternate controller, switches the paths that were passive to active, and then selects these active paths for I/O.

Open HyperSwap Replication

Open HyperSwap replication is a special Metro Mirror replication method that is designed to automatically failover I/O from the primary logical devices to the secondary logical devices in the event of a primary disk storage system failure. This function can be done with minimal disruption to the applications that are using the logical devices.

Open HyperSwap replication applies to both planned and unplanned replication sessions. When a session has Open HyperSwap enabled, an I/O error on the primary site automatically causes the I/O to switch to the secondary site without any user interaction, and with minimal application impact. In addition, while Open HyperSwap is enabled, the Metro Mirror session supports disaster recovery. If a write is successful on the primary site but is unable to get replicated on the secondary site, IBM Tivoli Storage Productivity Center for Replication suspends the entire set of data consistency checking, thus ensuring that a consistent copy of the data exists on the secondary site. If the system fails, this data might not be the latest data, but the data should be consistent and allow the user to manually switch host servers to the secondary site.

You can control Open HyperSwap from any system that is running IBM Tivoli Storage Productivity Center for Replication (AIX, Windows, Linux, or z/OS®). However, the volumes that are involved with Open HyperSwap must be attached to an AIX system that is connected to IBM Tivoli Storage Productivity Center for Replication.

SDD distinguishes the paths of the source volume from the paths of the target volume on an Open HyperSwap copy set. With an Open HyperSwap device, I/O can only be sent to the source volume, so when SDD selects paths for I/O, it only selects paths that are connected to the source volume. If there is no path on the source volume that can be used, SDD will initiate the Open HyperSwap request to Tivoli Storage Productivity Center for Replication and work together to perform the swap. After the swap, SDD will select the target volume paths for I/O.

The following output of the `pcmpath query device` command shows that the target volume paths are being selected.

```
DEV#: 14 DEVICE NAME: hdisk14 TYPE: 2107900 ALGORITHM: Load Balance
SESSION NAME: session1
OS Direction: H1<-H2
=====
PRIMARY SERIAL: 25252520000
-----
Path#    Adapter/Path Name    State    Mode    Select    Errors
  0      fscsi0/path0         OPEN     NORMAL   6091      0
  1      fscsi0/path2         OPEN     NORMAL   6300      0
  2      fscsi1/path4         OPEN     NORMAL   6294      0
  3      fscsi1/path5         OPEN     NORMAL   6187      0

SECONDARY SERIAL: 34343430000 *
-----
Path#    Adapter/Path Name    State    Mode    Select    Errors
  4      fscsi0/path1         OPEN     NORMAL   59463     0
  5      fscsi0/path3         OPEN     NORMAL   59250     0
  6      fscsi1/path6         OPEN     NORMAL   59258     0
  7      fscsi1/path7         OPEN     NORMAL   59364     0
```

In the preceding example, the source volume is on site one, and the target volume is on site two. The output shows that after the swap from site one to site two, SDD selects paths of devices on site two.

Note: The primary serial is not always the source volume. The primary serial is the serial number of the volume on site one, and secondary serial is the serial number of the volume on site two.

Chapter 2. Using SDDPCM on an AIX host system

SDDPCM is a loadable path control module for supported storage devices to supply path management functions and error recovery algorithms. When the supported storage devices are configured as Multipath I/O (MPIO) devices, SDDPCM is loaded as part of the AIX MPIO FCP (Fibre Channel Protocol) or AIX MPIO SAS (serial-attached SCSI) device driver during the configuration. The AIX MPIO-capable device driver with the supported storage devices SDDPCM module enhances the data availability and I/O load balancing.

This chapter provides a general view of the SDDPCM path control module, including where it resides on the I/O stack in the operating system and the features and functions that it supports. This chapter also provides procedures for the following management tasks:

- Install SDDPCM
- Configure SDDPCM MPIO-capable devices
- Uninstall SDDPCM
- Migrate disk storage MPIO-capable devices from the AIX default PCM to SDDPCM
- Migrate disk storage MPIO-capable devices from SDDPCM to the AIX default PCM or SDD
- Installing SDDPCM from AIX NIM SPOT to client SAN boot disk or internal boot disk

Figure 3 on page 12 shows the position of SDDPCM in the protocol stack. I/O operations are sent to the AIX disk driver. The SDDPCM path selection routine is invoked to select an appropriate path for each I/O operation.

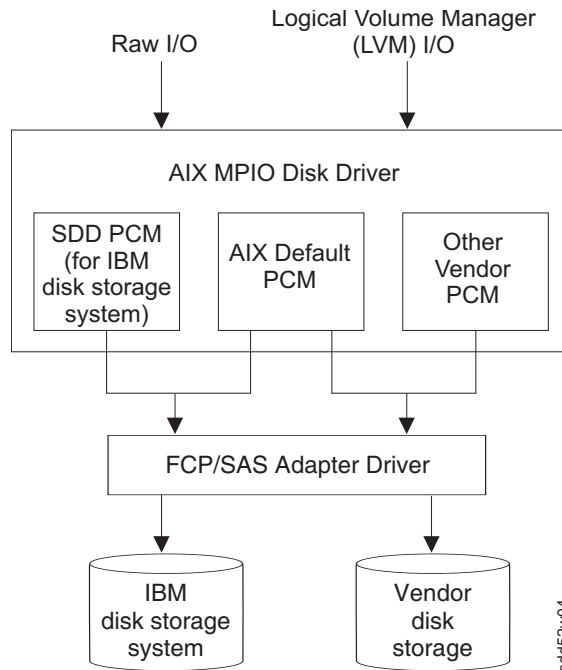


Figure 3. SDDPCM in the protocol stack

For detailed information about MPIO support on AIX 5.2 TL07 (or later), AIX 5.3 TL03 (or later), or AIX 6.1, contact the IBM Support team.

AIX MPIO-capable device drivers automatically discover, configure and make available every storage device path. SDDPCM manages the paths to provide:

- High availability and load balancing of storage I/O
- Automatic path-failover protection
- Concurrent download of supported storage devices licensed machine code
- Prevention of a single-point-failure

For updated and additional information that is not included in this chapter, see the Readme file on the CD-ROM or visit the SDD website:

www-947.ibm.com/support/entry/portal/product/system_storage/storage_software/other_software_products/system_storage_multipath_subsystem_device_driver?productContext=-1564959213

SDD and SDDPCM are exclusive software packages on a server. You cannot install both software packages on a server for supported storage devices. When supported storage devices are configured as non-MPIO-capable devices (that is, multiple logical device instances are created for a physical LUN), you should install SDD to get multipath support.

You must install SDDPCM in order to configure supported storage devices into MPIO-capable-devices (where only one logical device instance is created for a physical LUN). Before you install SDDPCM, make sure that you meet all the required hardware and software requirements. See “Verifying the hardware and software requirements” on page 15 and the “Preparing for SDDPCM installation for supported storage devices” on page 18.

Note: SDDPCM does not support SCSI storage devices.

With SDD 1.6.0.0 (or later), SDDPCM and SDD cannot coexist on a AIX server. If a server connects to any supported storage devices, all devices must be configured either as non-MPIO-capable devices or as MPIO-capable devices.

Supported SDDPCM features

The following SDDPCM features are supported in this release:

- 32-bit and 64-bit kernels
- Four types of reserve policies:
 - No reserve policy
 - Exclusive host access single path policy
 - Persistent reserve exclusive host policy
 - Persistent reserve shared host access policy
- Four path-selection algorithms:
 - Failover
 - Round robin
 - Load balancing
 - Load balancing port

This algorithm is supported only with DS8000, DS6000, ESS, and SAN Volume Controller device models.
- Automatic failed paths reclamation by healthchecker
- Failback error-recovery algorithm
- Fibre-channel dynamic device tracking
- Support for all DS4000, DS5000, DS3950, DS6000, DS8000, ESS FCP, and SAN Volume Controller devices
- Support SAN boot device on MPIO supported storage devices

Note:

1. SDDPCM supports ESS devices as SAN boot devices, beginning with AIX52 TL06 and AIX53 TL02.
 2. SDDPCM supports DS8000, DS6000, and SAN Volume Controller devices as SAN boot devices, beginning with AIX52 TL07 and AIX53 TL03.
 3. SDDPCM supports DS4000, DS5000, and DS3950 devices as SAN boot devices, beginning with AIX53 TL8 and AIX61 TL2
 4. SDDPCM supports RSSM devices as SAN boot devices, beginning with AIX61 TL3.
- Support for external supported MPIO storage devices as the primary or secondary dump device
 - Support storage devices multipath devices as system paging space
 - Support SDDPCM server daemon enhanced path health check function
 - Support for a maximum of 65536 LUNs for SDDPCM version 2.6.5.0 or later on an AIX system with sufficient resources to handle higher number of LUNs. For earlier versions of SDDPCM, a maximum of 1200 LUNs are supported.

Note: For more information about devices that SDDPCM supports, see “Maximum number of devices that SDDPCM supports” on page 116.

- Dynamically adding paths or adapters
- Dynamically removing paths or adapters
- Dynamically changing the device path selection algorithm

- Dynamically changing the device `hc_interval`
- Dynamically enabling or disabling the device health check function
- Dynamically changing the device `hc_mode`
- Web-based System Manager (WebSM) for MPIO supported storage devices (See www-03.ibm.com/systems/power/software/aix/index.html for more information about WebSM.)
- Reserve last path of a device in OPEN mode
- Support the `essutil` Product Engineering tool in the SDDPCM `pcmpath` command line program
- Support for Live Partition Mobility (LPM) environment in IBM Power servers. For information about LPM, see <http://www.redbooks.ibm.com/abstracts/sg247460.html>.
- Support HACMP™ with Enhanced Concurrent Mode volume group in concurrent resource groups and nonconcurrent resource groups

Note: This support does not include RSSM devices as HACMP is not supported on IBM JS-series blades.

- Support GPFS™ in AIX 5.2 TL06 (or later), 5.3 TL02 (or later), and AIX 6.1.
- Support Virtual I/O server with AIX 5.3 or later and AIX 6.1.

Note: This support does not include DS4000, DS5000, and DS3950 storage devices.

- Support Tivoli Storage Productivity Center for Replication Metro Mirror Failover/Failback replication for Open HyperSwap for System Storage DS8000.

Note: This support is only available on AIX 5.3 TL11 (or later), and AIX 6.1 TL04 (or later).

- Support for Non-disruptive Vdisk Movement (NDVM) feature of SVC. For information about SAN Volume Controller, see the *IBM System Storage SAN Volume Controller Software Installation and Configuration Guide*.

Note: This support is only available on SDDPCM 2.6.4.0 (or later) on AIX.

- Support for Workload partitions (WPAR) and Versioned WPAR (vWPAR) for AIX. For information about WPAR and vWPAR, see publib.boulder.ibm.com/infocenter/aix/v6r1/topic/com.ibm.aix.wpar/wpar-kickoff.htm.

Note: This support is only available on SDDPCM 2.6.5.0 (or later) on AIX.

- Support for stretched cluster environment of SVC. For information about stretched clusters, see pic.dhe.ibm.com/infocenter/svc/ic/topic/com.ibm.storage.svc.console.720.doc/svc_stretchedclusteroverview.html.

Note: This support is only available on SDDPCM 2.6.5.0 (or later) on AIX.

Unsupported SDDPCM features

The following SDDPCM features are not currently supported.

- HACMP with persistent reservation policies
- Multiple hosts sharing supported storage MPIO devices without supported clustering software installed
- HACMP with non-Enhanced Concurrent Mode volume group
- Mirror Write Consistency with volume group in a concurrent resource group

- Virtual I/O server is not supported with DS4000, DS5000, and DS3950 storage subsystems
- Open HyperSwap for System Storage DS8000 is not supported within a clustering environment.
- Open HyperSwap device is not supported with a SAN boot volume group.

Verifying the hardware and software requirements

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

Hardware

The following hardware components are needed:

- Supported storage devices (FCP and SAS devices only)
- One or more switches, if the supported storage devices are not direct-attached
- Host system
- Fibre-channel adapters or serial-attached SCSI adapters, and cables

Software

The following software components are needed:

- AIX 5.2 TL10 (or later), AIX 5.3 TL08 (or later), or AIX 6.1 TL02 (or later) operating system, with all the latest PTFs. Refer to the Readme file of the SDDPCM level that you plan to install for the required AIX TL for that level.
- If your attached storage is SAN Volume Controller version 4.2.1.6 or above and you require SAN Volume Controller APAR IC55826, you must install SDDPCM 2.2.0.3 or above with the required AIX TL and APAR. Refer to the Readme file of the SDDPCM level that you plan to install for the required AIX TL and APARs.
- Fibre-channel device drivers or serial-attached SCSI drivers
- One of the following installation packages:
 - devices.sddpcm.52.rte (version 2.5.1.0 or later)
 - devices.sddpcm.53.rte (version 2.5.1.0 or later)
 - devices.sddpcm.61.rte (version 2.5.1.0 or later)
- Supported storage devices:
 - devices.fcp.disk.ibm.mpio.rte (version 1.0.0.21 or later versions of 1.x.x.x) host attachment package for SDDPCM (version 2.x.x.x or prior versions)
 - devices.fcp.disk.ibm.mpio.rte (version 2.0.0.1 or later versions) host attachment package for SDDPCM (version 3.0.0.0 or later versions)
 - devices.sas.disk.ibm.mpio.rte (version 1.0.0.0 or later versions) host attachment package for SDDPCM

Unsupported environments

SDDPCM does not support:

- ESS SCSI devices
- A host system with both a SCSI and fibre-channel connection to a shared ESS logical unit number (LUN)
- Single-path mode during code distribution and activation of LMC nor during any supported storage devices concurrent maintenance that impacts the path attachment, such as a supported storage device host-bay-adapter replacement.
- AIX5.2 with DS4000, DS5000, and DS3950 storage subsystems.

- AIX5.2 with Open HyperSwap.

Host system requirements

To successfully install SDDPCM for supported storage devices, you must have the required AIX TL installed on your host system along with the AIX required fixes, APARs, and microcode updates that are identified on the following website:

www-933.ibm.com/support/fixcentral/

Starting with SDDPCM 2.2.0.0, SDDPCM requires AIX 5.2 TL10 (or later), AIX 5.3 TL06 (or later), or AIX 6.1, with all the latest PTFs. Always refer to the Readme file for the required AIX TL for the SDDPCM level that you plan to install.

Supported storage device requirements

To successfully install SDDPCM, ensure that the `devices.fcp.disk.ibm.mpio.rte`, or `devices.sas.disk.ibm.mpio.rte` package, is installed on the server. Refer to “Installing and upgrading the AIX SDDPCM host attachment” on page 22 for more information.

Fibre requirements

Note: There is no fibre requirement for RSSM devices that are connected through SAS.

You must check for and download the latest fibre-channel device driver APARs, maintenance-level fixes, and microcode updates from the following website:

www-933.ibm.com/support/fixcentral/

If your host has only one fibre-channel adapter, it requires you to connect through a switch to multiple supported storage device ports. You should have at least two fibre-channel adapters to prevent data loss due to adapter hardware failure or software failure.

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

www.ibm.com/servers/storage/support

To use the SDDPCM fibre-channel support, ensure that your host system meets the following requirements:

- The AIX host system is an IBM RS/6000® or IBM System p with AIX 5.2 TL10 (or later), AIX 5.3 TL06 (or later), or AIX 6.1.
- The AIX host system has the fibre-channel device drivers installed along with all latest APARs.
- The host system can be a single processor or a multiprocessor system, such as SMP.
- A fiber-optic cable connects each fibre-channel adapter to a supported storage system port.
- If you need the SDDPCM I/O load-balancing and failover features, ensure that a minimum of two paths to a device are attached.

Preparing for SDDPCM installation

The SDDPCM installation package installs a number of major files on your AIX system. The major files that are part of the SDDPCM installation package are:

File name	Description
-----------	-------------

sddpcmrtl	A dynamically loaded module added to the device configuration methods to extend the supported storage devices device configuration methods to facilitate the configuration operations of the PCM KE
------------------	---

sddpcmke	A dynamically-loaded module added to the AIX 5L™ kernel that provides path management functions for supported storage devices
-----------------	---

sdduserke	A dynamically-loaded module added to the AIX 5L kernel that provides the API to sddpcmke
------------------	--

pcmpath	SDDPCM command line tool
----------------	--------------------------

pcmsrv	Daemon for enhanced path healthcheck, and First Time Data Capture
---------------	---

sample_pcmsrv.conf	The sample SDDPCM server daemon configuration file
---------------------------	--

fcppcmmap	Collects supported storage devices fibre-channel device information through SCSI commands
------------------	---

pcmquerypr	SDDPCM persistent reserve command tool
-------------------	--

pcmgenprkey	SDDPCM persistent reserve command tool to generate persistent reserve key
--------------------	---

relbootrsv	Release SCSI-2 reserve on boot devices or on active nonboot volume groups
-------------------	---

Note: Beginning with SDDPCM version 2.5.1.0, the relbootrsv program also can be used to release SCSI-2 reserve on an MPIO hdisk.

relSDDPCMbootrsv	Automatically executed upon reboot to release leftover SCSI-2 reserve on SDDPCM boot device, beginning with SDDPCM version 2.2.0.1.
-------------------------	---

sddpcmgetdata	Script to collect SDDPCM information, trace log files, and system error logs into an sddpcmdata_host_date_time.tar file for problem determination
----------------------	---

sddpcm_get_config	Display configuration information for DS4000, DS5000, and DS3950 storage and MPIO-based devices.
--------------------------	--

lspcmcfg	Display SDDPCM MPIO device/path configuration/state information.
-----------------	--

AE Daemon for communication with Tivoli Storage Productivity Center for Replication to support Open HyperSwap.

Note: This file was added to the SDDPCM installation package beginning with SDDPCM 3.0.0.0.

Preparing for SDDPCM installation for supported storage devices

Before you install SDDPCM, you must complete the following tasks:

- Connect the supported storage device to your host system and the required fibre-channel adapters or SAS adapters that are attached.
- Configure the supported storage device for single-port or multiple-port access for each LUN. To use the load-balancing and failover features, SDDPCM requires a minimum of two independent paths that share the same logical unit. **With a single path, failover protection is not available.**

For more information about how to configure your supported storage device, see the Planning Guide for your product.

Before you install SDDPCM, you must:

- Determine that you have the correct installation package.
- Remove the SDD package, if it is installed.
- Remove the `ibm2105.rte` (version 32.6.100.x) and/or devices. `fc.disk.ibm.rte` (version 1.0.0.x), if they are installed.
- Install the AIX fibre-channel device drivers, if necessary.
- Verify and upgrade the fibre channel adapter firmware level.
- Install the SDDPCM host attachment: `devices.fc.disk.ibm.mpio.rte` (version 1.0.0.15 or later), or `devices.sas.disk.ibm.mpio.rte` (version 1.0.0.0 or later).

Determining the correct installation package

The package name of SDDPCM for different AIX operating system levels is the following:

- `devices.sddpcm.52.rte` for AIX 5.2
- `devices.sddpcm.53.rte` for AIX 5.3
- `devices.sddpcm.61.rte` for AIX 6.1

Determining if the SDD package is installed About this task

To determine if the SDD is installed:

1. Use the `lspp -l *ibmSdd*` and `lspp -l devices.sdd*` commands to determine if any SDD package is installed on the system.
2. If SDD is installed for supported storage device configuration, you must unconfigure and remove all SDD vpath devices, and then uninstall the SDD package.

Determining if the `ibm2105.rte` package is installed About this task

To determine if the `ibm2105.rte` package is installed:

Procedure

1. Use the **lslpp -l *ibm2105*** command to determine if any **ibm2105.rte** with VRMF 32.6.100.xx is installed.
2. If **ibm2105.rte** is installed, you must:
 - a. Unconfigure and remove all supported storage devices.
 - b. Use **smitty** to uninstall the **ibm2105.rte** package. If **ibm2105.rte** is installed, you must remove all supported storage devices and uninstall the **ibm2105.rte** package.

Determining if the **devices.fcp.disk.ibm.rte** package is installed

About this task

To determine if the **devices.fcp.disk.ibm.rte** package is installed:

Note: The following steps are not required for RSSM devices.

1. Use the **lslpp -l devices.fcp.disk.ibm*** command to determine if any **devices.fcp.disk.ibm.rte** with VRMF 1.0.0.x is installed.
2. If **devices.fcp.disk.ibm.rte** is installed, you must:
 - a. Unconfigure and remove all supported storage devices.
 - b. Use **smitty** to uninstall the **devices.fcp.disk.ibm.rte** package. If **devices.fcp.disk.ibm.rte** is installed, you must remove all supported storage devices and uninstall the **devices.fcp.disk.ibm.rte** package.

Installing the AIX fibre-channel device drivers

About this task

Note: Installing AIX fibre-channel device drivers is not a requirement for RSSM devices.

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

www-933.ibm.com/support/fixcentral/

Complete the following steps to install the AIX fibre-channel device drivers from the AIX compact disk:

1. Log in as the root user.
2. Load the compact disc into the CD-ROM drive.
3. From your desktop window, enter **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. The fibre-channel device drivers include the following installation packages:

devices.pci.df1080f9

The adapter device driver for RS/6000 or IBM System p with feature code 6239.

devices.pci.df1000f9

The adapter device driver for RS/6000 or IBM System p with feature code 6228.

devices.pci.df1000f7

The adapter device driver for RS/6000 or IBM System p with feature code 6227.

devices.common.IBM.fc

The FCP protocol driver.

devices.fcp.disk

The FCP disk driver.

Select each one by highlighting it and pressing **F7**.

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.
15. Check to see if the correct APARs are installed by entering the following command:

```
instfix -iv | grep IYnnnnn
```

where *nnnnn* represents the APAR numbers.

If the APARs are listed, that means that they are installed. If they are installed, go to “Configuring supported storage MPIIO-capable devices” on page 33. Otherwise, go to step 3.

Verifying and upgrading the fibre-channel adapter firmware level

Use the following procedures to verify and upgrade your current fibre-channel adapter firmware level.

Note: The following procedures do not apply to RSSM devices.

Verifying the adapter firmware level:

About this task

You must verify that your current adapter firmware is at the latest level. If your current adapter firmware is not at the latest level, you must upgrade to a new adapter firmware (microcode). To check the current supported firmware level for fibre-channel adapters, go to the following website:

www-933.ibm.com/support/fixcentral/

Complete the following steps to verify the firmware level that is currently installed:

1. Enter the **lscfg -vl fcsN** command. The vital product data for the adapter is displayed.
2. Look at the **ZB** field. The **ZB** field should look similar to:

(ZB).....S2F3.30X1

To verify the firmware level, ignore the second character in the **ZB** field. In the example, the firmware level is sf330X1.

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 fibre channel adapter firmware level.”

Upgrading the fibre channel adapter firmware level:

About this task

Upgrading the firmware level consists of downloading the firmware (microcode) from your AIX host system to the adapter. Before you upgrade the firmware, ensure that you have configured any fibre-channel-attached devices. After the devices are configured, download the firmware from the AIX host system to the FCP adapter by performing the following steps:

1. Verify that the correct level of firmware is installed on your AIX host system. Go to the /etc/microcode directory and locate the file called df1000f7.XXXXXXX for feature code 6227 and df1000f9.XXXXXXX for feature code 6228, where XXXXXX is the level of the microcode. This file was copied into the /etc/microcode directory during the installation of the fibre-channel device drivers.
2. From the AIX command prompt, enter **diag** and press **Enter**.
3. Highlight the **Task Selection** option.
4. Highlight the **Download Microcode** option.
5. Press **Enter** to 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. Highlight /etc/microcode and press **Enter**.
7. Follow the instructions that are displayed to download the firmware, one adapter at a time.

Fibre-channel HBA attributes for DS4000, DS5000, and DS3950 storage devices:

You must set the FC HBA **dyntrk** attribute to **yes** instead of the default setting, which is **no**.

Verifying and Upgrading SAS controller firmware

Refer to RSSM documentation, at the following URL, for instructions on how to verify and upgrade the integrated SAS controller firmware or SAS Expansion Card firmware.

www.ibm.com/systems/support/supportsite.wss/docdisplay?lnocid=MIGR-5078491&brandind=5000020

Installing and upgrading the AIX SDDPCM host attachment

About this task

The host attachment for SDDPCM adds supported storage devices information to allow AIX to properly configure these devices as MPIO-capable hdisks. The supported storage devices information allows AIX to perform the following actions:

- Identify the hdisks as 2105, 2145, 1750, 2107, 1820, DS4100, DS4200, DS4300, DS4500, DS4700, DS4800, DS5000, DS5020, or DS3950 hdisks.
- Set default hdisk attributes, such as `queue_depth` and `timeout` values.
- Indicate to the AIX device driver configure method to set 2105, 2145, 1750, 2107, 1820, DS3950, DS4100, DS4200, DS4300, DS4500, DS4700, DS4800, DS5000, or DS5020 hdisks as MPIO devices.

For fibre-channel attached devices, the AIX SDDPCM host attachment package name is `devices.fcp.disk.ibm.mpio.rte`. For RSSM devices, the AIX SDDPCM host attachment package name is `devices.sas.disk.ibm.mpio.rte`. See the SDDPCM Readme file for the latest host attachment level for the SDDPCM version that you are installing.

For AIX SDDPCM host attachment installation and upgrade instruction from the CD, see the *Host System Attachment Guide* for your storage device. Do not reboot the system before the SDDPCM package is installed on the system.

For AIX SDDPCM host attachment installation and upgrade from the SDD download Web site, use following procedure:

1. Download code from the website that is appropriate for your system.
2. Move the downloaded file to the `/usr/sys/inst.images` directory.
3. Change the directory to the `/usr/sys/inst.images` directory.
4. Untar the downloaded file. For example:

```
tar -xvf devices.fcp.disk.ibm.mpio.rte.tar
or
tar -xvf devices.sas.disk.ibm.mpio.rte.tar
```

5. Update the `.toc` file. For example:

```
pwd
rm -i .toc
inutoc .
grep -i devices.fcp.disk.ibm .toc
or
pwd
rm -i .toc
inutoc .
grep -i devices.sas.disk.ibm .toc
```

This command should reflect the newer SDDPCM host attachment version that will be uploaded.

6. 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.
7. Highlight **Install Software** and press **Enter**.
8. Type `.` (period) to indicate the current directory and press **Enter**.

9. Highlight **Software to Install** and press **F4**. The Software to Install panel is displayed.
10. Select the `devices.fcp.disk.ibm.mpio.rte` package.
11. Press **Enter**. The Install and Update from the LATEST Available Software panel is displayed with the name of the software that you selected to install.
12. Check the default option settings to ensure that they are what you need.
13. 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.
+-----+
```

14. Press **Enter** to continue. The installation process may take a few minutes to complete.
15. When the installation or upgrade is complete, press **F10** to exit from SMIT.
16. If this is a host attachment installation, do not reboot the system until you have the SDDPCM package installed. If this is a host attachment upgrade, and the SDDPCM package is already installed on the system, then reboot the system to complete the host attachment upgrade.
Attention: Do not reboot the system if you only have the SDDPCM host attachment package installed.

Installing and upgrading SDDPCM

Use these topics to install and upgrade SDDPCM.

Installing SDDPCM from CD-ROM

About this task

SDDPCM is released as an AIX installation image. The SDDPCM install image resides in the `/usr/sys/inst.images/SDDPCM` directory on CD-ROM directory. Because the package does not reside in the `/usr/sys/inst.images` directory, which is the default directory for the AIX install program, you must mount the CD-ROM file system before you can use SMIT to install SDDPCM from the CD-ROM directory.

Note:

1. To mount the CD-ROM and install SDDPCM, you must have root access and AIX system administrator knowledge.
2. The AIX SDDPCM host attachment package (`devices.fcp.disk.ibm.mpio.rte` or `devices.sas.disk.ibm.mpio.rte`) must be installed before you install the SDDPCM package (`devices.sddpcm.52.rte`, `devices.sddpcm.53.rte`, or `devices.sddpcm.61.rte`).

Creating and mounting the CD-ROM filesystem

About this task

To install SDDPCM from the CD-ROM, you must first create and mount the CD-ROM filesystem. Use SMIT to complete the following steps to create and mount the CD-ROM to CD-ROM file system.

Note: Throughout this procedure, `/dev/cd0` is used for the compact disc driver address. The driver address can be different in your environment.

1. Log in as the root user
2. Insert the compact disc into the CD-ROM drive.
3. From your desktop window, enter **smitty fs** and press **Enter**.
4. Select **Add / Change / Show / Delete File Systems** and press **Enter**.
5. Select **CDROM File System** and press **Enter**.
6. Select **Add a CDROM File System** and press **Enter**. The Add a CDROM File System panel is displayed.
7. Select **DEVICE name** and select **F4**. The DEVICE name panel is displayed.
8. Select the compact disc drive that you are using for the installation, (for example, cd0), and press **Enter**.
9. Select **MOUNT POINT** and enter a directory where you want the CDROM File System to be mounted, (for example, /cdmnt).
10. Click the default option settings for the other fields to ensure that they are what you need.

```

+-----+
+ Add a CDROM File System                                     +
+                                                           +
+ Type or select values in entry fields.                     +
+ Press Enter AFTER making all desired changes.              +
+                                                           +
+                                                           [Entry Fields] +
+ * DEVICE name                                             cd0      +
+ * MOUNT POINT                                           [/cdmnt]  +
+ Mount AUTOMATICALLY at system restart?      no          +
+                                                           +
+-----+

```

11. Press **Enter** to create the CDROM File System.
12. When the CDROM File System has been created, press **F10** to exit from smit.
13. From your desktop window, enter **smitty mount** and press **Enter**.
14. Select **Mount a File System** and press **Enter**. The Mount a File System panel is displayed.
15. Select **FILE SYSTEM name** and press **F4**
16. Select the CDROM File System that you created and press **Enter**.
17. Select **DIRECTORY** on which to mount and press **F4**.
18. Select the CDROM File System that you created and press **Enter**.
19. Select **TYPE of file system** and press **Enter**.
20. Select **cdarfs** as the type of file system and press **Enter**.
21. Select **Mount as a REMOVABLE file system?** and press **TAB** to change the entry to *yes*.
22. Select **Mount as a READ-ONLY system?** and press **TAB** to change entry to *yes*.
23. Click to check the default option settings for the other fields to ensure that they are what you need.

```

+-----+
+           Mount a File System                               +
+ Type or select values in entry fields.                     +
+ Press Enter AFTER making all desired changes.              +
+                                                           [Entry Fields] +
+ FILE SYSTEM name                                           [/dev/cd0] +
+ DIRECTORY over which to mount                             [/cdmnt]  +
+ TYPE of file system                                       cdarfs      +
+ FORCE the mount?                                           no          +
+ REMOTE NODE containing the file system                    []          +
+ to mount                                                  +
+-----+

```

```

+ Mount as a REMOVABLE file system?          yes          +
+ Mount as a READ-ONLY system?                yes          +
+ Disallow DEVICE access via this mount?      no           +
+ Disallow execution of SUID and sgid programs no          +
+ in this file system?                        +             +
+                                             +             +
+-----+

```

24. Press **Enter** to mount the file system.

25. When the file system has been mounted successfully, press **F10** to exit from smit.

Attention: Do not reboot the system if you only have the SDDPCM host attachment package installed.

Using the System Management Interface Tool facility to install SDDPCM

About this task

Use the System Management Interface Tool (SMIT) facility to install SDDPCM. The SMIT facility has two interfaces: nongraphical (enter **smitty** to invoke the nongraphical user interface) and graphical (enter **smit** to invoke the graphical user interface).

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

1. From your desktop window, cd to the directory where the CD-ROM file system is mounted, for example `/cdmnt`.
2. Go to the directory `usr/sys/inst.images/SDDPCM`.
3. From your desktop window, enter **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. Type `.` (period) to indicate the current directory and press **Enter**.
6. Highlight **Software to Install** and press **F4**. The Software to Install panel is displayed.
7. Select the `devices.sddpcm.52.rte`, `devices.sddpcm.53.rte`, or `devices.sddpcm.61.rte` package, based on the OS level.
8. Press **Enter**. The Install and Update from LATEST Available Software panel is displayed with the name of the software that you selected to install.
9. Check the default option settings to ensure that they are what you need.
10. 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.

```

11. Press **Enter** to continue. The installation process can take several minutes to complete.

12. When the installation is complete, press **F10** to exit from SMIT.

Unmounting the CD-ROM filesystem

About this task

After successfully installing SDDPCM, use the following procedure to unmount the CD-ROM filesystem in order to remove the CD-ROM:

Procedure

1. Go to the root (/) directory.
2. Enter **umount /cdmnt** and press **Enter** to unmount the CD-ROM filesystem from the /cdmnt directory.
3. Enter **rmfs /cdmnt** and press **Enter** to remove the CD-ROM filesystem that contains the SDDPCM package.
4. Remove the CD-ROM.

Installing SDDPCM from downloaded code

About this task

Use this procedure to install SDDPCM from downloaded code:

Procedure

1. Download code from the website that is appropriate for your system
2. Move the downloaded files to the /usr/sys/inst.images directory
3. Change directory to the /usr/sys/inst.images directory.
4. Untar the downloaded file: for example, `tar -xvf devices.sddpcm.53.rte.tar`
5. Update the .toc file. For example:

```
pwd
rm -i .toc
inutoc .
grep -i sdd .toc
```

This command should reflect the newer SDDPCM code version that will be updated.

6. Continue the installation by following the instructions beginning in step 3 on page 25.

Installing SDDPCM with the AIX OS from an AIX NIM SPOT server to the client SAN boot disk or the internal boot disk

About this task

You can install SDDPCM from an AIX Network Installation Management (NIM) server to the client SAN boot disk or the internal boot disk at the same time that the AIX OS is installed. You must set up the NIM master and create the lpp_source and Shared Product Object Tree (SPOT) resources with the images on a file system, which is either NFS-exported or is obtained from a CD or DVD.

Prepare for the NIM SPOT installation with AIX OS and SDDPCM on the client's SAN boot disk or the internal boot disk. To do this, first set up a NIM master and create the lpp_source and SPOT resource. You can use the System Management Interface Tool (SMIT) facility to implement the following procedures:

1. Install the following filesets to set up the system as an NIM master:

```
bos.sysmgt.min.master  
bos.sysmgt.nim.spot
```

2. Initialize the NIM master system by running the **smitty nim_config_env** command.
3. Create a new lpp_source and SPOT resource by running the **smitty nim_config_env** command.
4. Add the SDDPCM fileset to the newly created lpp_source by running the **smitty nim_task_inst** command.
5. Create a SPOT from the new lpp_source by running the **smitty nim_config_env** command.
6. Define an NIM client by running the **smitty nim** command.

See the NIM task roadmap on the Web for detailed information on how to complete these tasks:

publib16.boulder.ibm.com/pseries/en_US/aixins/insgdrf/nim_roadmap.htm#nim_roadmap

After you have successfully prepared for the NIM SPOT installation, you are ready to use the SMIT tool to start the NIM installation on the client system:

1. Run the **smitty nim** command.
 - a. Click **Perform NIM Administration Tasks > Manage Network Install Resource Allocation > Manage Machines > Allocate Network Install Resources**.
 - b. Select the hostname of the client that you defined previously.
 - c. Select the lpp_source and SPOT resources that you created previously, and then press **Enter**.
2. Run the **smitty nim** command again.
 - a. Click **Perform NIM Administration Tasks > Manage Machines > Perform Operations on Machines**.
 - b. Select the hostname of the client that you selected previously.
 - c. Click **bos_inst**.
 - d. Set the **ACCEPT new license agreements** field to **Yes**, and then press **Enter**.

The system automatically reboots after the **smitty nim** task completes. Use the following command to check the SAN boot disk and make sure the boot disk is configured with SDDPCM:

```
lsattr -El hdiskX (SAN boot disk device name)
```

From the output of this command, check the ODM attribute PCM to ensure that the value is *PCM/friend/sddpcm* or *PCM/friend/sddapcm*.

Updating SDDPCM

The following sections discuss methods of updating SDDPCM, verifying the currently installed version of SDDPCM, and the maximum number of devices that SDDPCM supports.

Updating SDDPCM packages by installing a newer base package or a program temporary fix

About this task

SDDPCM allows you to update SDDPCM by installing a newer base package or a program temporary fix (PTF). A PTF file has a file extension of .bff (for example, devices.sddpcm.52.rte.2.1.0.1.bff) and can either be applied or committed when it is installed. If the PTF is committed, the update to SDDPCM is permanent; to remove the PTF, you must uninstall SDDPCM. If the PTF is applied, you can choose to commit or to reject the PTF at a later time. If you decide to reject the PTF, you will not need to uninstall SDDPCM from the host system.

Note: If you are not upgrading the operating system, regardless of whether you have SAN boot devices, you can update SDDPCM packages by installing a newer base package or a program temporary fix. Otherwise, see “Migrating SDDPCM during an AIX OS upgrade with multipath SAN boot devices (on supported storage hdisks)” on page 32.

After applying the base package or the PTF, reboot the system. The SDDPCM server daemon should automatically start after restarting the system. If it does not start automatically, start the SDDPCM server daemon manually.

Use the SMIT facility to update SDDPCM. The SMIT facility has two interfaces, nongraphical (enter **smitty** to invoke the nongraphical user interface) and graphical (enter **smit** to invoke the GUI).

If the base package or PTF is on a CD-ROM, you must mount the CD file system. See “Creating and mounting the CD-ROM filesystem” on page 23 for directions on how to mount the CD file system. In the following procedure, /dev/cd0 is used for the CD drive address. The drive address can be different in your environment.

Complete the following SMIT steps to update the SDDPCM package on your system:

1. Log in as the root user.
2. Type **smitty install_update** and press **Enter** to go directly to the installation panels. The Install and Update Software menu is displayed.
3. Select **Install Software** and press **Enter**.
4. Press **F4** to display the INPUT Device/Directory for Software panel.
5. Select either a CD drive that you are using for the installation or a local directory where the packages reside; for example, /dev/cd0, and press **Enter**.
6. Press **Enter** again. The Install Software panel is displayed.
7. Select **Software to Install** and press **F4**. The Software to Install panel is displayed.
8. Select the base package or the PTF package that you want to install.
9. Press **Enter**. The Install and Update from LATEST Available Software panel is displayed with the name of the software that you selected to install.
10. If you only want to apply the PTF, select **Commit software Updates?** and tab to change the entry to *no*. The default setting is to commit the PTF. If you specify *no* to Commit Software Updates?, ensure that you specify *yes* to Save Replaced Files?.
11. Check the other 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.
15. Unmount the CD-ROM file system and remove the compact disc.

Committing or rejecting a program temporary fix update

About this task

Before you reject a PTF update, you need to unconfigure and remove all supported storage devices from your host system. Committing a PTF does not require this extra step. Complete the following steps to commit or reject a PTF update with the SMIT facility. The SMIT facility has two interfaces: nongraphical (enter **smitty** to invoke the nongraphical user interface) and graphical (enter **smit** to invoke the GUI).

1. Log in as the root user.
2. From your desktop window, enter **smitty install** and press **Enter** to go directly to the installation panels. The Software Installation and Maintenance menu is displayed.
3. Select **Software Maintenance and Utilities** and press **Enter**.
4. Select **Commit Applied Software Updates** to commit the PTF or select **Reject Applied Software Updates** to reject the PTF.
5. Press **Enter**. The Commit Applied Software Updates panel is displayed or the Reject Applied Software Updates panel is displayed.
6. Select **Software name** and press **F4**. The software name panel is displayed.
7. Select the Software package that you want to commit or reject.
8. Check the default option settings to ensure that they are what you need.
9. 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.
+-----+

```

10. Press **Enter** to continue. The commit or reject process can take several minutes to complete.
11. When the installation is complete, press **F10** to exit from SMIT.

Note: You do not need to restart the system even though the bosboot message may indicate that a restart is necessary.

Verifying the currently installed version of SDDPCM

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

islpp -l *sddpcm*

or

pcmpath query version

Note: Using the **pcmpath** command requires that at least one SDDPCM-supported MPIO device is configured on the system.

Maximum number of devices that SDDPCM supports

For SDDPCM 2.6.5.0 or later, a maximum of 65536 configured devices are supported and a maximum of 16 paths per device is supported. For earlier versions of SDDPCM, a maximum of 1200 configured devices are supported and a maximum of 16 paths per device is supported.

Thus, the maximum number of host adapter ports that are supported is 16. However, with the round robin or load balance path selection algorithms, configuring more than four paths per device might impact the I/O performance. Use the minimum number of paths necessary to achieve sufficient redundancy in the SAN environment. The recommended number of paths per device is four.

To support more than 600 storage device LUNs, system administrators must first determine whether the system has sufficient resources to support a large number of devices.

For AIX blade servers in an IBM BladeCenter S Chassis connected to RSSM devices, refer to the RSSM documentation at the following URL for the maximum number of RSSM LUNs supported:

www.ibm.com/systems/support/supportsite.wss/docdisplay?lnodocid=MIGR-5078491&brandind=5000020

For AIX 5.3, a single host should manage a maximum of 1024 devices when devices have been enabled for Open HyperSwap on the host, with 8 logical paths configured for each copy set in the session.

For AIX 6.1, a single host should manage a maximum of 1024 devices when devices have been enabled for Open HyperSwap on the host, with 16 logical paths configured for each copy set in the session.

Migrating SDDPCM

The following sections discuss the methods of migrating SDDPCM with and without SAN boot devices

- “Migrating the supported storage SAN boot device or nonboot volume group from AIX default PCM to SDDPCM”

Note: If the message WARNING!!!! OS and SDDPCM version are not compatible. Install compatible version of SDDPCM. Do you wish to continue with pcmpath (y/n): appears after running **pcmpath**, click IBM Fix Central or contact IBM support for the latest compatible version of SDDPCM.

- “Migrating from SDDPCM to the AIX default PCM or to SDD” on page 32
- “Migrating from SDD with SAN boot devices (on supported storage hdisks) to SDDPCM with multipath SAN boot devices” on page 32

Migrating the supported storage SAN boot device or nonboot volume group from AIX default PCM to SDDPCM

The default reserve policy of the AIX base PCM is a single-path policy, which is SCSI-2 reserve. The path selection algorithm is fail_over, which means only one path is opened at a time and that path made SCSI-2 reserve to the disk. All I/O is routed to this path. This reserve policy and path selection algorithm can cause

problems if, after the SDDPCM packages are installed, you open the default PCM device before you restart the system. The default PCM device can be opened if:

- You build a volume group and file system with AIX default PCM devices, and leave the volume groups active and file system mounted
- You configure default PCM devices as the backing devices of a virtual target device when you are in a VIOS environment

After the system starts, you might see some paths in the INVALID state. The INVALID state means that the path failed to open. This is because the SCSI-2 reserve is not released during the system restart; thus, only the paths previously opened with SCSI-2 reserve can be opened and used for I/O after system restart. You might not see paths in the INVALID state if your system is at AIX 5.2 TL10 or later or at AIX 5.3 TL07 or later, or if you have IY83717 or IY83847 installed on your system. Instead, you might see a heavier I/O select count on one path. This is because the SCSI-2 reserve is not released during the system restart. Even if all the paths are allowed to be opened, only opened paths that previously made SCSI-2 reserve can actually be used for I/O.

If you have supported storage SAN boot devices that are configured with AIX default PCM, and the reserve policy is single_path (SCSI-2 reserve), switching the boot devices from AIX default PCM to SDDPCM might result in this reservation conflict situation. If you install an SDDPCM version earlier than 2.2.0.1, you must always run the **relbootrsv** command to release the SCSI-2 reserve on SAN boot devices after you install the SDDPCM host attachment package and the SDDPCM package. Run the **relbootrsv** command before you restart the system and then run the following command against the hdisks that are part of the rootvg to verify that they are no longer reserved.

```
# pcmquerypr -Vh /dev/hdisk6
connection type: fscsi0
open dev: /dev/hdisk6
```

Attempt to read reservation key...

Attempt to read registration keys...

Read Keys parameter

Generation : 0

Additional Length: 0

resrvpolicy= no_reserve

Reserve Key provided by current host = none (hex)02bbb003

Not reserved.

If you install SDDPCM version 2.2.0.1 or later, the SCSI-2 reserve on SAN boot devices is released automatically during system boot.

In a VIOS environment, reservation conflict problems can occur on a virtual target device that used to have a default PCM device as its backing device. To prevent this problem, perform one of the following actions:

- Switch from the AIX default PCM to SDDPCM before you use the AIX default PCM device as the backing device of a virtual target device.
- Before switching from the AIX default PCM to SDDPCM, put the virtual target devices in the **Define** state. This properly closes the AIX default PCM and releases the SCSI-2 reserve before migrating to SDDPCM.

Reservation conflict problems can also occur on nonboot volume groups. To prevent this problem, perform one of the following actions:

- Switch from the AIX default PCM to SDDPCM before you make any volume groups and file systems.

- To switch from the AIX default PCM to SDDPCM, you must unmount file systems and vary off the volume group of the AIX default PCM to release the SCSI-2 reserve on the volume group before system restart.
- Issue **relbootrsv VGname** to release the SCSI-2 reserve on the active, nonboot volume group devices before you restart the system.

Note: If you specify a *VGname* (volume group name), **relbootrsv** releases the SCSI-2 reserve of the specified non-SAN boot volume group; otherwise, it releases the SCSI-2 reserve of a SAN boot volume group (rootvg).

Migrating from SDDPCM to the AIX default PCM or to SDD

Note: If you have supported storage devices configured with SDDPCM as MPIO boot devices, you need to contact IBM Customer Support for migration from SDDPCM to the AIX default PCM. The following procedure is applicable only for a system without SDDPCM MPIO devices configured as the SAN boot device.

To migrate from SDDPCM to the AIX default PCM or to SDD, you must first unconfigure the devices, stop the SDDPCM server daemon, and then uninstall the SDDPCM package and the SDDPCM host attachment package. See “Removing SDDPCM from an AIX host system” on page 36 for directions on uninstalling SDDPCM. After you uninstall SDDPCM, you can then restart the system to migrate supported storage MPIO devices to the AIX default PCM. If you want to migrate supported storage devices to SDD devices, you must then install the supported storage device host attachment for SDD and the appropriate SDD package for your system. Then restart the system to configure the supported storage devices to SDD vpath devices.

Migrating from SDD with SAN boot devices (on supported storage hdisks) to SDDPCM with multipath SAN boot devices

If you have supported storage devices configured with SDD and there are SAN boot devices with supported storage hdisk devices, you need to contact IBM Customer Support for migration from SDD to SDDPCM.

Migrating SDDPCM during an AIX OS upgrade with multipath SAN boot devices (on supported storage hdisks)

SDDPCM provides different packages to match the AIX OS level. If an AIX system is going to be upgraded to a different OS level; for example, from AIX 5.3 to AIX 6.1, you need to install the corresponding SDDPCM package for that OS level.

If you want to upgrade AIX OS and there are SAN boot devices with SDDPCM supported storage hdisk devices, you need to contact IBM Customer Support for migration from SDDPCM during the OS upgrade.

If you are not in SAN boot environment, or you are only upgrading the AIX OS Technology Level or Server Pack; for example, from AIX 5.3 TL04 to AIX 5.3 TL06, you can follow the procedures in “Updating SDDPCM” on page 27.

Configuring and unconfiguring supported storage MPIO-capable devices

After installing the MPIO-supported storage device host attachment and the SDDPCM package, you need to restart the system in order to configure supported storage devices as MPIO-capable devices. After the first system restart, you can then use the normal AIX command line configure programs to configure and unconfigure supported storage MPIO-capable devices.

After the system restarts, the SDDPCM server daemon (**pcmsrv**) should automatically start.

Configuring supported storage MPIO-capable devices

The newly installed supported storage devices must be configured as MPIO-capable devices before you can use them. Use one of the following commands to configure these devices:

- **cfgmgr** command

Note: If operating in a switched environment, issue the **cfgmgr** command once for each host adapter each time a device is added.

If you use the **cfgmgr** command to configure supported storage MPIO devices, you might need to start the SDDPCM server daemon manually, if it has not already started. See “SDDPCM server daemon” on page 51 for information describing how to check the daemon status and how to manually start the daemon.

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

After the system restarts, the SDDPCM server daemon (**pcmsrv**) should automatically start.

Verifying the SDDPCM configuration

About this task

To verify the SDDPCM configuration, you can use one of the following:

- SMIT MPIO management submenu
- SDDPCM **pcmpath query device** command

Complete the following steps using SMIT to verify the SDDPCM configuration on an AIX host system:

1. Enter **smitty MPIO** from your desktop window. The **MPIO management** menu is displayed.
2. Select MPIO Device Management and press **Enter**. The MPIO Device Management panel is displayed.
3. Select List ALL MPIO Devices and press **Enter**. All MPIO devices on the host are listed.
4. Search for all IBM MPIO FC XXXX devices, where XXXX can be 2105, 2107, 1750, or SAN Volume Controller MPIO devices. Also search for MPIO FC 2145 if you have a host attachment package for SDDPCM with version 1.0.0.8 or later. Ensure that these devices are in the **Available** state.

Search for all IBM MPIO DSXXXX array disks, where XXXX can be 4100, 4200, 4300, 4400, 4700, 4800, 5000, 5020, or 3950 devices. Ensure that these devices are in the **Available** state

Search for all IBM MPIO SAS 1820 devices. Ensure that these devices are in the **Available** state.

You can also use the SDDPCM **pcmpath query device** command to query the configuration status of supported storage devices.

Note:

1. If none of the supported storage devices are configured successfully as MPIO devices, the **pcmpath query device** command will fail.

2. Because the AIX disk-configure method supports parallel device configuration, the same MPIIO logical device name can be configured with different supported storage devices after each device configuration. If you have a program or script that has the MPIIO logical device name hardcoded, ensure that you check the MPIIO logical device name binding with the storage device LUN. If there is a change to the binding between an MPIIO logical device name and the storage device LUN, you must revise your program or script.

Dynamically adding and removing paths or adapters

SDDPCM supports dynamically adding or removing extra paths or adapters while I/O is running. To add extra paths that are attached to a fibre-channel adapter or a SAS adapter, to existing available devices, enter:

```
cfgmgr -vl fscsiX
```

or

```
cfgmgr -vl sasX
```

When the command returns successfully, the paths are added to the devices.

To check the device configuration status, enter:

```
lspath -l hdiskX -H -F "name path_id parent connection status"
```

or

```
pcmpath query device X
```

To add a new fibre-channel adapter to existing, available, supported, storage MPIIO devices, enter:

```
cfgmgr -vl fscX
```

To add a new SAS adapter, depending on the parent driver, enter:

```
cfgmgr -vl mptsasX
```

or

```
cfgmgr -vl sissasX
```

To check the adapter configuration status, enter:

```
pcmpath query adapter
```

or

```
pcmpath query device
```

To dynamically remove all paths under a parent fibre-channel adapter from a supported storage MPIIO device, enter:

```
rmpath -dl hdiskX -p fscsiY
```

To dynamically remove a fibre-channel or SAS adapter and all child devices from supported storage MPIO devices, use **smit mpio**, or enter the following on the command line:

```
rmdev -l fscsiX -R
```

or

```
rmdev -l sasY -R
```

To dynamically remove a particular path, run **smit mpio**, or enter one of the following commands on the command line:

```
rmpath -l hdiskX -p fscsiY -w connection location code
```

or

```
rmpath -l hdiskX -p sasY -w connection location code
```

or

```
rmpath -dl hdiskX -p fscsiY -w connection location code
```

or

```
rmpath -dl hdiskX -p sasY -w connection location code
```

Issue the following command to get a particular path connection location code:

```
lspath -l hdiskX -H -F "name path_id parent connection status"
```

Note: You cannot remove the last path from a supported storage MPIO device. The command will fail if you try to remove the last path from a supported storage MPIO device.

Unconfiguring supported storage MPIO-capable devices

About this task

Note: Contact IBM support if your system has SAN boot MPIO devices configured with SDDPCM on supported storage system disks. The SAN boot MPIO devices cannot be unconfigured with the following procedures.

To remove all non-SAN supported storage MPIO-capable devices:

1. Unmount the file systems of all supported storage devices.
2. Vary off all supported storage device volume groups.
3. Stop **pcmsrv**. See “Stopping the SDDPCM server” on page 52 for the procedure.
4. For fibre-channel-attached devices, enter the following command for each adapter:

```
rmdev -dl fcsX -R
```

5. For RSSM devices, enter the following command:

```
lsdev -Cc disk | grep 1820 | awk '{print $1}' | xargs -n1 rmdev -dl
```

Switching DS4000, DS5000, or DS3950 storage device configurations

For SDDPCM version 2.5.1.0 and subsequent releases, with systems having AIX 5.3 TL08 and AIX 6/1 TL02 and required AIX APAPs installed, users can use the AIX **manage_disk_drivers** command to display the configured drivers for DS3950, DS4100, DS4200, DS4300, DS4500, DS4700, DS4800, DS5100, and DS5020 storage devices, and a list of supported drivers for these device models. Supported drivers are SDDPCM (displayed as AIX_SDDAPPCM), AIX native PCM (displayed as AIX_APPCM), and AIX_FCP array driver (displayed as AIX_fcpcarray; only supports DS4K storage devices). For example:

```
[root@telephone] /home/root # manage_disk_drivers -l
```

```
Device Present Driver Driver Options
2810XIV AIX_AAPCM AIX_AAPCM,AIX_non_MPIO
DS4100 AIX_SDDAPPCM AIX_APPCM,AIX_fcpcarray
DS4200 AIX_SDDAPPCM AIX_APPCM,AIX_fcpcarray
DS4300 AIX_SDDAPPCM AIX_APPCM,AIX_fcpcarray
DS4500 AIX_SDDAPPCM AIX_APPCM,AIX_fcpcarray
DS4700 AIX_SDDAPPCM AIX_APPCM,AIX_fcpcarray
DS4800 AIX_SDDAPPCM AIX_APPCM,AIX_fcpcarray
DS3950 AIX_SDDAPPCM AIX_APPCM
DS5020 AIX_SDDAPPCM AIX_APPCM
DS5100 AIX_SDDAPPCM AIX_APPCM
```

This AIX command also allows users to switch DS4000, DS5000, and DS3950 storage device configuration drivers among these driver options. However, switching device configuration drivers requires a system reboot to reconfigure the devices after running this command. The syntax of this command function is:

```
manage_disk_drivers -d device -o driver_option
```

Removing SDDPCM from an AIX host system

About this task

Before you remove the SDDPCM package from your AIX host system, all supported storage devices must be unconfigured and removed from your host system, or migrated to the AIX default PCM. The SDDPCM server daemon must be stopped.

Note:

1. With version 3.0.0.0, it's no longer required to manually stop the SDDPCM server daemon (**pcmsrv**).
2. SDDPCM supports MPIO-supported storage devices as SAN boot devices. If your server has a supported storage device configured with SDDPCM as the SAN boot device, contact IBM support for your SAN boot configuration environment.

To remove SDDPCM, you must remove both the host attachment for SDDPCM and the SDDPCM software packages before you reconfigure supported storage devices or restart the system. Otherwise, the devices can be in the *Defined* state and cannot be configured as either MPIO or non-MPIO devices.

After all the supported storage devices are removed or migrated to the AIX default PCM and the SDDPCM server daemon (**pcmsrv**) is stopped, complete the following steps to remove the SDDPCM software package:

1. Enter **smitty deinstall** from your desktop window to go directly to the Remove Installed Software panel.
2. Press **F4** in the SOFTWARE name field to bring up a list of packages and press the **F7** key to select the package to uninstall.
3. Press **Tab** 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 precheck are displayed without removing the software. If the state for any supported storage MPIO 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 SDDPCM software package and the supported storage device host attachment for SDDPCM are removed from your system.

SDDPCM support for HACMP with Enhanced Concurrent Mode volume groups

Beginning with SDDPCM 2.1.2.0, SDDPCM supports HACMP V5.1, V5.3, and V5.4 on an AIX 5.2 TL07 (or later) and AIX 5.3 TL03 (or later) system with both concurrent and nonconcurrent resource groups. SDDPCM 2.4.0.0 supports HACMP V5.3, and V5.4 on an AIX 6.1 system with both concurrent and nonconcurrent resource groups.

This support requires definition of the shared volume groups as Enhanced Concurrent Mode volume groups, in either concurrent or nonconcurrent resource groups. This means that no reserve needs to be broken in response to a node failure, and hence any requirement on breaking reserves is removed. A special interaction between HACMP and LVM ensures that if the volume group is used in a nonconcurrent resource group, applications are allowed to access it on one node at a time. Only no_reserve policy is supported in both concurrent and nonconcurrent resource groups.

The Enhanced Concurrent Mode volume groups are sufficient to ensure high availability. However, If system ECM volume groups are in nonconcurrent resource groups, you should configure your SAN using the following guidelines:

- The interaction between HACMP and LVM to ensure that only one node has nonconcurrent access at a time is *advisory locking*. This is in contrast to the *mandatory locking* provided by SCSI reserves. To ensure that production data is not inadvertently modified by nodes that are not in the HACMP cluster, the following should be done:
 1. Use either physical cabling or zoning to ensure that only HACMP nodes have access to the shared LUNs. That is, non-HACMP nodes should be prevented by hardware from accessing the shared LUNs.

2. Start HACMP on the cluster nodes at boot time. This ensures that HACMP will activate the appropriate access controls on the shared disk before applications have a chance to modify the access controls.
- Configure disk heartbeating to reduce the likelihood of one node considering the other *dead* and attempting to take over the shared disks. (This is known as a *partitioned cluster*, or *split brain syndrome*). If the shared disks consist of multiple enclosures, use one disk in each enclosure as a heartbeat path.

Different storage systems or models might support different versions of HACMP and SDDPCM. For information, see the interoperability matrix for your storage:

www.ibm.com/systems/storage/disk/ds6000/
www.ibm.com/systems/storage/disk/ds8000/
www.ibm.com/systems/storage/software/virtualization/svc/

For HACMP v5.1, v5.2, v5.3, and v5.4 for AIX5L support information, go to the following website:

publib.boulder.ibm.com/infocenter/clresctr/vxrx/index.jsp?topic=/com.ibm.cluster.hacmp.doc/hacmpbooks.html

For HACMP up-to-date APAR information, go to the following website:

www14.software.ibm.com/webapp/set2/sas/f/hacmp/download/aix53.html

MPIO reserve policies

SDDPCM supports four types of MPIO reserve policies. You can select one of the four reserve policies based on their configuration environment or application needs. The supported reserve policies are:

- No Reserve reservation policy
- Exclusive Host Access Single Path reservation policy
- Persistent Reserve Exclusive Host Access reservation policy
- Persistent Reserve Shared Host Access reservation policy

No Reserve reservation policy

If you set MPIO devices with this reserve policy, there is no reserve being made on MPIO devices. A device without reservation can be accessed by any initiators at any time. I/O can be sent from all the paths of the MPIO device. This is the default reserve policy of SDDPCM.

Exclusive Host Access single-path reservation policy

This is the SCSI-2 reservation policy. If you set this reserve policy for MPIO devices, only the fail_over path selection algorithm can be selected for the devices. With this reservation policy, an MPIO device has all paths being opened; however, only one path made a SCSI-2 reservation on the device. I/O can only be sent through this path. When this path is broken, reserve is released, another path is selected, and SCSI-2 reserve is reissued by this new path. All input and output is now routed to this new path.

Persistent Reserve Exclusive Host Access reservation policy

If you set an MPIO device with this persistent reserve policy, a persistent reservation is made on this device with a persistent reserve (PR) key. Any initiators

who register with the same PR key can access this device. Normally, you should pick a unique PR key for a server. Different servers should have different unique PR key. I/O is routed to all paths of the MPIO device, because all paths of an MPIO device are registered with the same PR key. In a nonconcurrent clustering environment, such as HACMP, this is the reserve policy that you should select.

Current® HACMP clustering software supports no_reserve policy with Enhanced Concurrent Mode volume group. HACMP support for persistent reserve policies for supported storage MPIO devices is not available.

Persistent Reserve Shared Host Access reservation policy

If you set an MPIO device with this persistent reserve policy, a persistent reservation is made on this device with a persistent reserve (PR) key. However, any initiators that implemented persistent registration can access this MPIO device, even if the initiators are registered with different PR keys. In a concurrent clustering environment, such as HACMP, this is the reserve policy that you should select for sharing resources among multiple servers.

Current HACMP clustering software supports no_reserve policy with Enhanced Concurrent Mode volume group. HACMP support for persistent reserve policies for supported storage MPIO devices is not available.

SDDPCM active/passive storage device controller health-check feature

This controller health-check function, when enabled, is invoked when an enabled path become unavailable due to transport problems. Enabling this feature results in faster I/O failure time when the access to a LUN is lost. The faster failure time is controlled by the controller health check attribute setting: **cntl_delay_time**.

By default, the controller health-check feature is disabled. To enable this feature, set the following two ODM attributes to a non-zero value for the active/passive storage devices: **cntl_delay_time** and **cntl_hcheck_int**.

Note: Setting either value to zero (0) disables this feature. Setting **cntl_delay_time=1** also disables this feature.

For example, if you want to allow the storage device to come back on the fabric within 30 seconds after leaving the fabric, set **cntl_delay_time=30** and **cntl_hcheck_int=2**. The device, /dev/hdisk#, must not be in use when setting the ODM values with the **chdev** command, or the **chdev -P** option must be used, which requires a reboot to make the change to take effect.

Two pcmpath commands allow you to dynamically change these two controller health-check ODM attributes. See “pcmpath set device cntlhc_delay” on page 82 and “pcmpath set device cntlhc_interval” on page 82 for information about these commands.

CAUTION:

There are cases where the storage device may reboot both of the controllers and become inaccessible for a period of time. If the controller health check feature is enabled, and the `cntl_delay_time` is set too short, it may result in an I/O failure. Ensure that you have a mirrored volume with failover protection, or with a GPFS configuration, if you are running with controller health check enabled and the `cntl_delay_time` setting is under 60 seconds, or is not long enough to cover the temporary device inaccessible conditions that can occur during the storage concurrent code load, or other error injection operations.

SDDPCM ODM attribute settings

The following sections discuss the SDDPCM ODM attribute default settings, and how to change the attributes of the supported storage MPIO devices:

- “SDDPCM ODM attribute default settings”
- “Changing device reserve policies”
- “Changing the path selection algorithm” on page 41
- “Changing SDDPCM path healthcheck mode” on page 43
- “Changing SDDPCM path healthcheck time interval” on page 44
- “Changing the Open HyperSwap quiesce expire time” on page 44
- “Changing SDDPCM controller healthcheck delay_time” on page 46
- “Changing SDDPCM controller healthcheck interval time” on page 47

Note: For RSSM devices, refer to RSSM documentation, at the following URL, for information about setting `queue_depth` attribute

www.ibm.com/systems/support/supportsite.wss/docdisplay?Indocid=MIGR-5078491&brandind=5000020

SDDPCM ODM attribute default settings

SDDPCM has following default attributes settings:

Attribute	Default value
device reserve policy	<code>no_reserve</code>
path selection algorithm	<code>load balance</code>
healthcheck mode	<code>nonactive</code>
healthcheck time interval	<code>60 seconds</code>
quiesce expire time	<code>120 seconds</code>

Changing device reserve policies

Use the `chdev` command to change the reserve policy for a device. Because `chdev` requires the device to be unconfigured and reconfigured, this is a disruptive operation.

The following reserve policies can be used with any of the supported path selection algorithms (see “Supported SDDPCM features” on page 13):

- no_reserve
- persistent reserve exclusive host access
- persistent reserve shared host access

When the reserve policy of a device is exclusive host access single path (SCSI-2), the only supported path selection algorithm is the fail_over algorithm. The fail_over algorithm selects one path at a time for all I/Os. When the active path fails, then an alternative path is selected. The SCSI-2 reserve is reissued by this alternative path

To change the device reserve policy to no_reserve, enter:

```
chdev -l hdiskX -a reserve_policy=no_reserve
```

If you want to change the reserve policy to one of the persistent reserve policies, you must provide a persistent reserve key at the same time that you change the device policy to one of the persistent reserve types. For example, to change the reserve policy to PR_shared:

```
chdev -l hdiskX -a PR_key_value=0x1234 -a reserve_policy=PR_shared
```

Note: Beginning with SDDPCM 2.1.0.0, 2 persistent reserve tools are provided to manage supported storage system MPIO devices. See “Persistent reserve command tools” on page 54 for more information.

Changing the path selection algorithm

Starting with SDDPCM 2.1.0.0, you can use the **pcmpath set device algorithm** command to dynamically change the path selection algorithm. See “pcmpath set device algorithm” on page 80 for information about this command.

You can also use the **chdev** command to change the path selection algorithm of a device. Because **chdev** requires that the device be unconfigured and then reconfigured, this is a disruptive operation.

Use the following command to change the device path selection algorithm to round robin:

```
chdev -l hdiskX -a algorithm=round_robin
```

You can change the reserve_policy and algorithm for a device with one command. For example, to change the reserve policy to no_reserve and the path selection algorithm to round robin:

```
chdev -l hdiskX -a reserve_policy=no_reserve -a algorithm=round_robin
```

Using the load balancing port algorithm

Starting with SDDPCM 2.4.0.0, you can use the load balancing port algorithm to achieve better balanced I/O performance in certain specific SAN configuration environments. This path selection algorithm supports only 2105, 2107, 1750, and 2145 storage devices. This algorithm is based on the existing load balancing algorithm, but it also uses the incorporated I/O statistics on each target port to

which the host is connected. You can use this algorithm for SAN configurations where I/O throughput is unbalanced on the storage targets.

The following examples demonstrate the possible configurations in which this algorithm can help to improve performance.

In Figure 4, link 2 between the switch and the storage is receiving twice the load of the other links. This condition creates a throughput imbalance on link 2 that prevents optimal load balancing on both hosts.

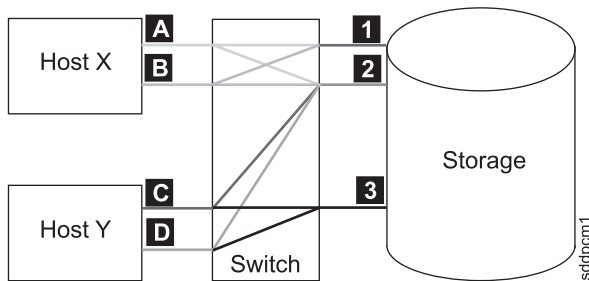


Figure 4. Workload imbalance when one link receives twice the load of the other links

Host X is attempting to balance the load across four paths (A1, A2, B1, B2). Host Y is attempting to balance the load across four paths (C2, C3, D2, D3).

In Figure 5, link 2 between the switch and the storage is more heavily loaded than link 1. This condition creates a throughput imbalance on link 2 that prevents optimal load balancing on Host X.

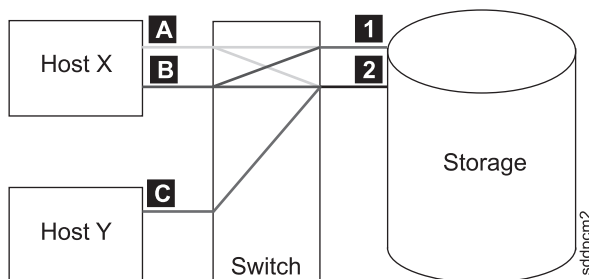


Figure 5. Workload imbalance when one link is more heavily loaded than another link

Host X is attempting to balance the load across four paths (A1, A2, B1, B2). Host Y has only one active path to the storage (C2).

In Figure 6 on page 43, one path is lost from a failed component, which results in the same workload imbalance shown in Figure 5.

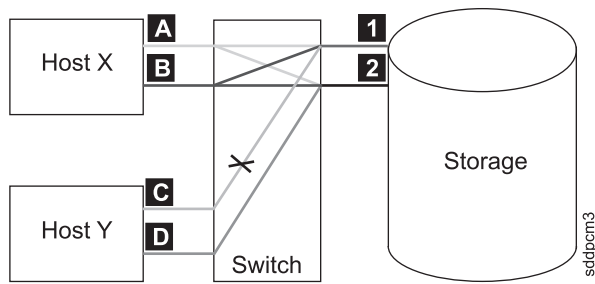


Figure 6. Workload imbalance when one host sharing workload across two paths loses one path

Host X is attempting to balance the load across four paths (A1, A2, B1, B2). Host Y has two paths to the storage, but only one path is active (C1, D2).

You can either use **pcmpath set device algorithm lbp** or **chdev -l hdiskX -a algorithm=load_balance_port** to configure the device with the load balancing port algorithm. To ensure that the load balancing port algorithm produces the desired result, all the hdisks on a host system that is attached to a given storage device must be configured with the same algorithm.

Note: This algorithm improves performance by balancing drastically unbalanced throughput on multiple target ports of the same storage. It cannot completely balance the throughput on the target ports because SDDPCM manages I/O load balancing only on the host where it is installed.

```
pcmpath query port target port number
pcmpath query portstats target port number
```

To display performance information about the target ports, you can use the **pcmpath query port target port number** command and the **pcmpath query portstats target port number** command. For more information, see “Using SDDPCM pcmpath commands” on page 58.

Changing SDDPCM path healthcheck mode

SDDPCM supports the path healthcheck function. If this function is enabled, SDDPCM tests opened paths and reclaims failed paths based on the value that is set in the following device healthcheck attribute:

hc_mode

Healthchecking supports the following modes of operations:

- Enabled - When this value is selected, the healthcheck command will be sent to paths that are opened with a normal path mode.
- Failed - When this value is selected, the healthcheck command is sent to paths that are in failed state.
- Nonactive - When this value is selected, the healthcheck command will be sent to paths that have no active I/O. This includes paths that are opened or in failed state.

If the algorithm selected is round robin or load balance, the healthcheck command will only be sent to failed paths, because the round robin and load-balancing algorithms route I/O to all opened paths that are functional. The default value setting of SDDPCM is *nonactive*.

Starting with SDDPCM 2.1.0.0, the **pcmpath set device hc_mode** command allows you to dynamically change the path healthcheck mode. See “pcmpath set device hc_mode” on page 81 for information about this command.

You can also use the **chdev** command to change the device path healthcheck mode. Because **chdev** requires that the device be unconfigured and then reconfigured, this is a disruptive operation. To change the path healthcheck mode to *failed*, issue the following command:

```
chdev -l hdiskX -a hc_mode=failed
```

Changing SDDPCM path healthcheck time interval

The **hc_interval** attribute will determine how often the paths of a device should be health-checked. The **hc_interval** attribute has a range of values from 0 - 3600 seconds. When a value of 0 is selected, the healthcheck function is disabled. Beginning with SDDPCM v2.1.2.3, the default value setting is changed from 20 (seconds) to 60 (seconds).

Starting with SDDPCM 2.1.0.0, the **pcmpath set device hc_interval** command allows you to dynamically change the path healthcheck time interval. See “pcmpath set device hc_interval” on page 81 for information about this command.

You can also use the **chdev** command to change the device path healthcheck time interval. Because **chdev** requires that the device be unconfigured and then reconfigured, this is a disruptive operation. To disable the path healthcheck interval function, issue the following command:

```
chdev -l hdiskX -a hc_interval=0
```

Note: Currently, the SDDPCM healthcheck function only checks the paths being opened. It does not healthcheck any path that is in the close state. The SDDPCM server daemon healthchecks close_failed paths. If a device healthcheck function is disabled, the SDDPCM server daemon healthchecks the device's failed path that is opened. See Chapter 5, “Using the SDDDSM or the SDDPCM daemon,” on page 157 for more information.

From SDDPCM v2.1.2.3 and later, a new feature of SDDPCM server daemon healthcheck function is introduced. The SDDPCM server daemon automatically starts or stops the healthcheck function on a device if you issue one of the following:

- **pcmpath set device m hc_interval 0** on the fly to disable a device internal healthcheck function
- **pcmpath set device m hc_interval n** to enable a device internal healthcheck function on the fly

Note: The SDDPCM server daemon only healthcheck FAILED paths. It does not implement healthcheck on opened or idle paths as the SDDPCM internal healthcheck does. This is the difference between the SDDPCM internal healthcheck and the SDDPCM server daemon healthcheck.

Changing the Open HyperSwap quiesce expire time

Beginning with SDDPCM 3.0.0.0, you can use the **chdev** command to change the Open HyperSwap quiesce expire time of a device. Because **chdev** requires that the

device be unconfigured and then reconfigured, this is a disruptive operation. Use the following command to change the device quiesce expire time:

```
chdev -l hdisk$i -a quiesce_timeout=n (30 < n < 600)
```

Note: Note: For a setup with a large number or the maximum number of devices, increase the **quiesce_timeout** to prevent a delayed recover command.

Supported AIX fibre-channel device driver features

SDDPCM supports the following fibre channel adapter driver features:

- Fast I/O failure of fibre channel devices
- Fibre-channel dynamic device tracking
- Changing SDDPCM controller healthcheck delay_time
- Changing SDDPCM controller healthcheck interval time

Fast I/O failure of fibre-channel devices

The AIX fibre channel adapter driver supports the new `fc_err_recov` attribute in AIX. If enabled, this attribute can reduce the amount of time needed to fail I/O in certain conditions. By default, this attribute has a value of `delayed_fail`, which means that the fast failure is disabled.

To enable fast failure, you must complete the following steps:

1. Change all the child devices of `fscsiX` on your system to the defined state by running the `rmdev -l fscsiX -R` command for all adapters on your system.
2. Enter the `chdev -l fscsiX -a fc_err_recov=fast_fail` command for all adapters on your system.
3. Enter the `cfgmgr` command to reconfigure all devices back to the available state.

Fibre channel dynamic device tracking

Dynamic Tracking support allows for the following scenarios without I/O errors or loss of access:

- Combine two switches in two different SANS into one SAN by connecting the switches with a cable and cascading the switches.
- Change the supported storage device FC cable from one switch port to a different switch port. The disconnected cable must be reconnected within 15 seconds.
- Swap two supported storage device FC cables on the switch ports. The disconnected cables must be reconnected within 15 seconds.
- Swap two supported storage device FC cables on the supported storage device ports. The disconnected cables must be reconnected within 15 seconds.

Note:

1. This 15 seconds window actually includes the time required to bring up the FC link after the cable is reconnected. For example, if it takes 4 seconds to bring up the FC link, the time allowed to leave the cable disconnected is 11 seconds. I/O will fail if the cable is disconnected longer than 11 seconds.
2. Fibre-channel device dynamic tracking does not support the case when a cable is moved from one adapter on the supported storage device to another free, previously unseen adapter on the supported storage device. The reason is that

the world wide port name (WWPN) will be different for that adapter, and the supported storage device cannot track that adapter. The WWPN must be a static identifier of a remote port.

AIX has added a new attribute that must be changed to enable dynamic tracking. By default, dynamic tracking is disabled. To enable dynamic tracking, you must do the following:

1. Change all the child devices of fscsiX on your system to the defined state by issuing the **rmdev -l fscsiX -R** command for all adapters on your system.
2. Issue the **chdev -l fscsiX -a dyntrk=yes** command for all adapters on your system.
3. Issue **cfgmgr** to reconfigure all devices back to the available state.

Note: You must set the FC HBA **dyntrk** attribute to **yes** for DS4000, DS5000, and DS3950 storage devices

For more information about Dynamic Tracking and Fast I/O Failure, see:

[www-01.ibm.com/support/docview.wss?rs=1203&context=SWGD0
&context=SWG10&context=SWGC0&context=HW182&dc=DB550
&q1=dynamic+fast+tracking+%22and%22+Fast+I%2fO+failure&uid=sg1IY37183
&loc=en_US&cs=UTF-8&lang=en](http://www-01.ibm.com/support/docview.wss?rs=1203&context=SWGD0&context=SWG10&context=SWGC0&context=HW182&dc=DB550&q1=dynamic+fast+tracking+%22and%22+Fast+I%2fO+failure&uid=sg1IY37183&loc=en_US&cs=UTF-8&lang=en)

Installing APAR IY37183 also installs the file:

`/usr/lpp/bos/README.FIBRE-CHANNEL`

This file has more information about the Dynamic Tracking and Fast I/O Failure features.

Changing SDDPCM controller healthcheck delay_time

Starting with SDDPCM V2.5.2.0 and subsequent releases, the **cntl_delay_time** attribute is used to specify the amount of time, in seconds, that the active/passive storage device's controller(s) will be health checked after a transport failure. At the end of the specified period, if no paths are detected as good, all pending and subsequent I/O to the device will fail until the device health checker detects that a failed path has recovered.

The **cntl_delay_time** attribute has a range of values from 0-300 seconds. When a value of 0 or 1 is selected, the controller healthcheck function is disabled. By default, this attribute value is set to 0, which means the controller health check function is disabled.

The **pcmpath set device cntlhc_delay** command allows you to dynamically change the controller health check delay_time. See “pcmpath set device cntlhc_delay” on page 82 for information about this command.

You can also use the **chdev** command to change the device controller healthcheck delay_time. Because chdev requires that the device be unconfigured and then reconfigured, this is a disruptive operation. Or you can use the **chdev -P** command, which requires a reboot to make the change take effect.

Note: To enable the active/passive storage device controller health check function, the values of both controller health check attributes **cntl_delay_time** and **cntl_hcheck_int** must be set to a non-zero value.

Changing SDDPCM controller healthcheck interval time

Starting with SDDPCM V2.5.2.0 and subsequent releases, the `cntl_hcheck_int` attribute is used to specify the amount of time, in seconds, that the next controller health check command is issued. When the controller health check is enabled, the first controller health check is issued after a storage fabric transport failure is detected. This value must be less than the `cntl_delay_time` unless set to zero (0), to disable this feature.

The `cntl_delay_time` attribute has a range of values from 0-300 seconds. When a value of 0 is selected, the controller healthcheck function is disabled. By default, this attribute value is set to 0, which means the controller health check function is disabled.

The `pcmpath set device cntlhc_interval` command allows you to dynamically change the controller health check interval time. See “`pcmpath set device cntlhc_interval`” on page 82 for information about this command.

You can also use the `chdev` command to change the device controller healthcheck `delay_time`. Because `chdev` requires that the device be unconfigured and then reconfigured, this is a disruptive operation. Or you can use the `chdev -P` command, which requires a reboot to make the change to take effect.

For example, to enable the device controller health check function, issue the following command to set `cntl_delay_time` and `cntl_hcheck_int` to non-zero values:

```
chdev -l hdiskX -a cntl_delay_time=60 -a cntl_hcheck_int=3
```

Multipath SAN boot support

This section describes how to configure supported storage system MPIO devices as the SAN boot device.

Attention: The `sddpcm` default reserve policy is `no_reserve` and the default path selection algorithm is `load_balance`. If the SAN boot devices are configured with the default reserve policy and path selection algorithm, you must not configure these SAN boot devices on other AIX servers. This is because no `scsi-2` reserve or `scsi-3` persistent reserve is implemented on these SAN boot devices to prevent access from another AIX server.

Configuring supported storage system MPIO devices as the SAN boot device

About this task

A supported storage MPIO device can be used as the system boot device. To configure the supported storage device boot device with the SDDPCM module:

1. Select one or more supported storage system devices as the boot device.
2. Install one of the following AIX operating systems on the selected supported storage devices:
 - If the selected supported storage device is ESS, the required operating system is AIX 5.2 TL06 (or later), AIX 5.3 TL02 (or later), or AIX 6.1 TL0 (or later).
 - If the selected supported storage device is DS6000, the required operating system is AIX 5.2 TL07 (or later), AIX 5.3 TL03 (or later), or AIX 6.1 TL0 (or later).

- If the selected supported storage device is DS8000, the required operating system is AIX 5.2 TL07 (or later), AIX 5.3 TL03 (or later), or AIX 6.1 TL0 (or later).
- If the selected supported storage device is SAN Volume Controller, the required operating system is AIX 5.2 TL07 (or later), AIX 5.3 TL03 (or later), or AIX 6.1 TL0 (or later).
- If the selected supported storage device is DS4000, DS5000, or DS3950, the required operating system is AIX53 TL8 (or later) or AIX61 TL2 (or later).
- If the selected supported storage device is RSSM, the required operating system is AIX 6.1 TL03 (or later). Refer to the following URL for RSSM documentation with instructions on how to install the AIX operating system on a JS blade with remote volumes:

www.ibm.com/systems/support/supportsite.wss/docdisplay?lnodocid=MIGR-5078491&brandind=5000020

3. Restart the system. The supported storage boot device is configured as an MPIIO device with AIX default PCM.

Note: For IBM DS4000 storage devices, if the OS is AIX53, or if the system was migrated from AIX53 to AIX61 (or later), the DS4000 devices are configured by the AIX FCPArray(RDAC) device driver instead of the AIX native MPIIO PCM.

4. Install the supported storage device host attachment for SDDPCM and the SDDPCM packages.
5. To release scsi-2 reserve on boot devices with SDDPCM v2.2.0.0 or earlier, you must issue the **relbootrsv** command. For boot devices with SDDPCM v2.2.0.1 or later, scsi-2 reserve is automatically released during the system reboot. If you want to release non-rootvg scsi-2 reserves, provide the volume group name as a parameter. For example: **relbootrsv vgrname**.
6. Restart the system.

All supported storage MPIIO devices, including supported storage MPIIO SAN boot devices, are now configured with SDDPCM.

When you convert a boot device with SDDPCM v2.2.0.0 and earlier from the AIX default PCM to SDDPCM, you must issue the **relbootrsv** command, as shown in step 5. If you fail to do so, you might encounter a problem where either all paths of the boot device cannot be opened successfully or they can be opened but cannot be used for I/O. This problem occurs because the AIX default PCM has a default reserve policy of single-path (SCSI-2). See “Migrating the supported storage SAN boot device or nonboot volume group from AIX default PCM to SDDPCM” on page 30 for information about solving this problem.

There is a known problem during the SAN boot configuration. After the system is restarted followed by the operating system installation on the supported storage MPIIO devices, you might see that some paths of the rootvg are in Failed path state. This can happen even if the system is successfully restarted.

This problem is corrected in AIX 5.2 TL08 or later and AIX 5.3 TL04 or later. Apply the following APARs on these OS levels after the first reboot followed by the operating system installation:

- AIX 5.2 TL08 or later: apply APAR IY83717
- AIX 5.3 TL04 or later: apply APAR IY83847

No APAR is available to correct this problem on AIX52 TL07 and AIX53 TL03. If you configure a SAN boot device with supported storage MPIIO devices on one of

these operating system levels and experience this problem, you can manually recover these failed paths by issuing one of the following commands:

- **chpath -s E -l hdiskX -p fscsiX**
- **pcmpath set device M path N online**

Support system dump device with the supported storage system MPIO device

You can choose a supported storage MPIO device to configure with the system primary and secondary dump devices. You can configure the system dump device with the supported SAN boot device, or with the nonboot device. The path selection algorithm for the system dump device automatically defaults to *failover_only* when the system dump starts.

During the system dump, only one path is selected for dump requests. If the first path fails, I/O is routed to the next path being selected.

You must apply all the APARs for AIX 5.2 TL08 and later, or AIX 5.3 TL04 and later.

Dynamically enabling and disabling paths or adapters

This section describes how to dynamically enable and disable paths and adapters.

Dynamically enabling or disabling a path

About this task

There are three ways to dynamically enable (place online) or disable (place offline) a path:

1. Use the following **pcmpath** commands to change the path state:

pcmpath set device M path N online

or

pcmpath set device M path N offline

2. Use the path control commands provided by AIX.

AIX 5.2 TL04 (or later) or AIX 5.3 TL01 (or later) provides several new path control commands. These commands can be used to configure or remove paths, change path state (enable or disable), and display the path current state.

Use the following AIX path command to change the path state of the fibre-channel or SAS-connected path:

chpath -l hdiskX -s E | D -p fscsiX -w "5005076300c99b0a,5200000000000000"

or

chpath -l hdisk1 -s E | D -p sasX -w 5005076b074012a0,1000000000000000

Note: To find the parent adapter and connect location of a path, use the following AIX path command:

lspath -l hdiskX -H -F "name path_id parent connection"

3. Use the smitty MPIO management submenu.

- a. Enter **smitty MPIO** and press **Enter**. This displays the MPIO Management panel.

- b. Select MPIIO Path Management and press **Enter**. This displays the MPIIO Path Management panel.
- c. Select Enable paths or Disable paths to enable or disable paths.

Note:

1. If you issue the **pcmpath set device M path N offline** command to a DS4000 or a DS5000 device and the path to be set offline is the last active path, it causes the device to fail over to the alternate controller. This is a time-consuming action, and might take a few seconds to complete; thus, after the **pcmpath set device M path N offline** command returns, the device might not have completed the controller failover yet. You must issue the **pcmpath query device M** command to check the result and to ensure that this set offline command completed successfully. If the command completed successfully, you can see that the active paths and passive paths are swapped. This is an asynchronous event.
2. For Open HyperSwap devices, an attempt to set the last active path of the source volume offline by using the **pcmpath set device M path N offline** command will be rejected. When the device is closed, it's allowed to set the last active path of the source volume offline. However, when the device is opened with all paths to the source volume offline, an unplanned HyperSwap will be triggered.

Dynamically enabling or disabling an adapter

About this task

The SDDPCM **pcmpath** command can be used to enable (place online) or disable (place offline) an adapter.

To disable an adapter, use the following command:

pcmpath set adapter N offline

Note:

1. Beginning with SDDPCM version 2.4.0.0, storage devices DS4000 and DS5000 are supported. These are active/passive storage devices, and behave differently than ESS, DS6000, DS8000, RSSM, and SAN Volume Controller storage devices. To support the new devices, the syntax of the **pcmpath set adapter N online | offline** command changed by adding the extra parameter **aa | ap**. To set the adapter that connects to ESS, DS6000, DS8000, RSSM, or SAN Volume Controller storage devices to online or offline, enter the **aa** parameter. To set the adapter that connects to DS4000, DS5000, or DS3950 storage devices to online or offline, enter the **ap** parameter.
2. SDDPCM reserves the last path of a device. This command will fail if there is any device using the last path attached to this adapter.
3. For DS4000 and DS5000 storage devices, this set adapter offline command might cause multiple devices to fail over to an alternate controller if the device path that is attached to this adapter is the last active path. Furthermore, if some devices are owned by controller A and some devices are owned by controller B, the set adapter offline command might cause some devices to fail over from controller A to controller B and some devices to fail over from controller B to controller A. It is possible that the **pcmpath set adapter M offline** command returns a failure message, but some number of devices are failed over

successfully and some devices are not. You must issue the **pcmpath query device** command to find out if the command is fully completed or partially completed.

4. For Open HyperSwap devices, when the device is open, an attempt to set the last active path of the source volume offline by the **pcmpath set adapter** command will be rejected. When the device is closed, it's allowed to set the last path of the source volume offline. However, when the device is opened with all paths to the source volume offline, an unplanned HyperSwap will be triggered.

Attention: If the AIX server has more than one DS4000, DS5000, or DS3950 device model configured, the **pcmpath set adapter N offline** command might cause multiple device models to fail over to the alternate controllers. If this is the case, the **pcmpath set adapter N offline** command is not supported.

Using the SDDPCM trace function

SDDPCM supports AIX trace function. The SDDPCM trace ID is 5A7. Trace ID 5A7 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, enter:

```
trace -a -j 5A7
```

To stop the trace function, enter:

```
trcstop
```

To read the report, enter:

```
trcrpt | pg
```

To save the trace data to a file, enter:

```
trcrpt > filename
```

Note: To perform the SDDPCM trace function, you must have the bos.sysmgt.trace installation package installed on your system.

SDDPCM server daemon

The SDDPCM server (also referred to as *pcmsrv*) is an integrated component of SDDPCM 2.1.0.0 (or later). This component consists of a UNIX application daemon that is installed in addition to the SDDPCM path control module. The SDDPCM server daemon provides path-recovery function for SDDPCM devices and the First Time Data Capture function. For detailed information about the SDDPCM server daemon, see Chapter 5, “Using the SDDDSM or the SDDPCM daemon,” on page 157.

Verifying if the SDDPCM server has started

After you have installed SDDPCM and restarted the system, verify if the SDDPCM server (**pcmsrv**) has automatically started by entering **lssrc -s pcmsrv**. If **pcmsrv** has automatically started, the output from the **lssrc -s pcmsrv** command looks like the following example:

```
+-----+
| Subsystem  GROUP  PID      Status |
| pcmsrv     |      2753006  Active  |
+-----+
```

The status of **pcmsrv** should be Active if the SDDPCM server has automatically started. If the SDDPCM server has not started, the status will be *Inoperative*. Go to “Starting the SDDPCM server manually” to proceed.

Because **pcmsrv** is bound to the SDDPCM kernel extension module, **pcmsrv** can fail to start if the SDDPCM is installed and the supported storage MPIO devices have not been configured yet. In this case, you can either restart the system or you can start **pcmsrv** manually after supported storage MPIO devices are configured.

Because **pcmsrv** is bound to the SDDPCM kernel extension module, in order to uninstall or upgrade SDDPCM, you must stop **pcmsrv** so that the SDDPCM kernel extension can be unloaded from the system. During an upgrade, the new SDDPCM kernel extension can be loaded into the system when supported storage MPIO devices are configured.

Starting the SDDPCM server manually

If **pcmsrv** did not start automatically after you performed the SDDPCM installation and configured the supported storage devices, you can start **pcmsrv** manually.

For SDDPCM 3.0.0.0 or later releases, you can start **pcmsrv** by entering:

```
startpcmsrv
```

For sddpcm 2.6.0.1 or prior releases, you can start **pcmsrv** by entering:

```
startsrc -s pcmsrv -e XPG_SUS_ENV=ON
```

Go to “Verifying if the SDDPCM server has started” to see if you successfully started the SDDPCM server.

Stopping the SDDPCM server

You can manually stop **pcmsrv**.

For SDDPCM 3.0.0.0 or later releases, you can permanently stop **pcmsrv** by entering:

```
stoppcmsrv
```

For SDDPCM 2.6.0.1 or earlier releases, you can temporarily disable **pcmsrv** by entering:

```
stopsrc -s pcmsrv.
```

The **stopsrc -s pcmsrv** command will stop the current version of **pcmsrv**, but **pcmsrv** will start again if the system is restarted.

In certain cases, when you want to permanently disable **pcmsrv** on SDDPCM 2.6.0.1 or earlier releases, so that it does not start even after a system restart, you must remove the following line in the system init table (/etc/inittab):

```
srv:2:wait:/usr/bin/startsrc -s pcmsrv -e XPG_SUS_ENV=ON > /dev/null 2>&1
```

Attention: The SDDPCM server (**pcmsrv**) recovers failed paths for devices that have disabled the SDDPCM healthcheck function. Furthermore, SDDPCM server provides the First Time Data Capture function, which saves an SDDPCM internal trace into a log file. You should not stop **pcmsrv** permanently.

See Chapter 5, “Using the SDDDSM or the SDDPCM daemon,” on page 157 for information about the following tasks:

- Enabling or disabling a TCP/IP port for SDDPCM server (“Enabling or disabling the sddsrv or pcmsrv TCP/IP port” on page 161)
- Changing to a different port number for the SDDPCM server (“Changing the sddsrv or pcmsrv TCP/IP port number” on page 162)

AE daemon

For SDDPCM 3.0.0.0 or later releases, a UNIX[®] application daemon, AE server, is added to SDDPCM path control module. The AE server daemon interfaces with the TPC-R server and the SDDPCM kernel driver to provide OpenSwap functionality.

Verifying if the AE server has started

After you have installed SDDPCM and restarted the system, verify if the AE server has automatically started by entering `lssrc -s AE`. If AE has automatically started, the output from the `lssrc -s AE` command looks like this:

```
+-----+
Subsystem Group PID Status
AE NNN active
```

where NNN is the process ID number.

The status of AE should be *Active* if the AE server has automatically started. If the AE server has not started, the status will be *Inoperative*. Go to “Starting the AE server manually” to proceed.

Starting the AE server manually

If AE server did not start automatically after you performed the SDDPCM installation, you can start AE by entering:

```
startAE
```

Go to “Verifying if the AE server has started” to see if you successfully started the AE server.

Stopping the AE server manually

You can temporarily disable AE by entering:

```
stopAE
```

Attention: Don't manually stop AE while the application is running and there are devices configured. AE is an integral part of the Open HyperSwap functionality. If AE is not running, Open HyperSwap functionality is not available. It is important to ensure that AE is running.

SDDPCM utility programs

This section describes the persistent reserve command tools, the SDDPCM `pcmpath` commands, and a tool to query DS4000 and DS5000 storage subsystem and MPIO device configuration information.

Persistent reserve command tools

Starting with SDDPCM 2.1.0.0, SDDPCM supports two persistent reserve command tools. The following sections describe the persistent reserve command tools.

pcmquerypr

The **pcmquerypr** command provides a set of persistent reserve functions. This command supports the following persistent reserve service actions:

- Read persistent reservation key
- Release persistent reserve
- Preempt-abort persistent reserve
- Clear persistent reserve and registration keys

This command can be issued to all system MPIO devices, including MPIO devices not supported by SDDPCM.

The **pcmquerypr** command can be used in the following situation: the reserve policy of the SDDPCM MPIO devices is set to either persistent reserve exclusive host access (PR_exclusive) or persistent reserve shared host access (PR_shared), and persistent reserve has been left on the device by a node, blocking access by another node. The **pcmquerypr** command can be used in this situation to query, preempt, or clear the persistent reserve left by a node or server on the devices.

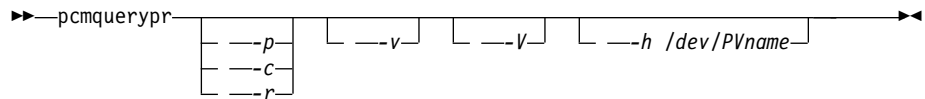
There are more cases when you might need this tool to solve persistent reserve related problems, such as unexpected persistent reserve left on devices because of failing to release the persistent reserve. Caution must be taken with the command, especially when implementing preempt-abort or clear persistent reserve service action. With preempt-abort service action not only the current persistent reserve key is preempted; it also aborts tasks on the LUN that originated from the initiators that are registered with the preempted key. With clear service action, both persistent reservation and reservation key registrations are cleared from the device.

The following information describes in detail the syntax and examples of the **pcmquerypr** command.

Description

The **pcmquerypr** command implements certain SCSI-3 persistent reservation commands on a device. The device can be a supported storage MPIO device. This command supports persistent reserve IN and OUT service actions, such as read, reservation key, release persistent reservation, preempt-abort persistent reservation, or clear persistent reservation and reservation key registrations.

Syntax



Flags:

- p** If the persistent reservation key on the device is different from the current host reservation key, the existing persistent reservation key on the device is preempted. This option can be issued only when the device is not already open.
- c** If there is a persistent reservation on the device, the persistent reservation is removed and all reservation key registrations on the device are cleared. This option can be issued only when the device is not already open.
- r** Removes the persistent reservation key on the device made by this host. This option can be issued only when the device is not already open.
- v** Displays the persistent reservation key if it exists on the device.
- V** Verbose mode. Prints detailed message.
- h /dev/PVname**
Specifies the device.

Return code

If the command is issued without options of -p, -r or -c, the command will return:

- 0** There is no persistent reservation key on the device, or the device is reserved by the current host
- 1** The persistent reservation key is different from the host reservation key
- 2** The command failed.

If the command is issued with one of the options of -p, -r or -c, it returns:

- 0** The command was successful.
- 2** The command failed.

Examples

1. To query the persistent reservation on a device, enter **pcmquerypr -h /dev/hdisk30**.
This command queries the persistent reservation on the device without displaying. If there is a persistent reserve on a disk, it returns 0 if the device is reserved by the current host. It returns 1 if the device is reserved by another host.
2. To query and display the persistent reservation on a device, enter **pcmquerypr -vh /dev/hdisk30**.
Same as Example 1. In addition, it displays the persistent reservation key.
3. To query and display which type of persistent reservation is on a device, enter **pcmquerypr -Vh /dev/hdisk#**.
The following output indicates there is SCSI-2 reserve on the device:

```
# pcmquerypr -Vh /dev/hdisk27
connection type: fscsi3
open dev: /dev/hdisk27
```

Attempt to read reservation key...

```
*> ioctl(PR_READ) error; errno = 5 (I/O error)
*> status_validity=0x1, scsi_bus_status=0x2
```

Attempt to read reservation key...

```
*> ioctl(PR_READ) error; errno = 5 (I/O error)
*> status_validity=0x1, scsi_bus_status=0x18
```

Attempt to read reservation key...

```
*> ioctl(PR_READ) error; errno = 5 (I/O error)
*> status_validity=0x1, scsi_bus_status=0x18
```

Attempt to read reservation key...

```
*> ioctl(PR_READ) error; errno = 5 (I/O error)
*> status_validity=0x1, scsi_bus_status=0x18
```

The following output indicates that there is SCSI-3 reserve on the device:

```
# pcmquerypr -Vh /dev/hdisk43
connection type: fscsi0
open dev: /dev/hdisk43
```

Attempt to read reservation key...

```
*> ioctl(PR_READ) error; errno = 5 (I/O error)
*> status_validity=0x1, scsi_bus_status=0x2
```

Attempt to read reservation key...

Attempt to read registration keys...

Read Keys parameter

Generation : 12

Additional Length: 32

Key0 : 0x3236303232344446

Key1 : 0x3236303232344446

Key2 : 0x3236303232344446

Key3 : 0x3236303232344446

resrvpolicy= no_reserve

Reserve Key provided by current host = none (hex)0924ffff

Reserve Key on the device: 0x3236303232344446

Reservation key type: 0x6

Device is reserved by SDD device.

4. To release the persistent reservation if the device is reserved by the current host, enter **pcmquerypr -rh /dev/hdisk30**.

This command releases the persistent reserve if the device is reserved by the current host. It returns 0 if the command succeeds or the device is not reserved. It returns 2 if the command fails.

5. To reset any persistent reserve and clear all reservation key registrations, enter **pcmquerypr -ch /dev/hdisk30**.

This command resets any persistent reserve and clears all reservation key registrations on a device. It returns 0 if the command succeeds, or 2 if the command fails.

6. To remove the persistent reservation if the device is reserved by another host, enter **pcmquerypr -ph /dev/hdisk30**.

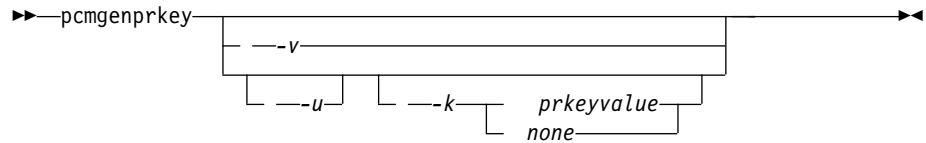
This command removes an existing registration and persistent reserve from another host. It returns 0 if the command succeeds or if the device is not persistent reserved. It returns 2 if the command fails.

pcmgenprkey

Description

The **pcmgenprkey** command can be used to set or clear the PR_key_value ODM attribute for all SDDPCM MPIO devices. It also can be used to query and display the reservation policy of all SDDPCM MPIO devices and the persistent reserve key, if those devices have a PR key.

Syntax



Flags:

-v

Displays the reserve_policy, the PR_key_value attribute, and the persistent reserve key attribute of all the SDDPCM devices.

-u

Updates the persistent reserve key attribute.

-k *prekeyvalue*

Sets the persistent reserve key of all SDDPCM MPIO devices with the provided key value.

-k *none*

Clears the PR_key_value attribute from all SDDPCM MPIO devices.

Examples

1. To set the persistent reserve key to all SDDPCM MPIO devices with a provided key value, issue **pcmgenprkey -u -k 0x1234567890abcdef**. This creates a customized PR_key_value attribute with the provided key value for all SDDPCM MPIO devices, except the devices that already have the same customized PR key attribute. The provided key must contain either a decimal integer or a hexadecimal integer.
2. To clear the PR_key_value attribute from all SDDPCM MPIO devices, issue **pcmgenprkey -u -k none**.
3. To update the customized PR_key_value attribute with the HACMP-provided Preserve key or the output string from the **uname** command for all the SDDPCM MPIO devices, issue **pcmgenprkey -u**. When the **-u** option is used without the **-k** option, this command searches for the HACMP-provided Preservekey attribute and uses that value as the PR key if that attribute is available; otherwise, it uses the output string from the **uname** command as the PR key.
4. To display the reserve_policy, the PR_key_value attribute, and the persistent reserve key attribute of all the SDDPCM devices, issue **pcmgenprkey -v**. If the MPIO device does not have a persistent reserve key, a value of *none* is displayed.

sddpcm_get_config

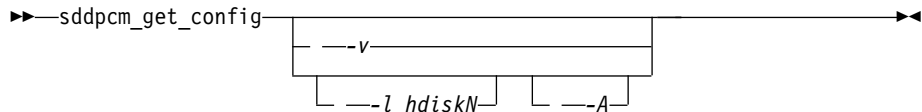
Description

The **sddpcm_get_config** command can be used to display information about MPIO-based DS4000 or DS5000 subsystems and the hdisks associated with them. Specifically, it displays information about the frame

(subsystem), including the frame's assigned name and worldwide name, and a list of hdisks (only those currently in the *Available* state) that are associated with that subsystem, including the hdisk name, LUN number, current ownership, preferred path, and the user-assigned label for that volume.

Attention: To protect the configuration database, the `sddpcm_get_config` command is not interruptible, because stopping this command before it completes could result in a corrupted database.

Syntax



Flags

-l hdiskN

List information for the subsystem which includes hdiskN.

-A

List information for all attached subsystems.

-v

List additional information, largely of limited value, including the MPIO SDDPCM internal frame number, number of controllers, partition number, and partition count.

Example

Display information about the frame of which hdisk4 is a member.

```
sddpcm_get_config -l hdisk4
```

The system displays a message similar to the following:

```
Storage Subsystem Name = 'SDD_DS5300'
  hdisk      LUN #   Ownership      User Label
  hdisk34      0     B (preferred)  ocotillop2_1
  hdisk35      1     A (preferred)  ocotillop2_2
  hdisk36      2     B (preferred)  ocotillop2_3
  hdisk37      3     A (preferred)  ocotillop2_4
```

Using SDDPCM pcmpath commands

SDDPCM provides commands that you can use to display the status of adapters that are used to access managed devices, to display the status of devices that the device driver manages, or to map supported storage MPIO devices or paths to a supported storage device location. You can also set individual path conditions either to online or offline, set all paths that are connected to an adapter either to online or offline, or set all paths that are connected to a supported storage device port or ports to online or offline. This section includes descriptions of these commands. Table 3 on page 59 provides an alphabetical list of these commands, a brief description, and where to go in this chapter for more information.

Note: Changes to the path configuration as a result of the `pcmpath set` commands are logged in `pcm.log`.

Table 3. Commands

Command	Description	Page
pcmpath clear device count	Dynamically clears the error count or error/select counts to zero.	"pcmpath clear device count" on page 60
pcmpath disable ports	Places paths connected to certain ports offline.	"pcmpath disable ports" on page 61
pcmpath enable ports	Places paths connected to certain ports online.	"pcmpath disable ports" on page 61
pcmpath open device path	Opens an INVALID path.	"pcmpath open device path" on page 63
pcmpath query adapter	Displays information about adapters.	"pcmpath query adapter" on page 65
pcmpath query adaptstats	Displays performance information for all FCS adapters that are attached to SDDPCM devices.	"pcmpath query adaptstats" on page 66
pcmpath query device	Displays information about devices.	"pcmpath query device" on page 67
pcmpath query devstats	Displays performance information for a single SDDPCM device or all SDDPCM devices.	"pcmpath query devstats" on page 72
pcmpath query essmap	Displays each device, path, location, and attributes.	"pcmpath query essmap" on page 73
pcmpath query port	Displays information about a single target port or all target ports that are attached to SDDPCM-configured MPIO devices.	"pcmpath query port" on page 74
pcmpath query portmap	Displays the status of the logic paths that are managed by SDDPCM between the host and the storage ports.	"pcmpath query portmap" on page 76
pcmpath query portstats	Displays performance information about a single target port or all target ports that are attached to SDDPCM-configured MPIO devices.	"pcmpath query portstats" on page 77
pcmpath query version	Displays the version of the currently installed SDDPCM.	"pcmpath query version" on page 78
pcmpath query wwpn	Displays the world wide port name (WWPN) for all fibre-channel adapters.	"pcmpath query wwpn" on page 78
pcmpath set adapter	Sets all device paths that are attached to an adapter to online or offline.	"pcmpath set adapter" on page 79
pcmpath set device path	Sets the path of a device to online or offline.	"pcmpath set device path" on page 83
pcmpath set device algorithm	Set all or some of supported storage MPIO device path selection algorithm	"pcmpath set device algorithm" on page 80
pcmpath set device hc_interval	Set all or some of supported storage MPIO device health check time interval	"pcmpath set device hc_interval" on page 81
pcmpath set device hc_mode	Set all or some of supported storage MPIO device health check mode	"pcmpath set device hc_mode" on page 81
pcmpath set device cntlhc_interval	Set all or some of supported active/passive MPIO device controller health check time interval	"pcmpath set device cntlhc_interval" on page 82
pcmpath set device cntlhc_delay	Set all or some of supported active/passive MPIO device controller health check delay_time	"pcmpath set device cntlhc_delay" on page 82
pcmpath set device recoverDEDpath	Set all or some of the supported storage MPIO device recoverDEDpath option.	"pcmpath set device recoverDEDpath" on page 84

Table 3. Commands (continued)

Command	Description	Page
pcmpath set device retry_timeout	Set all or some of the supported storage MPIIO device timeout value for I/O retry on last path.	"pcmpath set device retry_timeout" on page 84
pcmpath set device svc_sb_ttl	Set the time to live attribute for hdisks in the stretched cluster environment of SVC	"pcmpath set device svc_sb_ttl" on page 85
pcmpath set device timeout_policy	Set all or some of the supported storage MPIIO device timeout_policy	"pcmpath set device timeout_policy" on page 86

pcmpath clear device count

The **pcmpath clear device count** command dynamically sets the error counter or error/select counters to zero.

Syntax

```

>>—pcmpath clear—device number 1—┬──count──┬──error──┬──
                                └──device number 2┘       └──all┘

```

Parameters

device number 1 <**device number 2**>

When two device numbers are entered, this command applies to all the devices whose index numbers fit within the range of these two device index numbers.

error

Clears the error counter of the specified SDDPCM MPIIO device or devices.

all

Clears both the select counter and the error counter of the specified SDDPCM MPIIO device or devices.

Examples

If you have a non-zero select counter or error counter, entering **pcmpath query device 20** causes the following output to be displayed:

```

DEV#: 20  DEVICE NAME: hdisk20  TYPE: 2145  ALGORITHM:  Load Balance
SERIAL: 600507680181802358000000000000463
=====
Path#      Adapter/Path Name    State   Mode    Select    Errors
  0         fscsil/path0       CLOSE   NORMAL    14         0
 1*         fscsil/path1       CLOSE   NORMAL     8         0
  2         fscsi3/path2       CLOSE   NORMAL  10009         0
 3*         fscsi3/path3       CLOSE   NORMAL     8         0

```

If you enter the **pcmpath clear device 20 count all** and then enter **pcmpath query device 20**, the following output is displayed:

```

DEV#: 20  DEVICE NAME: hdisk20  TYPE: 2145  ALGORITHM:  Load Balance
SERIAL: 600507680181802358000000000000463
=====
Path#      Adapter/Path Name    State   Mode    Select    Errors
  0         fscsil/path0       CLOSE   NORMAL     0         0
 1*         fscsil/path1       CLOSE   NORMAL     0         0
  2         fscsi3/path2       CLOSE   NORMAL     0         0
 3*         fscsi3/path3       CLOSE   NORMAL     0         0

```

pcmpath disable ports

The **pcmpath disable ports** command sets SDDPCM MPIO device paths offline for the specified supported storage system location code.

Syntax

►—pcmpath disable ports—*connection*—*ess essid*—►

Parameters

connection

The connection code must be in one of the following formats:

- Single port = R1-Bx-Hy-Zz
- All ports on card = R1-Bx-Hy
- All ports on bay = R1-Bx

Use the output of the **pcmpath query essmap** command to determine the connection code.

essid

The supported storage device serial number, given by the output of **pcmpath query portmap** command.

Examples

If you enter the **pcmpath disable ports R1-B1-H3 ess 12028** command and then enter the **pcmpath query device** command, the following output is displayed:

DEV#: 3 DEVICE NAME: hdisk3 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20712028

```
=====
Path#      Adapter/Path Name    State   Mode     Select   Errors
  0         fscsi0/path0         CLOSE   OFFLINE     6         0
  1         fscsi0/path1         CLOSE   NORMAL      9         0
  2         fscsi1/path2         CLOSE   OFFLINE    11         0
  3         fscsi1/path3         CLOSE   NORMAL      9         0
```

DEV#: 4 DEVICE NAME: hdisk4 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20712028

```
=====
Path#      Adapter/Path Name    State   Mode     Select   Errors
  0         fscsi0/path0         CLOSE   OFFLINE   8702         0
  1         fscsi0/path1         CLOSE   NORMAL   8800         0
  2         fscsi1/path2         CLOSE   OFFLINE   8816         0
  3         fscsi1/path3         CLOSE   NORMAL   8644         0
```

DEV#: 5 DEVICE NAME: hdisk5 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20912028

```
=====
Path#      Adapter/Path Name    State   Mode     Select   Errors
  0         fscsi0/path0         CLOSE   OFFLINE   8917         0
  1         fscsi0/path1         CLOSE   NORMAL   8919         0
  2         fscsi1/path2         CLOSE   OFFLINE   9008         0
  3         fscsi1/path3         CLOSE   NORMAL   8944         0
```

DEV#: 6 DEVICE NAME: hdisk6 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20B12028

```
=====
Path#      Adapter/Path Name    State   Mode     Select   Errors
```

0	fscsi0/path0	CLOSE	OFFLINE	9044	0
1	fscsi0/path1	CLOSE	NORMAL	9084	0
2	fscsi1/path2	CLOSE	OFFLINE	9048	0
3	fscsi1/path3	CLOSE	NORMAL	8851	0

DEV#: 7 DEVICE NAME: hdisk7 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20F12028

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	CLOSE	OFFLINE	9089	0
1	fscsi0/path1	CLOSE	NORMAL	9238	0
2	fscsi1/path2	CLOSE	OFFLINE	9132	0
3	fscsi1/path3	CLOSE	NORMAL	9294	0

DEV#: 8 DEVICE NAME: hdisk8 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 21012028

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	CLOSE	OFFLINE	9059	0
1	fscsi0/path1	CLOSE	NORMAL	9121	0
2	fscsi1/path2	CLOSE	OFFLINE	9143	0
3	fscsi1/path3	CLOSE	NORMAL	9073	0

pcmpath enable ports

The **pcmpath enable ports** command sets MPIIO device paths online for the specified supported storage device location code.

Syntax

►►—pcmpath enable ports—*connection*—*ess* *essid*—►►

Parameters

connection

The connection code must be in one of the following formats:

- Single port = R1-Bx-Hy-Zz
- All ports on card = R1-Bx-Hy
- All ports on bay = R1-Bx

Use the output of the **pcmpath query essmap** command to determine the connection code.

essid

The supported storage device serial number, given by the output of **pcmpath query portmap** command.

Examples

If you enter the **pcmpath enable ports R1-B1-H3 ess 12028** command and then enter the **pcmpath query device** command, the following output is displayed:

DEV#: 3 DEVICE NAME: hdisk3 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20112028

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	CLOSE	NORMAL	6	0
1	fscsi0/path1	CLOSE	NORMAL	9	0
2	fscsi1/path2	CLOSE	NORMAL	11	0
3	fscsi1/path3	CLOSE	NORMAL	9	0

DEV#: 4 DEVICE NAME: hdisk4 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20712028

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	CLOSE	NORMAL	8702	0
1	fscsi0/path1	CLOSE	NORMAL	8800	0
2	fscsi1/path2	CLOSE	NORMAL	8816	0
3	fscsi1/path3	CLOSE	NORMAL	8644	0

DEV#: 5 DEVICE NAME: hdisk5 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20912028

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	CLOSE	NORMAL	8917	0
1	fscsi0/path1	CLOSE	NORMAL	8919	0
2	fscsi1/path2	CLOSE	NORMAL	9008	0
3	fscsi1/path3	CLOSE	NORMAL	8944	0

DEV#: 6 DEVICE NAME: hdisk6 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20B12028

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	CLOSE	NORMAL	9044	0
1	fscsi0/path1	CLOSE	NORMAL	9084	0
2	fscsi1/path2	CLOSE	NORMAL	9048	0
3	fscsi1/path3	CLOSE	NORMAL	8851	0

DEV#: 7 DEVICE NAME: hdisk7 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20F12028

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	CLOSE	NORMAL	9089	0
1	fscsi0/path1	CLOSE	NORMAL	9238	0
2	fscsi1/path2	CLOSE	NORMAL	9132	0
3	fscsi1/path3	CLOSE	NORMAL	9294	0

DEV#: 8 DEVICE NAME: hdisk8 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 21012028

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	CLOSE	NORMAL	9059	0
1	fscsi0/path1	CLOSE	NORMAL	9121	0
2	fscsi1/path2	CLOSE	NORMAL	9143	0
3	fscsi1/path3	CLOSE	NORMAL	9073	0

pcmpath open device path

The **pcmpath open device path** command dynamically opens a path that is in the invalid state. You can use this command to open an invalid path even when I/O is actively running on the devices.

Syntax

►►pcmpath open device—*device number*—path—*path number*—►►

Parameters

device number

The logical device number of this hdisk, as displayed by the **pcmpath query device** command.

path number

The path ID that you want to change, as displayed under "Path Name" by the **pcmpath query device** command.

Examples

If you enter the **pcmpath query device 23** command, the following output is displayed:

```
DEV#: 23 DEVICE NAME: hdisk23 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20112028
=====
Path#      Adapter/Path Name    State   Mode     Select   Errors
  0         fscsi1/path0         OPEN    NORMAL    557      0
  1         fscsi1/path1         OPEN    NORMAL    568      0
  2         fscsi0/path2         INVALID NORMAL     0        0
  3         fscsi0/path3         INVALID NORMAL     0        0
```

Note that the current state of path 2 and path 3 is INVALID, which means that open path 2 and path 3 failed.

If the root cause of the path 2 open failure is fixed and you enter the **pcmpath open device 23 path 2** command, the following output is displayed:

```
Success: device 23 path 2 opened

DEV#: 23 DEVICE NAME: hdisk23 TYPE: 2105E20 ALGORITHM: Load Balance
SERIAL: 20112028
=====
Path#      Adapter/Path Name    State   Mode     Select   Errors
  0         fscsi1/path0         OPEN    NORMAL    557      0
  1         fscsi1/path1         OPEN    NORMAL    568      0
  2         fscsi0/path2         OPEN    NORMAL     0        0
  3         fscsi0/path3         INVALID NORMAL     0        0
```

After issuing the **pcmpath open device 23 path 2** command, the state of path 2 becomes OPEN.

The terms used in the output are defined as follows:

Dev# The logical device number of this hdisk.

Device name

The name of this device.

Type The device product ID from inquiry data.

Algorithm

The current path selection algorithm for the device. The algorithm selected is one of the following types: load balancing, load balancing port, round robin, or failover.

Serial The LUN for this device.

Path# The path index displayed by the **pcmpath query device** command.

Adapter

The name of the adapter to which the path is attached.

Path Name

The name of the path. The number displayed as part of the name is the path ID of this path that is used by the **pcmpath open device path** and **pcmpath set device path** commands.

State The condition of each path of the named device:

Open Path is in use.

Close Path is not being used.

Close_Failed

Path is broken and is not being used.

Failed Path is opened, but no longer functional because of error.

Invalid

The path failed to open.

Mode The mode of the named path, which is either *Normal* or *Offline*.

Select The number of times this path was selected for I/O.

Errors The number of I/O errors that occurred on this path.

pcmpath query adapter

The **pcmpath query adapter** command displays information about a single adapter or all adapters that are attached to SDDPCM-configured MPIO devices.

Syntax

```

>>—pcmpath query adapter—adapter number—
                                     ┌──aa──┐
                                     └──ap──┘

```

Parameters*adapter number*

The index number of the adapter for which you want information displayed. If you do not enter an adapter index number, information about all adapters is displayed.

aa The adapter of active/active storage controller devices.

ap The adapter of active/passive storage controller devices.

Examples

If you enter the **pcmpath query adapter** command and your system has both Dual Active or Active/Asymmetric (for example, ESS) and Active/Passive (for example, DS4800) devices, the following output is displayed:

Total Dual Active and Active/Asymmetric Adapters : 2

Adpt#	Name	State	Mode	Select	Errors	Paths	Active
0	fscsi2	NORMAL	ACTIVE	920506	0	80	38
1	fscsi0	NORMAL	ACTIVE	921100	0	80	38

Total Active/Passive Adapters : 2

Adpt#	Name	State	Mode	Select	Errors	Paths	Active
0	fscsi0	NORMAL	ACTIVE	0	0	30	0
1	fscsi1	NORMAL	ACTIVE	0	0	30	0

If you enter the **pcmpath query adapter** command on a host with RSSM LUNs, the following output is displayed:

Total Dual Active and Active/Asymmetric Adapters : 1

Adpt#	Name	State	Mode	Select	Errors	Paths	Active
0	sas1	NORMAL	ACTIVE	1680197	0	32	32

The terms used in the output are defined as follows:

Adpt #

The index number of the 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 opened paths are not functioning.

Failed All opened paths that are attached to this adapter are not functioning.

Mode The mode of the named adapter, which is either *Active* or *Offline*.

Select The number of times this adapter was selected for I/O.

Errors The number of errors that occurred on all paths that are attached to this adapter.

Paths The number of paths 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 opened paths attached to this adapter minus any that are identified as failed or disabled (offline).

pcmpath query adaptstats

The **pcmpath query adaptstats** command displays information about a single or all fibre-channel adapters that are attached to SDDPCM-configured MPIO devices. If you do not enter an adapter number, information about all adapters is displayed.

Syntax

```

>>—pcmpath query adaptstats—adapter number—
                                     ┌──aa──┐
                                     └──ap──┘

```

Parameters

adapter number

The index number of the adapter for which you want information displayed. If you do not enter an adapter index number, information about all adapters is displayed.

aa The adapter of active/active storage controller devices.

ap The adapter of active/passive storage controller devices.

Examples

If you enter the **pcmpath query adaptstats** command and your system only has Active/Passive devices (for example, DS4800), the following output is displayed:

Total Active/Passive Adapters : 2

Adapter #: 0

=====

	Total Read	Total Write	Active Read	Active Write	Maximum
I/O:	0	0	0	0	0
SECTOR:	0	0	0	0	0

Adapter #: 1

=====

	Total Read	Total Write	Active Read	Active Write	Maximum
I/O:	0	0	0	0	0
SECTOR:	0	0	0	0	0

/*-----*/

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 or Write

pcmpath query device

The **pcmpath query device** command displays information about a single SDDPCM MPIIO device, a set of SDDPCM MPIIO devices between device M and N, a specific model of SDDPCM MPIIO devices, or all SDDPCM MPIIO devices. If two device numbers are entered, the command displays device information for a set of devices between these two device numbers. The option to specify a model cannot be used when you query with device numbers. If you do not enter a device number, information about all devices is displayed. If a device number is entered, the command displays the device information about the hdisk that is associated with this number.

Beginning with SDDPCM 2.1.0.7, a new option, **-d**, is provided to display devices of a particular device model. The valid device models are:

- 1750 - All 1750 models (DS6000)
- 2105 - All 2105 models (ESS)

- 2107 - All 2107 models (DS8000)
- 2145 - All 2145 models (SAN Volume Controller)

Beginning with SDDPCM 2.4.0.0, the following device models are added for option -d:

- 1722 - All 1722 devices (DS4300)
- 1724 - All 1724 devices (DS4100)
- 1742 - All 1742 devices (DS4400 and DS4500)
- 1814 - All 1814 devices (DS4200 and DS4700)
- 1815 - All 1815 devices (DS4800)
- 1818 - All 1818 devices (DS5100 and DS5300)

Beginning with SDDPCM 2.6.0.0, the following device model is added for option -d:

- 1820 - All 1820 devices (RSSM)

Beginning with SDDPCM 2.1.0.7, a new feature is available to verify SAN configurations in a controller environment, such as DS6000 or SAN Volume Controller. A nonpreferred path will be marked with “*”.

For example, if you configure 4 paths per MPIIO hdisk device and you want to configure an equal distribution between preferred controller and nonpreferred controller of DS6000 devices, you can configure your environment with 2 paths connected to a preferred controller and 2 paths connected to a nonpreferred controller. This feature will help you verify your configuration by indicating which path is connected to the nonpreferred controller before the device starts operation.

Note:

1. You must open SDDPCM MPIIO devices of DS6000, and SAN Volume Controller, once before the '*' mark on nonpreferred paths can be displayed in the following three commands:
 - **pcmpath query device**
 - **pcmpath query essmap**
 - **pcmpath query portmap**
2. You must open SDDPCM MPIIO RSSM devices before the '*' mark on nonpreferred paths can be displayed in the **pcmpath query device** command. For DS4000 and DS5000 SDDPCM MPIIO devices, only opened passive paths are displayed with the '*' mark in the **pcmpath query device** command.

Beginning with SDDPCM 2.1.3.0, two new options are added to the **device query** command. The first option lets you specify two numbers to query a set of devices; the second option *-i x y* lets you repeat the query command every *x* seconds for *y* times.

Beginning with SDDPCM 3.0.0.0, a new **session name** option is added to the **device query** command that allows you to query a session name to show the set of devices in that session.

The **pcmpath query device** commands display only supported storage MPIIO devices that are configured with the SDDPCM module. Any AIX internal disks or non-SDDPCM-configured MPIIO devices are not displayed.

Syntax

```
►►pcmpath query device —device number
                        —device number m device number n
                        —d device model
                        —S session name
                        —i x
                        —i x y
```

Parameters

device number

The device number refers to the logical device number of the hdisk.

device_number_m device_number_n

Use the *device_number_m device_number_n* option to provide a range of device index numbers.

device model

Displays devices of a particular device model. The valid device models are:

- 1722 - All 1722 devices (DS4300)
- 1724 - All 1724 devices (DS4100)
- 1742 - All 1742 devices (DS4400 and DS4500)
- 1750 - All 1750 models (DS6000)
- 1814 - All 1814 devices (DS4200 and DS4700)
- 1815 - All 1815 devices (DS4800)
- 1818 - All 1818 devices (DS5100 and DS5300)
- 2105 - All 2105 models (ESS)
- 2107 - All 2107 models (DS8000)
- 2145 - All 2145 models (SAN Volume Controller)
- 1820 - All 1820 devices (RSSM)

session name

Displays the set of devices in the specified session.

i Repeats the command every *x* seconds for *y* times. If you do not specify *y*, the command repeats indefinitely every *x* seconds.

Examples

If you enter the **pcmpath query device 65 66** command, the following output is displayed:

For the supported storage devices:

```
DEV#: 65  DEVICE NAME: hdisk65  TYPE: 1814      ALGORITHM:  Load Balance
SERIAL: 600A0B800011796C0000B68148283C9C
=====
Path#      Adapter/Path Name      State   Mode      Select    Errors
0*         fscsi0/path0           OPEN    NORMAL    42        0
1*         fscsi1/path2           OPEN    NORMAL    44        0
2          fscsi0/path1           OPEN    NORMAL    54        0
3          fscsi1/path3           OPEN    NORMAL    52        0

DEV#: 66  DEVICE NAME: hdisk66  TYPE: 1814      ALGORITHM:  Load Balance
SERIAL: 600A0B80001179440000C1FE48283A08
=====
Path#      Adapter/Path Name      State   Mode      Select    Errors
```

0	fscsi0/path0	CLOSE	NORMAL	44	1
1	fscsi1/path2	CLOSE	NORMAL	57	0
2	fscsi0/path1	CLOSE	NORMAL	0	0
3	fscsi1/path3	CLOSE	NORMAL	1	0

If you enter the **pcmpath query device 4 5** command, the following output is displayed:

DEV#: 4 DEVICE NAME: hdisk4 TYPE: 1820N00 ALGORITHM: Load Balance
SERIAL: 6005076B07409F7F4B54DCE9000000B9

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	sas1/path0	OPEN	NORMAL	1748651	0
1*	sas1/path1	OPEN	NORMAL	364	0

DEV#: 5 DEVICE NAME: hdisk5 TYPE: 1820N00 ALGORITHM: Load Balance
SERIAL: 6005076B07409F7F4B54DCE0000000BA

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	sas1/path0	OPEN	NORMAL	1748651	0
1*	sas1/path1	OPEN	NORMAL	364	0

If hdisk2 is an Open HyperSwap device that has never been opened, and you enter **pcmpath query device 2**, the following output is displayed:

DEV#: 2 DEVICE NAME: hdisk2 TYPE: 2107900 ALGORITHM: Load Balance
SESSION NAME: session10S
DIRECTION: H1->H2

=====

PRIMARY SERIAL: 10000000F00

SECONDARY SERIAL: 20000000F80

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	CLOSE	NORMAL	0	0
1	fscsi0/path1	CLOSE	NORMAL	0	0
2	fscsi0/path2	CLOSE	NORMAL	0	0
3	fscsi0/path3	CLOSE	NORMAL	0	0
4	fscsi1/path4	CLOSE	NORMAL	0	0
5	fscsi1/path5	CLOSE	NORMAL	0	0
6	fscsi1/path6	CLOSE	NORMAL	0	0
7	fscsi1/path7	CLOSE	NORMAL	0	0

If hdisk2 is an Open HyperSwap device that is being opened, and you enter **pcmpath query device 2**, the following output is displayed.

Note: In the following example, hdisk2 is created on two physical devices. At any time, only one of the two physical devices is active for I/Os. The asterisk (*) indicates the active device to which the current I/Os are being sent.

DEV#: 2 DEVICE NAME: hdisk2 TYPE: 2107900 ALGORITHM: Load Balance
SESSION NAME: session1
OS DIRECTION: H1->H2

=====

PRIMARY SERIAL: 10000000F00 *

=====

Path#	Adapter/Path Name	State	Mode	Select	Errors
0	fscsi0/path0	OPEN	NORMAL	8	0
1	fscsi0/path2	OPEN	NORMAL	9	0
2	fscsi1/path4	OPEN	NORMAL	9	0
3	fscsi1/path5	OPEN	NORMAL	9	0

SECONDARY SERIAL: 20000000F80

=====

Path#	Adapter/Path Name	State	Mode	Select	Errors
4	fscsi0/path1	OPEN	NORMAL	0	0
5	fscsi0/path3	OPEN	NORMAL	0	0
6	fscsi1/path6	OPEN	NORMAL	0	0
7	fscsi1/path7	OPEN	NORMAL	0	0

The terms used in the output are defined as follows:

Dev# The logical device number of this hdisk.

Name The logical name of this device.

Type The device product ID from inquiry data.

Algorithm

The current path selection algorithm selected for the device. The algorithm selected is one of the following: load balancing, load balancing port, round robin, or failover.

Session name

The name of the Tivoli Productivity Center for Replication session in which this Open HyperSwap device is contained.

Serial The LUN for this device.

OS direction

The current Open HyperSwap direction. H1->H2 shows that the I/O is active on the H1 site. H1<-H2 shows that the I/O is active on the H2 site.

Primary serial

The serial number of the volume on the H1 site.

Secondary serial

The serial number of the volume on the H2 site.

Path# The path index displayed by device query command.

Adapter

The name of the adapter to which the path is attached.

Path Name

The name of the path. The number displayed as part of the name is the path ID that is used by **pcmpath open device path** and **pcmpath set device path** commands.

State The condition of the path attached to the named device:

Open Path is in use.

Close Path is not being used.

Failed Path is no longer being used. It has been removed from service due to errors.

Close_Failed

Path was detected to be broken and failed to open when the device was opened. The path stays in Close_Failed state when the device is closed.

Invalid

The path is failed to open, but the MPIO device is opened.

Mode The mode of the named path. The mode can be either *Normal* or *Offline*.

Select The number of times this path was selected for I/O.

Errors The number of input and output errors that occurred on a path of this device.

pcmpath query devstats

The **pcmpath query devstats** command displays performance information for a single SDDPCM MPIO device or all SDDPCM MPIO devices. If you do not enter a device number, information about all devices is displayed. If a device number is entered, the command displays the device information about the hdisk that is associated with this number.

Note: The **pcmpath query devstats** command displays only SDDPCM MPIO devices. Any AIX internal disks or non-SDDPCM configured MPIO devices will not be displayed.

Beginning with SDDPCM 2.1.3.0, two new options are added to the **query devstats** command. The first option lets you specify two numbers to query a set of devices; the second option **-i x y** lets you repeat the query command every *x* seconds for *y* times.

Syntax

```
➤—pcmpath query devstats—

|                                            |
|--------------------------------------------|
| — <i>device number</i> —                   |
| — <i>device number m device number n</i> — |
| — <i>-d device model</i> —                 |
| — <i>-i x</i> —                            |
| — <i>-i x y</i> —                          |

➤
```

Parameters

device number

The device number refers to the logical device number of the hdisk.

device_number_m device_number_n

Use the *device_number_m device_number_n* option to provide a range of device index numbers.

device model

Displays devices of a particular device model. The valid device models are:

- 1722 - All 1722 devices (DS4300)
- 1724 - All 1724 devices (DS4100)
- 1742 - All 1742 devices (DS4400 and DS4500)
- 1750 - All 1750 models (DS6000)
- 1814 - All 1814 devices (DS4200 and DS4700)
- 1815 - All 1815 devices (DS4800)
- 2105 - All 2105 models (ESS)
- 2107 - All 2107 models (DS8000)
- 2145 - All 2145 models (SAN Volume Controller)
- 1820 - All 1820 devices (RSSM)

i Repeats the command every *x* seconds for *y* times. If you do not specify *y*, the command repeats indefinitely every *x* seconds.

Examples

If you enter the **pcmpath query devstats 2** command, the following output about hdisk2 is displayed:

```
DEV#: 2 DEVICE NAME: hdisk2
=====
              Total Read  Total Write  Active Read  Active Write  Maximum
I/O:           60         10           0           0           2
SECTOR:        320          0           0           0          16

Transfer Size:  <= 512      <= 4k      <= 16K      <= 64K      > 64K
                30         40           0           0           0
/*-----*/
```

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 or write

Transfer size

- <= 512: the number of I/O requests received, whose transfer size is 512 bytes or less
- <= 4k: the number of I/O requests received, whose transfer size is 4 KB or less (where KB equals 1024 bytes)
- <= 16K: the number of I/O requests received, whose transfer size is 16 KB or less (where KB equals 1024 bytes)
- <= 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)

pcmpath query essmap

The **pcmpath query essmap** command displays data collected from the **fcppcmmap** program after the system has been restarted, or by the **pcmpath** program if any device configuration change occurs after the system has been restarted. The **fcppcmmap** program issues SCSI commands directly to the disks to collect the information that is displayed. This command is supported for disk storage systems only.

Syntax

►► `pcmpath query essmap` ◀◀

Examples

If you enter the **pcmpath query essmap** command, the following output is displayed:

Disk	Path	P	Location	adapter	LUN	SN	Type	Size	LSS	Vol	Rank	C/A	S	...
hdisk5	path0	*	30-60-01[FC]	fscsi1	13AAAKA1200	IBM	1750-500	1.1	18	0	0000	01	Y	...
hdisk5	path1		30-60-01[FC]	fscsi0	13AAAKA1200	IBM	1750-500	1.1	18	0	0000	01	Y	...
hdisk5	path2	*	20-60-01[FC]	fscsi0	13AAAKA1200	IBM	1750-500	1.1	18	0	0000	01	Y	...
hdisk5	path3		20-60-01[FC]	fscsi1	13AAAKA1200	IBM	1750-500	1.1	18	0	0000	01	Y	...

The terms used in the output are defined as follows:

Disk The logical device name assigned by the host.

Path The logical path name of a MPIO device.

P Indicates the logical paths and whether the path is preferred and nonpreferred. "*" indicates that the path is a nonpreferred path.

Location

The physical location code of the host adapter through which the LUN is accessed.

Adapter

The logical adapter name assigned by the host LUN.

LUN SN

The unique serial number for each LUN within the supported storage device.

Type The device and model.

Size The capacity of the configured LUN.

LSS The logical subsystem where the LUN resides. (Beginning with 2.1.3.0, the value displayed is changed from decimal to hexadecimal.)

Vol The volume number within the LSS.

Rank The unique identifier for each RAID array within the supported storage device.

C/A The cluster and adapter accessing the array.

S Indicates that the device is shared by two and more supported storage device ports. Valid values are *yes* or *no*.

Connection

The physical location code of supported storage device adapter through which the LUN is accessed.

Port The supported storage device port through which the LUN is accessed.

RaidMode

The disk RAID mode.

pcmpath query port

The **pcmpath query port** command displays information about a single target port or all target ports that are attached to SDDPCM-configured MPIO devices.

Syntax

►►—pcmpath query port—*target port number*—►►

Parameters

target port number

Use the target port number option to display information about the target port. If you do not enter a target port number, information about all target ports is displayed.

Examples

If you have 12 active ports and enter the **pcmpath query port** command, the following output is displayed:

Port#	Wwpn	State	Mode	Select	Errors	Paths	Active
0	5005022300ca031e	NORMAL	ACTIVE	0	0	60	0
1	5005022307044750	NORMAL	ACTIVE	0	0	64	0
2	5005022307155750	NORMAL	ACTIVE	0	0	64	0
3	500502230e02ac54	NORMAL	ACTIVE	0	0	64	0
4	500502230e01fe54	NORMAL	ACTIVE	0	0	64	0
5	500502230eb3d54	NORMAL	ACTIVE	0	0	64	0
6	500503380110046b	NORMAL	ACTIVE	0	0	60	0
7	5005033801100d64	NORMAL	ACTIVE	0	0	60	0
8	50050338011003d1	NORMAL	ACTIVE	0	0	60	0
9	5005033801100118	NORMAL	ACTIVE	0	0	60	0
10	500503330323006a	NORMAL	ACTIVE	3167	0	62	4
11	500503330323406a	NORMAL	ACTIVE	3220	1	62	4

The terms used in the output are defined as follows:

Port # The index number of the port.

WWPN

The worldwide port name of the target port.

State The condition of the named target port, which can be one of the following types:

Normal

The target port that is in use.

Degraded

One or more of the opened paths are not functioning.

Failed All opened paths that are attached to this target port are not functioning.

Mode The mode of the named target port, which is either *Active* or *Offline*.

Select The number of times this target port was selected for input or output.

Errors The number of errors that occurred on all paths that are attached to this target port.

Paths The number of paths that are attached to this target port.

Active The number of functional paths that are attached to this target port. The number of functional paths is equal to the number of opened paths that are attached to this target port minus any that are identified as failed or disabled (offline).

Note: This command is supported only with 1750, 2105, 2107, and 2145 device types.

pcmpath query portmap

The **pcmpath query portmap** command displays the status of the logic paths that are managed by SDDPCM between the host and the storage ports. This command is supported for disk storage systems only.

Syntax

►—pcmpath query portmap—◄◄

Examples

If you enter the **pcmpath query portmap** command, the following output is displayed:

ESSID	DISK	BAY-1(B1)				BAY-2(B2)				BAY-3(B3)				BAY-4(B4)			
		H1	H2	H3	H4	H1	H2	H3	H4	H1	H2	H3	H4	H1	H2	H3	H4
		ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD
		BAY-5(B5)				BAY-6(B6)				BAY-7(B7)				BAY-8(B8)			
		H1	H2	H3	H4	H1	H2	H3	H4	H1	H2	H3	H4	H1	H2	H3	H4
		ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD
13AAAKA	hdisk5	0---	----	----	----	0---	----	----	----	----	----	----	----	----	----	----	----
13AAAKA	hdisk6	Y---	----	----	----	y---	----	----	----	----	----	----	----	----	----	----	----

Y = online/open
O = online/closed
N = offline
- = path not configured
PD = path down

y = (alternate path) online/open
o = (alternate path) online/closed
n = (alternate path) offline

The terms used in the output are defined as follows:

- Y** The port is online and open, meaning that at least one path attached to this port is functional.
- y** Paths connected to this port are nonpreferred paths. The port is online and open, meaning that at least one path attached to this port is functional.
- O** The port is online and closed, meaning that at least one path state and mode is closed and online.
- o** Paths connected to this port are nonpreferred paths. The port is online and closed, meaning that at least one path state and mode is closed and online.
- N** The port is offline, meaning that all paths attached to this port are offline.
- n** Paths connected to this port are nonpreferred paths. The port is offline, meaning that all paths attached to this port are offline.
- The path is not configured.
- PD** The path is down. It is either not functional or has been placed offline.

Note: The following fields apply only 1750 devices and can only be shown after the device is opened once:

- y
- o
- n

The serial number of ESS devices is five digits, whereas the serial number of DS6000 and DS8000 devices is seven digits.

pcmpath query portstats

The **pcmpath query portstats** command displays performance information about a single target port or all target ports that are attached to SDDPCM-configured MPIO devices. If you do not enter a device number, information about all devices is displayed.

Syntax

►—pcmpath query portstats—*target port number*—►

Parameters

target port number

Use the target port number option to display information about the target port. If you do not enter a target port number, information about all target ports is displayed.

Examples

If you have four target ports and enter the **pcmpath query portstats** command, the following output is displayed:

```
Port #: 0
=====
              Total Read  Total Write  Active Read  Active Write  Maximum
I/O:              0           0           0           0           0
SECTOR:           0           0           0           0           0

Port #: 1
=====
              Total Read  Total Write  Active Read  Active Write  Maximum
I/O:              0           0           0           0           0
SECTOR:           0           0           0           0           0

Port #: 2
=====
              Total Read  Total Write  Active Read  Active Write  Maximum
I/O:           3109         58           0           0           2
SECTOR:       28292       4084           0           0       2096

Port #: 3
=====
              Total Read  Total Write  Active Read  Active Write  Maximum
I/O:           3169         51           0           0           2
SECTOR:       24762       6470           0           0       2096
```

The terms used in the output are defined as follows:

Total Read

- I/O: The total number of completed read requests
- SECTOR: The total number of sectors that have been read

Total Write

- I/O: The total number of completed write requests
- SECTOR: The total number of sectors that have been written

Active Read

- I/O: The total number of read requests in process
- SECTOR: The total number of sectors to read in process

Active Write

- I/O: The total number of write requests in process
- SECTOR: The 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 or Write

Note:

1. This command is supported only with 1750, 2105, 2107, and 2145 device types.
2. Data that is displayed by this command is collected only when the device's algorithm is set to lbp. For example, if the algorithm from hdisk10 to hdisk20 is set to lbp, the statistical data for each device is saved in the associated ports and displayed here. If none of the device's algorithm is set to lbp, there is no change in the port statistical output.

pcmpath query version

The **pcmpath query version** command displays the version of SDDPCM that is installed.

Syntax

►►—pcmpath query version—►►

Parameters

None

Examples

If you enter the **pcmpath query version** command, the following output is displayed:

```
[root@abc]> pcmpath query version
IBM SDDPCM Version 2.1.1.0 (devices.sddpcm.52.rte)
```

pcmpath query wwpn

The **pcmpath query wwpn** command displays the World Wide Port Name (WWPN) of the host fibre-channel adapters.

Syntax

►►—pcmpath query wwpn—►►

Parameters

None

Examples

If you enter the **pcmpath query wwpn** command, the following output is displayed:

Adapter Name	PortWWN
fscsi0	10000000C925F5B0
fscsi1	10000000C9266FD1

pcmpath set adapter

The **pcmpath set adapter** command sets all device paths attached to an adapter either to online or offline. SDDPCM reserves the last path of a device if the device is opened. This command will fail if there is any device that has the last path attached to this adapter. If all paths of a device are attached to a single fibre-channel adapter that connects to multiple storage ports through a switch, the **pcmpath set adapter 0 offline** command will fail, because the device will lose all its paths.

Attention: If the device is closed, the **pcmpath set adapter offline** command does not have the last path offline protection.

Note: For DS4000 and DS5000 storage devices, this set adapter offline command might cause multiple devices to fail over to an alternate controller if the device path that is attached to this adapter is the last active path. Furthermore, if some devices are owned by controller A and some devices are owned by controller B, the set adapter offline command might cause some devices to fail over from controller A to controller B and some devices to fail over from controller B to controller A. It is possible that the **pcmpath set adapter M offline** command returns a failure message, but some number of devices are failed over successfully and some devices are not. You must issue the **pcmpath query device** command to find out if the command is fully completed or partially completed.

Attention: If the AIX server has more than one DS4000 or DS5000 device model configured, the **pcmpath set adapter N offline** command might cause multiple device models to fail over to the alternate controller. In this case, the **pcmapth set adapter N offline** command is not supported.

Attention: For Open HyperSwap devices, when the device is open, an attempt to set the last active path of the source volume offline by issuing the **pcmpath set adapter** command will be rejected. When the device is closed, it's allowed to set the last path of the source volume offline. However, when the device is opened with all paths to the source volume offline, an unplanned HyperSwap will be triggered.

Syntax

```
►►—pcmpath set adapter—adapter number—┐ —online—┐ —aa—┐
                                          └ —offline—┘ └ —ap—┘ ───────────►◄
```

Parameters

adapter number

The index number of the adapter that you want to change.

online

Enables the adapter for service.

offline

Disables the adapter from service.

aa The adapter of active/active storage controller devices.

ap The adapter of active/passive storage controller devices.

Examples

If you enter the **pcmpath set adapter 0 offline ap** command:

- Adapter 0 of the active/passive controller devices changes to *Offline* mode and, if there are some paths in the opened state, its state might change to *failed*.
- All paths of the active/passive controller devices that are attached to adapter 0 change to *Offline* mode and their states change to *Dead*, if they were in the *Open* state.

pcmpath set device algorithm

The **pcmpath set device algorithm** command dynamically changes the path selection algorithm per MPIO device.

Syntax

```
►►—pcmpath set device— —num1—┐——algorithm—option——►►
                               └—num2—┘
```

Note: If the device reserve policy is set to *single_path* (SCSI-2 reserve), the device algorithm must be set to *fail_over*. Any attempt to set the algorithm to *round_robin*, *load_balance*, or *load_balance_port* with *single_path* reserve policy will fail.

Parameters

num1 [*num2*]

- When only *num1* is specified, the command applies to the hdisk specified by *num1*.
- When two device logical numbers are entered, this command applies to all the devices whose logical numbers fit within the range of the two device logical numbers.

option

Specifies one of the following path selection algorithms:

- **rr**, where *rr* indicates round robin
- **lb**, where *lb* indicates load balancing
- **fo**, where *fo* indicates failover policy
- **lbp**, where *lbp* indicates load balancing port

Note:

1. You can enter the **pcmpath set device N algorithm rrlfolbl/lbp** command to dynamically change to the path selection algorithm associated with SDDPCM MPIO devices that are in either Close or Open state.
2. Beginning with SDDPCM 2.4.0.0, the algorithm *lbp* incorporates I/O statistics from both host adapters and target ports in the path selection algorithm. This new algorithm is applicable only for device models 1750, 2105, 2107, and 2145.

Examples

If you enter **pcmpath set device 2 10 algorithm rr**, the path-selection algorithm of hdisk 2 to hdisk 10 is immediately changed to the round robin algorithm.

You can also use the **chdev** command to change the path selection algorithm of a device: **chdev -l hdiskX -a algorithm=load_balance_port**

pcmpath set device hc_interval

The **pcmpath set device hc_interval** command dynamically changes the health check time interval for SDDPCM MPIO devices or disables the health check function of a device.

Note: Starting with SDDPCM v2123, when you issue this command to change the SDDPCM internal health check function for one or more devices from *enable* to *disable* or from *disable* to *enable*, the SDDPCM server daemon (pcmsrv) automatically starts or stops the health check function on the devices.

Syntax

►►pcmpath set device— —num1— [—num2—] hc_interval—t—►►

Parameters

num1 [num2]

- When only *num1* is specified, the command applies to the hdisk specified by *num1*.
- When 2 device logical numbers are entered, this command applies to all the devices whose logical numbers fit within the range of the two device logical numbers.

t The range of supported values for health check interval is 1-3600 seconds. To disable the health check function of a device, set interval time to 0.

Examples

If you enter **pcmpath set device 2 10 hc_interval 30**, the health check time interval of hdisk2 to hdisk10 is immediately changed to 30 seconds.

pcmpath set device hc_mode

The **pcmpath set device hc_mode** command dynamically changes the MPIO device health check mode.

Syntax

►►pcmpath set device— —num1— [—num2—] hc_mode—option—►►

Parameters

num1 [num2]

- When only *num1* is specified, the command applies to the hdisk specified by *num1*.
- When 2 device logical numbers are entered, this command applies to all the devices whose logical numbers fit within the range of the two device logical numbers.

option

Specifies one of the following policies:

- **enabled**, indicates the health check command will be sent to paths that are opened with a normal path mode.
- **failed**, indicates the health check command will be sent to paths that are in failed state.
- **nonactive**, indicates the health check command will be sent to paths that have no active I/O. This includes paths that are opened or in failed state.

Examples

If you enter **pcmpath set device 2 10 hc_mode enabled**, the health check mode of MPIO hdisk2 to hdisk10 is immediately changed to the enabled mode.

pcmpath set device cntlhc_interval

The **pcmpath set device cntlhc_interval** command dynamically changes the Active/Passive MPIO device controller health check time interval or disables this feature.

Syntax

►►pcmpath set device — *num1* — — *num2* — cntlhc_interval — *t* —►►

Parameters

num1 [*num2*]

- When only *num1* is specified, the command applies to the hdisk specified by *num1*.
- When 2 device logical numbers are entered, this command applies to all active/passive devices whose logical numbers fit within the range of the two device logical numbers.

t The range of supported values for controller health check time interval is 0-300 seconds. Setting the value to 0 will disable this feature.

Examples

If you enter **pcmpath set device 2 10 cntlhc_interval 3**, the controller health check time interval of hdisk2 to hdisk10 is immediately changed to 3 seconds, if hdisk2 to hdisk10 are all active/passive devices.

pcmpath set device cntlhc_delay

The **pcmpath set device cntlhc_delay** command dynamically changes the active/passive MPIO device controller health check delay time or disables this feature.

Syntax

►►pcmpath set device — *num1* — — *num2* — cntlhc_delay — *t* —►►

Parameters

num1 [*num2*]

- When only *num1* is specified, the command applies to the hdisk specified by *num1*.
- When 2 device logical numbers are entered, this command applies to all active/passive devices whose logical numbers fit within the range of the two device logical numbers.

t The range of supported values for controller health check time interval is 0-300 seconds. Setting the value to 0 will disable this feature.

Examples

If you enter `pcmpath set device 2 10 cntlhc_delay 30`, the controller health check delay time of hdisk2 to hdisk10 is immediately changed to 30 seconds, if hdisk2 to hdisk10 are all active/passive devices.

Note:

1. If `cntl_delay_time` is set to '1', it disables the controller health check feature, which is the same as setting it to '0'.
2. If you try to set `cntl_hcheck_int` with a value larger than `cntl_delay_time`, then `cntl_hcheck_int` will be set to the same value as `cntl_delay_time`.
3. If you try to set `cntl_delay_time` with a value smaller than `cntl_hcheck_int`, the command will fail with the INVALID parameter.

pcmpath set device path

The **pcmpath set device path** command sets the path of a device either to *online* or *offline*. You cannot remove the last path to an opened device from service. This prevents a data access failure from occurring.

Attention: If the device is closed, the **pcmpath set adapter offline** command does not have the last path offline protection.

Attention: For Open HyperSwap devices, when the device is open, an attempt to set the last active path of the source volume offline by issuing the **pcmpath set device M path N offline** command will be rejected. When the device is closed, it's allowed to set the last path of the source volume offline. However, when the device is opened with all paths to the source volume offline, an unplanned HyperSwap will be triggered.

Syntax

```
►►—pcmpath set device—device number—path—path-ID——online—  
—offline—►►
```

Parameters

device number

The logical device number of the hdisk.

path ID

The path ID that you want to change, as displayed under “Path Name” by the **pcmpath query device** command.

online

Enables the path for service.

offline

Disables the path from service.

Examples

If you enter the **pcmpath set device 5 path 0 offline** command, path 0 for device 5 changes to Offline mode.

pcmpath set device recoverDEDpath

The **pcmpath set device recoverDEDpath** command dynamically changes the SDDPCM MPIO device recoverDEDpath option. Use this command to dynamically turn on or turn off health check recovery of Distributed Error Detection (DED) failed paths.

The default setting for the **recoverDEDpath** parameter is *no*, which means no path health check is implemented on DED failed paths.

To check and recover DED failed paths, set the **recoverDEDpath** parameter to *yes*.

Syntax

➡ pcmpath set device $\left[\begin{array}{c} \text{num1} \\ \text{num1} \quad \text{num2} \end{array} \right]$ recoverDEDpath $\left[\begin{array}{c} \text{no} \\ \text{yes} \end{array} \right]$ ➡

Parameters

num1

When only *num1* is specified, the command applies to the hdisk specified by *num1*.

num1 num2

Optional. When two device logical numbers are entered, the command applies to all devices with logical numbers within the range of the two device logical numbers.

recoverDEDpath no

Default. The health check does not recover paths that are failed by the Distributed Error Detection algorithm.

recoverDEDpath yes

The health check recovers paths that are failed by the Distributed Error Detection algorithm.

Examples

To immediately change the path recovery policy of hdisk2 to hdisk10 to allow the health check to recover paths failed by the Distributed Error Detection algorithm, issue the following command:

```
pcmpath set device 2 10 recoverDEDpath yes
```

pcmpath set device retry_timeout

pcmpath set device retry_timeout command allows user to set the timeout value for I/O retry on the last path before SDDPCM fails the I/O. The default value of this attribute is 120 seconds with the valid range of 30 to 600 seconds.

Setting the `retry_timeout` to a lower value helps in the situation where a device access is lost on all the paths permanently and the command fails with `TIMEOUT` error. This feature enables fast path failure and avoids I/O hanging problem.

Setting the `retry_timeout` to a larger value helps in the situation where a device access is lost temporarily. For example, during concurrent code download or storage warmstart, it is possible that all the paths to a device access may be lost for a short period of time temporarily and I/O should be retried on the last path for an extended period of time to prevent failing the I/O back to application.

Syntax

►—`pcmpath set device <num1> [num2] retry_timeout <t>`—►

Parameters

num1

When only `num1` is specified, the command applies to the `hdisk` specified by `num1`.

num2

When two device logical numbers are entered, this command applies to all the devices whose logical numbers fit within the range of the two device logical numbers.

t The range of supported values for the `retry_timeout` attribute of SVC is 30-600 seconds.

Examples

If you enter `pcmpath set device 2 10 retry_timeout 180`, the `retry_timeout` attribute of `hdisk2` to `hdisk10` is immediately changed to 180 seconds.

pcmpath set device svc_sb_ttl

The **`pcmpath set device svc_sb_ttl`** command dynamically changes the time for which an I/O must remain active after it gets issued.

The SVC storage can encounter a fault scenario called the split-brain condition. In this scenario, the two nodes of the I/O group of an SVC cluster fail to communicate with each other for some time. SVC can recover from this split-brain scenario in a stretched cluster environment in approximately 95 to 120 seconds. During this period, any I/O to the storage is either queued causing a timeout or gets a 'no-device response' error. After this period, one of the nodes performs a target reset and the other node takes over the ownership of the devices.

To provide more time for the storage to establish ownership of the devices, the **`svc_sb_ttl`** ("SVC time to live") tunable attribute is used. With this attribute set to an appropriate value, SDDPCM detects if all the good paths have been tried at least once and whether the I/O has encountered errors indicating a split-brain condition. In a split-brain scenario, the I/O does not fail immediately, but is retried on all paths again.

Attention: Set the **`svc_sb_ttl`** attribute **only** for a stretched cluster environment of SVC. In other cases, retain the default attribute value, which is 0.

Syntax

►►pcmpath set device — *num1* — — *num2* — svc_sb_ttl=*t* —►►

Parameters

num1 [*num2*]

- When only *num1* is specified, the command applies to the hdisk specified by *num1*.
- When 2 device logical numbers are entered, this command applies to all the devices whose logical numbers fit within the range of the two device logical numbers.

t The range of supported values for the **time to live** attribute of SVC is 0-240 seconds.

Examples

If you enter `pcmpath set device 2 10 svc_sb_ttl 180`, the **time to live** attribute of hdisk2 to hdisk10 is immediately changed to 180 seconds.

Note: The value of `svc_sb_ttl` must be more than `rw_timeout` so that SVC has additional time to recover from split-brain scenario.

pcmpath set device timeout_policy

The **pcmpath set device timeout_policy** command dynamically changes `timeout_policy` options for Active and Active/Asymmetric MPIO devices.

Three possible values exist for the **timeout_policy** parameter:

- `retry_path`

This represents the legacy behavior, where a command can be retried on the same path that just experienced a command timeout. This is likely to lead to delays in I/O recovery, as the command continues to fail on this path. Only after several consecutive failures, AIX fails the path and tries the I/O on an alternate path.

- `fail_path`

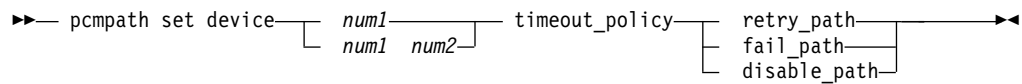
This setting causes AIX to fail the path after a single command timeout, assuming the device has at least one other path that is not in the failed state. Failing the path forces the I/O to be retried on a different path. This can lead to quick recovery from a command time out and much quicker detection of all path failures to a device.

A path that is failed due to timeout policy can later be recovered by the AIX health check commands. However, AIX avoids I/O to the path for a period of time after recovery to ensure that the path is not experiencing repeated failures. (Other PCMs might not implement this grace period.)

- `disable_path`

This setting disables the path. A disabled path must be recovered manually using the **chpath** command to re-enable the path.

Syntax



Parameters

num1

When only num1 is specified, then the command applies to the hdisk specified by num1.

num2

Optional. When two device logical numbers are entered, this command applies to all devices whose logical numbers fit within the range of the two device logical numbers.

timeout_policy retry_path

The device path that failed due to a TIMEOUT is recoverable with a single successful health check command.

This represents the legacy behavior, where a command can be retried on the same path that just experienced a command timeout. This is likely to lead to delays in I/O recovery, as the command continues to fail on this path. Only after several consecutive failures, AIX fails the path and tries the I/O on an alternate path.

timeout_policy fail_path

The device path that failed due to a TIMEOUT is recoverable by two consecutive successful health check commands.

This setting causes AIX to fail the path after a single command timeout, assuming the device has at least one other path that is not in the failed state. Failing the path forces the I/O to be retried on a different path. This can lead to quick recovery from a command time out and much quicker detection of all path failures to a device.

A path that is failed due to timeout policy can later be recovered by AIX health check commands. However, AIX avoids I/O to the path for a period of time after recovery to ensure that the path is not experiencing repeated failures. (Other PCMs might not implement this grace period.)

timeout_policy disable_path

The device path that failed after a certain number of TIMEOUTs during a period of time is set to disabled and stays in DISABLE mode until manually recovered.

This setting disables the path. A disabled path must be recovered manually using the **chpath** command to re-enable the path.

Example

To immediately change the timeout_policy of MPIO hdisk2 to hdisk10 to the retry_path timeout_policy, issue the following command:

```
pcmpath set device 2 10 timeout_policy retry_path
```

Note: The fail_path and the disable_path values of the **timeout_policy** parameter do not apply to devices with the failover_only path selection algorithm.

pcmpath chgprefercntl device

The **pcmpath chgprefercntl device** command identifies the preferred controller path to support NDVM.

Starting with SDDPCM 2.6.4.0, the **pcmpath chgprefercntl device** command is added to the pcmpath utility. NDVM is an SVC feature that can be used to associate vdisks with two or more io groups, add or remove access to io groups, and move vdisk access from one io group to another without disruption. For more information about the SAN Volume Controller, see *IBM System Storage SAN Volume Controller Software Installation and Configuration Guide*.

SDDPCM discovers the preferred controller as exported by the target by using in-band commands. For an optimized path control function, SDDPCM must rediscover the change in preferred controller when a vdisk access is moved from one io group to another.

Syntax

►—pcmpath chgprefercntl device—*device number*—►

Parameters

device number

The logical device number of the hdisk.

Examples

On SVC: hdisk5 has 8 paths. Paths 0-3 are from iogroup 0 and paths 4-7 are from iogroup 1. Currently iogroup 0 has access to the vdisk corresponding to hdisk5. Paths 0 and 2 are the preferred paths.

```
# pcmpath query device 5
DEV#: 5 DEVICE NAME: hdisk5 TYPE: 2145 ALGORITHM: Load Balance
SERIAL: 60050768018182DDC0000000000001BE
=====
Path#    Adapter/Hard Disk    State    Mode    Select    Errors
0        fscsi0/path0         OPEN     NORMAL  51        0
1*       fscsi0/path1         OPEN     NORMAL  35        0
2        fscsi0/path2         OPEN     NORMAL  35        0
3*       fscsi0/path3         OPEN     NORMAL  35        0
4*       fscsi0/path4         OPEN     NORMAL  5         0
5*       fscsi0/path5         OPEN     NORMAL  5         0
6*       fscsi0/path6         OPEN     NORMAL  5         0
7*       fscsi0/path7         OPEN     NORMAL  5         0
```

To move access of hdisk5 to iogroup 1, run `svctask movevdisk -iogrp 1 <vdisk_id>`.

Now, if you enter the `pcmpath chgprefercntl device 5` command, then SDDPCM rediscovers the preferred controllers. After a few seconds, enter `pcmpath query device 5` and see the change in output.

```
# pcmpath query device 5
DEV#: 5 DEVICE NAME: hdisk5 TYPE: 2145 ALGORITHM: Load Balance
SERIAL: 60050768018182DDC0000000000001BE
=====
Path#    Adapter/Hard Disk    State    Mode    Select    Errors
0*       fscsi0/path0         OPEN     NORMAL  53        0
1*       fscsi0/path1         OPEN     NORMAL  35        0
2*       fscsi0/path2         OPEN     NORMAL  38        0
```

3*	fscsi0/path3	OPEN	NORMAL	35	0
4	fscsi0/path4	OPEN	NORMAL	7	0
5*	fscsi0/path5	OPEN	NORMAL	7	0
6	fscsi0/path6	OPEN	NORMAL	7	0
7*	fscsi0/path7	OPEN	NORMAL	7	0

Paths 4 and 6 are now the preferred paths.

pcmpath configuration save

pcmpath configuration save command saves values of SDDPCM's disk attributes like **algorithm**, **hcheck_interval**, **hcheck_mode**, **retry_timeout**, **recoverDEDpath**, **timeout_policy**, **svc_sb_ttl** into the `/etc/pcmpath.conf` file.

Syntax

►►—pcmpath configuration save—►►

If you enter **pcmpath configuration save** for `hdisk1` with the following attributes:

```
bash-3.2# lsattr -El hdisk1
      PCM                      PCM/friend/sddpcm          PCM                      True
PR_key_value  none                      Reserve Key                      True+
algorithm     load_balance          Algorithm                        True+
clr_q         no                      Device CLEARS its Queue on error True
dist_err_pcnt 0                      Distributed Error Percentage     True
dist_tw_width 50                     Distributed Error Sample Time    True
flashcpy_tgtvol no                   Flashcopy Target Lun            False
hcheck_interval 60                 Health Check Interval           True+
hcheck_mode    nonactive              Health Check Mode               True+
location      location                 Location Label                  True+
lun_id        0x0                      Logical Unit Number ID          False
lun_reset_spt yes                     Support SCSI LUN reset          True
max_coalesce  0x40000                 Maximum COALESCE size           True
max_transfer  0x40000                 Maximum TRANSFER Size           True
node_name     0x500507680100a8d3      FC Node Name                    False
pvid          00f69962f9514bf80000000000000000
q_err         yes                      Physical volume identifier      False
q_type        simple                    Use QERR bit                    True
qfull_dly     2                      Queuing TYPE                    True
queue_depth   20                     delay in seconds for SCSI TASK SET FULL True
recoverDEDpath no                   Queue DEPTH                     True+
reserve_policy no_reserve              Recover DED Failed Path         True
retry_timeout  120                    Reserve Policy                  True+
rw_timeout    60                      Retry Timeout                   True
scbsy_dly     20                     READ/WRITE time out value       True
scsi_id       0x20001                 delay in seconds for SCSI BUSY  True
start_timeout 180                    SCSI ID                         False
svc_sb_ttl    0                      START unit time out value       True
timeout_policy fail_path              IO Time to Live                 True
unique_id     332136005076801A805469800000000001404214503IBMfcp
Device Unique Identification False
ww_name       0x500507680122a8d3      FC World Wide Name              False
```

Screen output similar to the following output is displayed.

DEV# 1 attributes are saved to `/etc/pcmpath.conf` file

with

```
lunid:6005076801A805469800000000000014,algorithm:load_balance,hcheck_interval:60,
check_mode:nonactive,retry_timeout:120,recoverDEDpath:no,timeout_policy:fail_path,svc_sb_ttl:0
```

written to the `/etc/pcmpath.conf` file. LUN id(lunid) is the unique serial number for each LUN.

pcmpath configuration load

pcmpath configuration load command reads values of SDDPCM's disk attributes like **algorithm**, **hcheck_interval**, **hcheck_mode**, **retry_timeout**, **recoverDEDpath**, **timeout_policy**, **svc_sb_ttl** from the `/etc/pcmpath.conf` file and sets these values to the disk for the matching LUN id.

Syntax

►—pcmpath configuration load—◄◄

If you enter **pcmpath configuration load** for a `/etc/pcmpath.conf` file containing the following values -

```
lunid:6005076801A805469800000000000014,algorithm:load_balance,hcheck_interval:60,  
hcheck_mode:nonactive,retry_timeout:120,recoverDEDpath:no,timeout_policy:fail_path,svc_sb_ttl:0
```

Attributes of `hdisk1` with LUN Id `6005076801A805469800000000000014` are changed to the attributes in the `/etc/pcmpath.conf` file.

Summary of command syntax

SDDPCM supports the following **pcmpath** commands:

- **pcmpath query adapter** [`<n>` `aa` | `ap`]
- **pcmpath query device** `<n>` / [`<m>` `<n>`] [`-d` `<device_model>`] [`-i` `<x>` / (`<x>` `<y>`)]
- **pcmpath query port** [`|n`]
- **pcmpath query adaptstats** [`<n>` `aa` | `ap`]
- **pcmpath query devstats** `<n>` / [`<m>` `<n>`] [`-d` `<device_model>`] [`-i` `<x>` / (`<x>` `<y>`)]
- **pcmpath query portstats** [`|n`]
- **pcmpath query portmap** [`| -S`]
- **pcmpath query essmap** [`| -S`]
- **pcmpath query wwpn**
- **pcmpath query version**
- **pcmpath set adapter** `<n>` `online` | `offline` `aa` | `ap`
- **pcmpath set device** `<n>` `path` `<m>` `online` / `offline`
- **pcmpath set device** `<n>` / (`<n>` `<n>`) `algorithm` `<rr/fo/lb/lbp>`
- **pcmpath set device** `<n>` / (`<n>` `<n>`) `hc_interval` `<t>`
- **pcmpath set device** `<n>` / (`<n>` `<n>`) `hc_mode` `<nonactive/enabled/failed>`
- **pcmpath set device** `<n>` / (`<n>` `<n>`) `cntlhc_interval` `<t>`
- **pcmpath set device** `<n>` / (`<n>` `<n>`) `cntlhc_delay` `<t>`
- **pcmpath set device** `<n>` / (`<n>` `<n>`) `retry_timeout` `<t>`
- **pcmpath set device** `<n>` / (`<n>` `<n>`) `recoverDEDpath` `yes/no`
- **pcmpath set device** `<n>` / (`<n>` `<n>`) `timeout_policy` `retry_path/fail_path/disable_path`
- **pcmpath set device** `<n1>` [`n2`] `svc_sb_ttl` `<t>`
- **pcmpath open device** `<n>` `path` `<m>`
- **pcmpath clear device** `<n>` / (`<n>` `<n>`) `count error/all`
- **pcmpath chgprefercntl device** `<n>` / (`<n>` `<n>`)
- **pcmpath disable/enable ports** `<connection>` `ess` `<essid>`

Note: single port =R1-Bx-Hy-Zz, all ports on card =R1-Bx-Hy, all ports on bay =R1-Bx. See the portmap output for the connection string and ESS serial number. Examples of valid device model: 2145 - Displays all 2145 models. 2107 - Displays all 2107 devices (DS 8000)

- **pcmpath configuration save**
- **pcmpath configuration load**

Note: If the commands are used for a device, the *n* is the number of the device logical name. For example, **pcmpath query devstats 3** queries the device statistics for hdisk3.

If the commands are used for adapter, the *n* is the index of the adapter. For example, **pcmpath query adapter 2** queries the adapter statistics for the third adapter in adapter list order, which can be fscsi5.

SDDPCM release 2.6.7.0 features

SDDPCM release 2.6.7.0 offers the following features:

Support for live kernel update

SDDPCM offers the following components to enable live kernel update:

- kernel extension: sddpcmke for Active/Active and Active/Asymmetric devices.
- user space service: pcmsrv

The downtime when AIX Logical Partition takes effect, is eliminated. The Live Kernel Update operation is divided into three phases:

1. Pre-update: Preparation of surrogate.
2. Mobility: Checkpoint on the original and restart on surrogate.
3. Post-update: Cleanup of the original and complete install on surrogate.

Note: SDDPCM does not support:

1. Live kernel updates for Active/Passive storage devices.
2. SAN boot support with live kernel update.

Support for disk name change

SDDPCM allows you to change the name of a disk, using the **rendev** command. The command is **rendev -l hdisk1 -n hdisk1_new**

SDDPCM release 2.6.8.0 features

SDDPCM release 2.6.8.0 does not offer new features.

SDDPCM release 2.6.9.0 features

SDDPCM release 2.6.9.0 offers the following features:

Dynamically change SDDPCM ODM Attributes

SDDPCM allows you to change disk characteristics using **chdev** command with **-U** flag while disk is in available state. The command is **chdev -l hdiskX -a attributeName=attributeValue -U**.

See AIX documentation for supported attributes with the above command.

Allow Modifying Log Event Time Interval

The time interval after which `pcm.log` gets updated can be changed to any value between 60 - 7200 seconds. The default value is 900 seconds. Modify `log_trace_interval` in `pcmsrv.conf` file for the change to take effect. See `pcmsrv.conf` file format section for more details.

LKU SAN BOOT Support

SDDPCM supports live kernel update with SAN BOOT Devices from AIX 7.2 TL1 level.

AIX and SDDPCM version compatibility check

If AIX is upgraded without a compatible SDDPCM upgrade, the following warning message appears about incompatibility between AIX and SDDPCM versions after a `pcmpath` command is run.

```
WARNING!!!! OS and SDDPCM version are not compatible. Install compatible
version of SDDPCM. Do you wish to continue with pcmpath (y/n):
```

SDDPCM release 2.7.0.0 features

SDDPCM release 2.7.0.0 offers the following features:

SCSI behavior change for Spectrum Virtualize

Spectrum Virtualize is enhanced to issue an asymmetric access state changed unit attention 30 seconds before a graceful shutdown of a node on any volumes that are accessed through the node that is shutting down.

SDDPCM issues the RTPG command on this unit attention. The node that is about to shutdown has its target port group reported as Active/Non-Optimized state and another node (usually the partner node) has its target port group reported as Active/Optimized state. This reduces the in-flight I/Os to the node when it shuts down, thus avoiding expensive error recovery at the storage.

pcmpath configuration save and pcmpath configuration load commands

The `pcmpath configuration save` command and the `pcmpath configuration load` command are new for the `pcmpath` utility.

The `pcmpath configuration save` command saves values of SDDPCM's disk attributes like `algorithm`, `hcheck_interval`, `hcheck_mode`, `retry_timeout`, `recoverDEDP`, `path timeout_policy`, `svc_sb_ttl` into the `/etc/pcmpath.conf` file.

The `pcmpath configuration load` command reads values of SDDPCM's the disk attributes from the `/etc/pcmpath.conf` file and sets the values to the disk for the matching LUN ID.

SDDPCM release 2.7.1.1 features

SDDPCM release 2.7.1.1 offers the following features:

Fix performance issue when hit SCSI_NO_DEVICE_RESPONSE

In some instances the SDDPCM driver does not fail the path immediately when it hits a "no device response" issue. Not failing immediately can cause performance issues and IO failure. This problem has been fixed.

Fix logging issue for RTPG commands

A logging issue that writes an erroneous and old default controller ID to the `pcm.log` file is fixed.

Chapter 3. Using the SDD on an HP-UX host system

This chapter provides step-by-step procedures for you to install, configure, remove, and use SDD on a Hewlett-Packard (HP-UX) host system that is attached to supported storage devices.

For updated and additional information that is not included in this manual, see the Readme file on the CD-ROM or go to SDD website:

www.ibm.com/servers/storage/support/software/sdd

Verifying the hardware and software requirements

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

Hardware

The following hardware components are needed:

- One or more of the supported storage devices.
- For ESS devices: 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-channel adapter that connects through a switch to multiple ESS ports is considered to have multiple fibre-channel SDD vpath devices.

For information on the fibre-channel adapters that can be used on your HP-UX host system go to:

www.ibm.com/servers/storage/support

- A SCSI cable to connect each SCSI host adapter to a storage system controller port
- Subsystem LUNs that have been created and confirmed for multipoint access
- A fiber-optic cable to connect each fibre-channel adapter to a supported storage device port

Software

SDD supports certain HP-UX kernel levels.

SDD-supported HP-UX kernel levels

SDD supports the following HP-UX kernel levels:

- HP-UX 11.11 (11i) 32-bit and 64-bit
- HP-UX 11.23 (11i v2) PA_RISC 64-bit and IA 64-bit

Ensure that the patches listed in Table 5 on page 98 or newer patches are installed on your HP-UX host system.

Unsupported environments

SDD does not support the following environments:

- HP-UX 11.0 32-bit kernel
- HP-UX 11.0 64-bit kernel
- A system start from an SDD pseudo device
- A system paging file on an SDD pseudo device
- A host system with both a SCSI and fibre-channel connection to a shared LUN
- Single-path mode during concurrent download of licensed machine code nor during any disk storage system concurrent maintenance that impacts the path attachment, such as a disk storage system-host-bay-adapter replacement
- Single-path configuration for fibre channel
- DS8000 and DS6000 with SCSI connectivity

Understanding how SDD works on an HP-UX host system

SDD resides above the HP SCSI disk driver (sdisk) in the protocol stack. For more information about how SDD works, see “The SDD architecture” on page 2.

Preparing for the SDD installation

Before you install the SDD, you must configure the supported storage devices to your host system and attach the required SCSI or fibre-channel adapters. A maximum of 1200 LUNs can be configured by the SDD. The HP-UX SDD supports up to 32 paths per LUN. Be aware that there is no performance gain with a large number of LUNs that are smaller in size. The larger the configuration, the more system resources are required.

Note: 1200 LUNs are supported only by HP-UX 11.23 (PA-RISC 64 and IA64). 600 LUNs are supported by HP-UX 11.11.

Configuring the disk storage system

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 path-failover-protection features. **With a single path, failover protection is not provided.**

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

Configuring the virtualization products

Before you install SDD, configure your SAN Volume Controller devices 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 path-failover-protection features. **With a single path, failover protection is not provided.**

For information about configuring your SAN Volume Controller, see the *IBM System Storage SAN Volume Controller Software Installation and Configuration Guide*.

Configuring DS4000 and DS5000 family disk systems

Before you install the SDD, follow the instructions in the *IBM System Storage DS4x00 Installation, User's and Maintenance Guide* and the *IBM System Storage*

DS4000 Storage Manager Concepts Guide for configuring LUNs that are attached to the HP-UX host system. The SDD requires a minimum of two independent paths that share the same logical unit to use load balance and path failover features. With a single path, failover protection is not provided.

The DS4000 and DS5000 controllers can be set to two different modes: AVT or non-AVT but can operate only in one mode per storage partition. The controller mode is determined by the host type, which is predefined in the DS4000 or DS5000 Storage Manager profile. Only the AVT mode is supported for the HP-UX host type.

To ensure that a single path failure does not result in controller failover during recovery, configure redundant paths to each controller. Because switching to another controller affects performance, configuring the redundant path to a controller can avoid unnecessary controller failover that is caused by a path failure.

Bypassing the boot disk check

The SDD installation process checks the boot disk and then excludes the bootable disk from the SDD configuration. This process attempts to read the boot record from every device instance of the system, so the process can be lengthy if your configuration is large or if the devices are unable to satisfy the I/O request.

If the system boot disk is not an SDD-supported disk, you can bypass the process that checks the boot disk. To do this, enter the following before the SDD installation:

```
touch /opt/IBMsdd/BYPASS_BOOTDISK_CHECK
```

You might want to bypass boot disk checking for systems with DS4000 or DS5000 devices, because reading the boot record from every device instance of DS4000 or DS5000 can be very time consuming.

Planning for installation

Before you install SDD on your HP-UX host system, you need to understand what kind of software runs on your host. The way you install SDD depends on the kind of software that you are running. Two types of special device files 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 that you have installed:

Table 4 further describes the various installation scenarios and how you should proceed. Table 5 on page 98 lists the patches necessary for proper operation of SDD on HP-UX .

Table 4. SDD installation scenarios

Installation scenario	Description	How to proceed
-----------------------	-------------	----------------

Table 4. SDD installation scenarios (continued)

Scenario 1	<ul style="list-style-type: none"> SDD is not installed. The SDD server for Expert is installed. No software application or DBMS communicates directly to sdisk interface. 	Go to: <ol style="list-style-type: none"> “Determining if the SDD 1.3.1.5 (or later) server for Expert is installed” “Installing SDD” on page 99 “Standard UNIX applications” on page 117
Scenario 2	<ul style="list-style-type: none"> SDD is not installed. The SDD server for Expert is installed. An existing application package or DBMS communicates directly to the sdisk interface. 	Go to: <ol style="list-style-type: none"> “Determining if the SDD 1.3.1.5 (or later) server for Expert is installed” “Installing SDD” on page 99 “Using applications with SDD” on page 117
Scenario 3	<ul style="list-style-type: none"> SDD is installed. The SDD server for Expert is installed. 	Go to <ol style="list-style-type: none"> “Determining if the SDD 1.3.1.5 (or later) server for Expert is installed” “Upgrading the SDD” on page 101

Table 5. Patches necessary for proper operation of SDD on HP-UX

HP-UX	Patch bundles
11.23	March 06, standard patch bundles
11.11	September 05, support plus

See www11.itrc.hp.com/service/home/home.do?admit=109447626+1266865784425+28353475 for patch details and prerequisites for patches.

Determining if the SDD 1.3.1.5 (or later) server for Expert is installed

Note: IBM does not support ESS. For more information, contact the IBM Support team.

If you previously installed the SDD server (the stand-alone version) for IBM TotalStorage Expert V2R1 (ESS Expert) on your HP-UX host system, you must remove this stand-alone version of the SDD server before you proceed with SDD 1.3.1.5 installation. The installation package for SDD 1.3.1.5 includes the SDD server daemon (also referred to as `sddsrv`), which incorporates the functionality of the stand-alone version of the SDD server (for ESS Expert).

To determine if the stand-alone version of the SDD server is installed on your host system, enter:

```
swlist SDDsrv
```

If you previously installed the stand-alone version of the SDD server, the output from the **swlist SDDsrv** command looks similar to this:

Note:

1. The installation package for the stand-alone version of the SDD server (for ESS Expert) is SDDsrvHP**bb_yymmdd**.depot (where *bb* represents 32- or 64-bit, and *yymmdd* represents date of installation package). For ESS Expert V2R1, the stand-alone SDD server installation package is SDDsrvHP32_020115.depot for a 32-bit environment, and SDDsrvHP64_020115.depot for a 64-bit environment.)
2. For instructions on how to remove the stand-alone version of the SDD server (for ESS Expert) from your HP-UX host system, see the IBM SUBSYSTEM DEVICE DRIVER SERVER 1.0.0.0 (sddsrv) readme for IBM TotalStorage Expert V2R1 at the following website:
www.ibm.com/servers/storage/support

For more information about the SDD server daemon, go to “SDD server daemon” on page 112.

Installing SDD

Before you install SDD, make sure that you have root access to your HP-UX host system and that all the required hardware and software is ready.

Installing SDD from CD-ROM

About this task

Complete the following steps to install SDD on your HP-UX host system:

Procedure

1. Make sure that the SDD compact disc (CD) is available.
2. Insert the CD-ROM into your CD-ROM drive.
 If CD-ROM directory is not known:
 - a. Run `ioscan -funC disk`.
 - b. Record the CD-ROM or DVD-ROM directory.
3. 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.

4. Run the **sam** program.


```
> sam
```
5. Select **Software Management**.
6. 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 IBMssdd.depot file.

For 32-bit mode applications, use:

`/cdrom/hp32bit/IBMsdd.depot`

or

`/your_installation_directory/hp32bit/IBMsdd.depot`

For 64-bit mode applications, use:

`/cdrom/hp64bit/IBMsdd.depot`

or

`/your_installation_directory/hp64bit/IBMsdd.depot`

c. Click **OK**.

You will see output similar to the following example:

IBMsdd_tag 1.7.0.3 IBMsdd Driver 64-bit Version: 1.7.0.3 Sep-24-2007 16:35

8. Click the **IBMsdd_tag** product.
9. From the Bar menu, click **Actions** → **Mark for Install**.
10. From the Bar menu, click **Actions** → **Install (analysis)**. An Install Analysis panel is displayed, showing the status of **Ready**.
11. Click **OK** to proceed. A Confirmation window opens and states that the installation will begin.
12. Click **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. Click **Yes** and press **Enter**. The installation of IBMsdd will now proceed.
14. An Install window opens, informing you about the progress of the IBMsdd software installation. The window looks similar to the following:

```
Press 'Product Summary' and/or 'Logfile' for more target information.
Target          : XXXXX
Status          : Executing install setup
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 is complete.

15. Click **Done**.

Results

Note: SDD 1.5.0.4 is changed from a static driver to a dynamic loadable kernel module (DLKM) driver. The system does not restart after SDD is installed.

After the installation is finished, the SDD driver is automatically loaded.

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

Installing SDD from downloaded code

About this task

The SDD download website, www-01.ibm.com/support/docview.wss?uid=ssg1S4000053, has several SDD packages for different versions of HP-UX. The SDD packages are in tar archives. After you have downloaded the appropriate SDD package into your chosen directory, you can untar the file using the **tar xvf IBMsdd*.tar** command. The complete the following steps to install SDD:

1. Run the sam program.

```
> sam
```
2. Select **Software Management**.
3. Select **Install Software to Local Host**.
4. At this point, the SD Install - Software Selection panel is displayed. Then a Specify Source menu is displayed:
 - a. Select the Local Directory for **Source Depot Type**.
 - b. Select the directory in which you have issued the **tar xvf IBMsdd*.tar** command to untar the file and the IBMsdd.depot file for the **Source Depot Path**. Use the fully-qualified path name for the depot file as shown below.
`/your_installation_directory/IBMsdd.depot`
 - c. Click **OK**. Output similar to the following example is displayed:

Name	Revision	Information	Size(Kb)	Architecture	Category
IBMsdd_tag	-> B.11.23.01	IBMsdd Driver 64-bit <version> <date>	nnnn	HPUX_B.11.23_ia64	
5. Click the **IBMsdd_tag** product and complete the steps beginning with step 9 on page 100 shown in "Installing SDD from CD-ROM" on page 99.

Upgrading the SDD

Use these sections to upgrade SDD:

Upgrading from SDD 1.6.0.x to SDD 1.6.1.0 or later with concurrent access

The memory management and the installation process have been enhanced to allow installation of the SDD package while the LVM volume groups are active and user applications are running. The concurrent driver upgrade function permits uninterrupted operation when installing SDD.

The installation process:

1. Converts SDD vpath devices to PVLINK devices
2. Unloads and reloads the SDD driver
3. Converts the PVLINK devices back to SDD vpath devices after the new package is installed.

Because the volume groups must be active for the PVLINK conversion process, the following are the limitations:

1. The volume groups must be managed by HP-UX LVM.
2. The MC Service Guard cluster must be halted prior to upgrade. The primary node and the adoptive node or nodes must operate in a single-host environment. The shared volume groups in the adoptive nodes must be exported so that the volumes are not shared; the volume groups can be active in the primary node only. Restore the cluster environment after upgrading SDD.

Performance during upgrade: You should consider the following performance topics while you are upgrading:

- The PVLINK conversion process and the driver reload require additional system resources such as LVM lock, accessing LVM meta data and the kernel memory. With the concurrent I/O, the upgrade process can take longer because the conversion process must wait for the I/O to complete before a link can be removed from PVLINK.
- Reloading the SDD driver can also take longer because of the contention with the kernel memory; the system must wait for a window when the resources become available. The actual time for installation depends on the processor model, physical memory size, I/O intensity, and configuration size. The larger the SDD configuration or the more concurrent I/O activities, the longer it can take to upgrade. The installation time can also take longer if the devices from the ioscan output are not accessible. If there were a lot of inaccessible devices as the result of fabric reconfiguration, you should attempt to clean up the configuration before upgrading.
- After the upgrade, you should check the VPATH_EVENT for allocation failures in syslog.log, /var/adm/IBMsdd/hd2vp.errlog and vp2hd.errlog. These are the indications that the upper limit of the resources have been reached during the conversion process and that you should take a more conservative approach next time. That is, the concurrent upgrade should be performed during a period when the system load is lighter than the normal operation.
- The installation process also ensures that the current SDD state is not in any degraded state; the recovery process can be lengthy if the upgrade failed due to the hardware errors. Issue the **swjob** command that is indicated at the end of swinstall output to get detailed information about the installation.
- The diagnose message in the package installation and configuration process has been greatly improved to include logs for **cfgvpath**, **vp2hd**, **hd2vp** and the syslog messages. All the SDD related logs have been moved to the /var/adm/IBMsdd directory.

Upgrading from SDD 1.5.0.4 to SDD 1.6.1.0 or later with nonconcurrent access.

Upgrading SDD consists of removing and reinstalling the IBMsdd package. If you are upgrading SDD, go to “Uninstalling SDD” on page 111 and then go to “Installing SDD” on page 99.

Upgrading SDD 1.3.0.2 or earlier to SDD 1.5.0.4 or later About this task

SDD 1.3.0.2 (or earlier) could have created a vpath0 device. vpath0 should not be configured. To upgrade your SDD, you need to ensure that you have no vpath0 devices using the following steps:

1. Remove its /etc/vpathsave.cfg (vpath name reservation file) file.
2. Issue **cfgvpath -c** to reconfigure SDD.

To upgrade from SDD 1.3.0.2 (or earlier) to SDD 1.5.0.4 (or later):

1. Uninstall SDD 1.3.0.2 (or earlier). Because SDD 1.3.0.2 (or earlier) does not have the volume group conversion scripts **hd2vp** and **vp2hd**, the uninstallation will not convert the existing volume groups back to cXtXdX devices.
2. Install SDD 1.5.0.4 (or later) on your host.
3. After installation, check to see that you have:

- a. The volume group conversion scripts **hd2vp** and **vp2hd** in `/opt/IBMdpo/bin`
 - b. The `/etc/vpathsave.cfg` file
 4. Use the **vp2hd** script to convert volume groups from volume groups containing SDD vpath devices to volume groups containing cXtXdX devices.
 5. When the volume groups have been converted:
 - a. Remove the `/etc/vpathsave.cfg` file.
 - b. Issue **cfgvpath -c** to reboot.
 6. When the host responds, use the **showvpath** command to determine that vpath0 has been removed. If vpath0 no longer exists and the state of all the SDD vpath devices looks good in the **datapath query device** output, use the **hd2vp** script to change volume groups to volume groups containing SDD vpath devices.
- Note:** Vpathname vpathN is reserved when it is assigned to a LUN even after the LUN has been removed from the host. The same vpathname, vpathN, will be assigned to the same LUN when it is reconnected to the host.
7. `/etc/vpathsave.cfg` is the file to reserve vpathnames. Improper removal of the file will invalidate existing volume groups. Do not remove the `/etc/vpathsave.cfg` file.

Installing an additional package for DS4000 and DS5000 support

The HP SDD support for DS4000 and DS5000 is enabled through the On-Demand-Device function, which recognizes the new devices as a plug-in to the driver. You can install the On-Demand package before or after you install the traditional SDD package.

Note: DS5000 support is limited to HP-UX 11.23 systems, including both IA64 and PA-RISC architectures.

If the On-Demand package is installed later, run **cfgvpath -r** to recognize and reconfigure the DS4000 or DS5000 device. If the On-Demand package was installed earlier, the installation process automatically recognizes and configures the DS4000 and DS5000 devices.

To install the DS On-Demand-Device package, issue the following command:

For DS4000: **swinstall IBMsdd_ds4k_platform.depot IBMsdd_ds4k_tag**

For DS5000: **swinstall IBMsdd_ds5k_platform.depot IBMsdd_ds5k_tag**

Configuring the SDD

This section provides information necessary to configure the SDD. Use the HP command line interface (CLI) to manage SDD devices.

Maximum number of LUNs

A maximum of 1200 LUNs can be configured by SDD. HP-UX SDD supports up to 32 paths per LUN.

Changing an SDD hardware configuration

About this task

When you are adding or removing multiport SCSI devices, you must reconfigure SDD to recognize the new devices. Complete the following steps to reconfigure SDD:

1. Issue the **cfgvpath** command to reconfigure the SDD vpath device by entering:

```
/opt/IBMsdd/bin/cfgvpath
```

2. Restart the system by entering:

```
shutdown -r 0
```

Note: Restarting the system is no longer required for SDD 1.5.0.4 or later.

The **querysn** command can be used to list all disk storage system devices visible to the host. The **querysn** command reads the unique serial number of a disk storage system device (sdisk). To manually exclude devices from the SDD configuration, their serial number information can be included in the `/etc/vpathmanualexcl.cfg` text file. For bootable devices, the **get_root_disks** command generates a file called `/etc/vpathexcl.cfg` to exclude bootable disks from the SDD configuration.

Converting a volume group

SDD provides the following conversion scripts:

hd2vp The **hd2vp** script converts a volume group from supported storage device sdisk into SDD vpath devices.

The syntax for **hd2vp** script is as follows:

```
hd2vp vname
```

vp2hd The **vp2hd** script converts a volume group from SDD vpath devices into supported storage device sdisk. Use the **vp2hd** program when you want to configure your applications back to original supported storage device sdisk.

The syntax for **vp2hd** script is as follows:

```
vp2hd vname
```

hd2vp and **vp2hd** convert a volume group from an sdisk pblink to and from SDD vpaths devices. The **hd2vp** conversion program is invoked at the system boot time to ensure the conversion of sdisk to SDD vpath devices. Beginning with SDD 1.6.0.12, **vp2hd** is not invoked at the system shutdown.

Dynamic reconfiguration

About this task

Dynamic reconfiguration provides a way to automatically detect path configuration changes without requiring a reboot.

1. **cfgvpath -r:**

This operation finds the current hardware configuration and compares it to the SDD vpath device configuration in memory and then identifies a list of differences. It then issues commands to update the SDD vpath device

configuration in memory with the current hardware configuration. The commands that **cfgvpath -r** issues to the vpath driver are:

- a. Add an SDD vpath device.
 - b. Remove an SDD vpath device; this will fail if device is busy.
 - c. Add path to the SDD vpath device.
 - d. Remove path from the SDD vpath device; this will fail deletion of the path if the device is busy, but will set path to DEAD and OFFLINE.
2. **rmvpath** command removes one or more SDD vpath devices.
- ```
rmvpath -all # Remove all SDD vpath devices

rmvpath vpath_name # Remove one SDD vpath device at a time
 # this will fail if device is busy
```

## Dynamically changing the SDD path-selection policy algorithm

SDD 1.4.0.0 (or later) supports path-selection policies that increase the performance of multipath-configured supported storage devices and make path failures transparent to applications. The following path-selection policies are supported:

### 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.

### 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. Load balancing mode also incorporates failover protection.

**Note:** The load balancing policy is also known as the optimized policy.

### round robin (rr)

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

The path-selection policy is set at the SDD device level. The default path-selection policy for an SDD device is load balancing. You can change the policy for an SDD device. SDD version 1.4.0.0 (or later) supports dynamic changing of the SDD devices path-selection policy.

Before changing the path-selection policy, determine the active policy for the device. Enter **datapath query device N** where *N* is the device number of the SDD vpath device to show the current active policy for that device.

### datapath set device policy command

Use the **datapath set device policy** command to change the SDD path-selection policy dynamically:

See “datapath set device policy” on page 184 for more information about the **datapath set device policy** command.

## Preferred node path-selection algorithm for the virtualization products

The virtualization products are two-controller disk subsystems. SDD distinguishes the paths to a virtualization product LUN as follows:

1. Paths on the preferred controller
2. Paths on the alternate controller

When SDD selects paths for I/O, preference is always given to a path on the preferred controller. Therefore, in the selection algorithm, an initial attempt is made to select a path on the preferred controller. Only if no path can be used on the preferred controller will a path be selected on the alternate controller. This means that SDD will automatically fail back to the preferred controller any time a path on the preferred controller becomes available during either manual or automatic recovery. Paths on the alternate controller are selected at random. If an error occurs and a path retry is required, retry paths are first selected on the preferred controller. If all retries fail on the preferred controller's paths, paths on the alternate controller will be selected for retry. The following is the path selection algorithm for SDD:

1. With all paths available, I/O is only routed to paths on the preferred controller.
2. If no path on the preferred controller is available, I/O fails over to the alternate controller.
3. When failover to the alternate controller has occurred, if a path on the preferred controller is made available, I/O automatically fails back to the preferred controller.

## SDD datapath query adapter command changes for SDD 1.4.0.0 (or later)

For SDD 1.4.0.0 (or later), the output of some of the datapath commands has changed. See Chapter 6, "Using the datapath commands," on page 163 for details about the datapath commands.

For SDD 1.3.3.11 (or earlier), the output of the **datapath query adapter** command shows all the fibre-channel arrays as different adapters, and you need to determine which hardware paths relate to which adapters. If you need to place an adapter offline, you need to manually issue multiple commands to remove all the associated hardware paths.

For SDD 1.4.0.0 (or later), the output of the **datapath query adapter** command has been simplified.

The following examples show the output resulting from the **datapath query adapter** command for the same configuration for SDD 1.3.3.11 (or earlier) and for SDD 1.4.0.0 (or later).

Example output from **datapath query adapter** command issued in SDD 1.3.3.11 (or earlier):

```
Active Adapters :8
Adapter# Adapter Name State Mode Select Error Path Active
0 0/7/0/0.4.18.0.38 NORMAL ACTIVE 0 0 1 1
1 0/4/0/0.4.18.0.38 NORMAL ACTIVE 0 0 1 1
2 0/7/0/0.4.18.0.36 NORMAL ACTIVE 0 0 2 2
3 0/4/0/0.4.18.0.36 NORMAL ACTIVE 0 0 2 2
4 0/7/0/0.4.18.0.34 NORMAL ACTIVE 0 0 2 2
```

|   |                   |        |        |   |   |   |   |
|---|-------------------|--------|--------|---|---|---|---|
| 5 | 0/4/0/0.4.18.0.34 | NORMAL | ACTIVE | 0 | 0 | 2 | 2 |
| 6 | 0/7/0/0.4.18.0.32 | NORMAL | ACTIVE | 0 | 0 | 1 | 1 |
| 7 | 0/4/0/0.4.18.0.32 | NORMAL | ACTIVE | 0 | 0 | 1 | 1 |

Adapter #s 0, 2, 4, 6 belong to the same physical adapter. In order to place this adapter offline, you need to issue **datapath set adapter offline** four times. After the four commands are issued, the output of **datapath query adapter** will be:

```
Active Adapters :8
Adapter# Adapter Name State Mode Select Error Path Active
0 0/7/0/0.4.18.0.38 NORMAL OFFLINE 0 0 1 0
1 0/4/0/0.4.18.0.38 NORMAL ACTIVE 0 0 1 0
2 0/7/0/0.4.18.0.36 NORMAL OFFLINE 0 0 2 0
3 0/4/0/0.4.18.0.36 NORMAL ACTIVE 0 0 2 0
4 0/7/0/0.4.18.0.34 NORMAL OFFLINE 0 0 2 0
5 0/4/0/0.4.18.0.34 NORMAL ACTIVE 0 0 2 0
6 0/7/0/0.4.18.0.32 NORMAL OFFLINE 0 0 1 0
7 0/4/0/0.4.18.0.32 NORMAL ACTIVE 0 0 1 0
```

Example output from **datapath query adapter** command issued in SDD 1.4.0.0 (or later):

```
Active Adapters :2
Adapter# Adapter Name State Mode Select Error Path Active
0 0/7/0/0 NORMAL ACTIVE 0 0 6 6
1 0/4/0/0 NORMAL ACTIVE 0 0 6 6
```

Adapters 0 and 1 represent two physical adapters. To place one of the adapters offline, you need to issue one single command, for example, **datapath set adapter 0 offline**. After the command is issued, the output of **datapath query adapter** will be:

```
Active Adapters :2
Adapter# Adapter Name State Mode Select Error Path Active
0 0/7/0/0 NORMAL OFFLINE 0 0 6 0
1 0/4/0/0 NORMAL ACTIVE 0 0 6 0
```

## SDD datapath query device command changes for SDD 1.4.0.0 (or later)

The following change is made in SDD for the **datapath query device** command to accommodate the serial numbers of supported storage devices. The locations of Serial and Policy are swapped because the SAN Volume Controller serial is too long to fit in the first line.

Example output from **datapath query device** command issued in SDD 1.3.3.11 (or earlier):

```
Dev#: 3 Device Name: vpath5 Type: 2105800 Serial: 14123922
Policy: Optimized
=====
Path# Adapter H/W Path Hard Disk State Mode Select Error
0 0/7/0/0 c19t8d1 OPEN NORMAL 3869815 0
1 0/7/0/0 c13t8d1 OPEN NORMAL 3872306 0
2 0/3/0/0 c17t8d1 OPEN NORMAL 3874461 0
3 0/3/0/0 c11t8d1 OPEN NORMAL 3872868 0
Dev#: 3 Device Name: vpath5 Type: 2105800 Policy: Optimized
Serial: 14123922
=====
Path# Adapter H/W Path Hard Disk State Mode Select Error
0 0/7/0/0 c19t8d1 OPEN NORMAL 3869815 0
1 0/7/0/0 c13t8d1 OPEN NORMAL 3872306 0
2 0/3/0/0 c17t8d1 OPEN NORMAL 3874461 0
3 0/3/0/0 c11t8d1 OPEN NORMAL 3872868 0
```

Example output from **datapath query device** command issued in SDD 1.4.0.0 (or later): (This example shows a SAN Volume Controller and a disk storage system device.)

```

Dev#: 2 Device Name: vpath4 Type: 2145 Policy: Optimized
Serial: 60056768018506870000000000000000
=====
Path# Adapter H/W Path Hard Disk State Mode Select Error
0 0/7/0/0 c23t0d0 OPEN NORMAL 2736767 62
1 0/7/0/0 c9t0d0 OPEN NORMAL 6 6
2 0/3/0/0 c22t0d0 OPEN NORMAL 2876312 103
3 0/3/0/0 c8t0d0 OPEN NORMAL 102 101
Dev#: 3 Device Name: vpath5 Type: 2105800 Policy: Optimized
Serial: 14123922
=====
Path# Adapter H/W Path Hard Disk State Mode Select Error
0 0/7/0/0 c19t8d1 OPEN NORMAL 3869815 0
1 0/7/0/0 c13t8d1 OPEN NORMAL 3872306 0
2 0/3/0/0 c17t8d1 OPEN NORMAL 3874461 0
3 0/3/0/0 c11t8d1 OPEN NORMAL 3872868 0

```

**Note:** vpathname *vpathN* is reserved once it is assigned to a LUN even after the LUN has been removed from the host. The same vpathname, *vpathN*, will be assigned to the same LUN when it is reconnected to the host.

## Postinstallation

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 Table 6 through Table 8 on page 109.

Table 6. SDD components installed for HP-UX host systems

| File               | Location                       | Description                                                                                                                                     |
|--------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| mod.o              | /opt/IBMsdd/bin                | Object file for the SDD driver module                                                                                                           |
| Executables        | /opt/IBMsdd/bin                | Configuration and status tools                                                                                                                  |
| README.sd          | /opt/IBMsdd                    | README file                                                                                                                                     |
| sddsrv             | /sbin/sddsrv                   | SDD server daemon                                                                                                                               |
| sample_sddsrv.conf | /etc/                          | Sample SDD server configuration file                                                                                                            |
| sddserver          | /sbin/init.d                   | Script to start or stop the SDD daemon at system up/down time                                                                                   |
| confserver         | /sbin/init.d                   | Script to load SDD driver and run cfgvpath at system boot time                                                                                  |
| mvserver           | /sbin/init.d                   | Script to move /sbin/rc1.d/S100localmount to /sbin/rc1.d/S250localmount in order to fix the auto mount problem for SDD vpath device filesystems |
| datapath.1         | /usr/local/man/man1/datapath.1 | Manpage for datapath                                                                                                                            |
| rmvpath.1          | /usr/local/man/man1/rmvpath.1  | Manpage for rmvpath                                                                                                                             |

Table 6. SDD components installed for HP-UX host systems (continued)

|              |                                  |                        |
|--------------|----------------------------------|------------------------|
| showvpath.1  | /usr/local/man/man1/showvpath.1  | Manpage for showvpath  |
| gettrace.1   | /usr/local/man/man1/gettrace.1   | Manpage for gettrace   |
| sddsrv.1     | /usr/local/man/man1/sddsrv.1     | Manpage for sddsrv     |
| vp2hd.1      | /usr/local/man/man1/vp2hd.1      | Manpage for vp2hd      |
| hd2vp.1      | /usr/local/man/man1/hd2vp.1      | Manpage for hd2vp      |
| cfgvpath.1   | /usr/local/man/man1/cfgvpath.1   | Manpage for cfgvpath   |
| vpcluster.1  | /usr/local/man/man1/vpcluster.1  | Manpage for vpcluster  |
| sddgetdata.1 | /usr/local/man/man1/sddgetdata.1 | Manpage for sddgetdata |

Table 7. System files updated for HP-UX host systems

| File  | Location           | Description               |
|-------|--------------------|---------------------------|
| vpath | /usr/conf/master.d | Master configuration file |
| vpath | /stand/system.d    | System configuration file |

Table 8. SDD commands and their descriptions for HP-UX host systems

| Command                                 | Description                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| cfgvpath                                | Configures new SDD vpath devices when there are no existing vpath devices. Do not use the legacy parameter "-c".                                                                                                                                                                                                            |
| cfgvpath [-r] (Dynamic reconfiguration) | The SDD vpath device configuration is updated without system reboot. If initially there is no SDD vpath device configured, <b>cfgvpath -r</b> will fail with message "failed to get information from kernel, don't run dynamic configuration, do cfgvpath instead." In this case, issue <b>cfgvpath</b> without any option. |
| showvpath                               | Lists the configuration mapping between the SDD devices and underlying disks.                                                                                                                                                                                                                                               |
| datapath                                | The SDD driver console command tool.                                                                                                                                                                                                                                                                                        |
| hd2vp                                   | Converts a volume group from sdisks into the SDD vpath devices.                                                                                                                                                                                                                                                             |
| vp2hd                                   | Converts a volume group from the SDD vpath devices into sdisks.                                                                                                                                                                                                                                                             |
| vpcluster                               | Imports or exports MC Service Guard volume groups.                                                                                                                                                                                                                                                                          |
| rmvpath [-all, -vpathname]              | Removes the SDD vpath devices from the configuration.                                                                                                                                                                                                                                                                       |
| gettrace                                | Debug tool that gets trace information when problem occurs.                                                                                                                                                                                                                                                                 |
| sddgetdata                              | The SDD data collection tool for problem analysis.                                                                                                                                                                                                                                                                          |

Table 8. SDD commands and their descriptions for HP-UX host systems (continued)

| Command | Description                                                                                                                                                                                                                                                                         |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| man     | Manpage for SDD commands, for example, <b>man datapath</b> . Supported SDD commands are <b>datapath</b> , <b>gettrace</b> , <b>hd2vp</b> , <b>querysn</b> , <b>rmvpath</b> , <b>sddsrv</b> , <b>sddgetdatashowvpath</b> , <b>vp2hd</b> , <b>vpcluster</b> , and <b>sddgetdata</b> . |

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 the SDD. Go to “Standard UNIX applications” on page 117 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 117 and read the information specific to the application that you are using.

During the installation process, the following files were copied from the IBMsdd\_depot to the system:

#### # Kernel-related files

- /opt/IBMsdd/bin/mod.o
- /stand/system.d/vpath
- /usr/conf/master.d/vpath

#### # SDD driver-related files

- /opt/IBMsdd
- /opt/IBMsdd/bin
- /opt/IBMsdd/README.sd
- /opt/IBMsdd/bin/cfgvpath
- /opt/IBMsdd/bin/datapath
- /opt/IBMsdd/bin/showvpath
- /opt/IBMsdd/bin/master
- /opt/IBMsdd/bin/system
- /opt/IBMsdd/bin/mod.o
- /opt/IBMsdd/bin/rmvpath
- /opt/IBMsdd/bin/get\_root\_disks
- /opt/IBMsdd/bin/gettrace
- /opt/IBMsdd/bin/sddgetdata
- /opt/IBMsdd/bin/hd2vp
- /opt/IBMsdd/bin/vp2hd
- /opt/IBMsdd/bin/vpcluster
- /sbin/cfgvpath
- /sbin/datapath
- /sbin/get\_root\_disks
- /sbin/rmvpath
- /sbin/showvpath
- /sbin/hd2vp
- /sbin/vp2hd
- /sbin/vpcluster



- /sbin/sddgetdata
- /sbin/sddsrv
- /etc/sample\_sddsrv.conf

During installation, /opt/IBMsdd/bin/cfgvpath program is initiated to create SDD vpath devices in the /dev/dsk and /dev/rdisk directories for all IBM disks that are available on the system. After installation is done, all SDD vpath devices are configured and the driver is loaded. The system will not reboot.

**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/vpath1.

---

## Uninstalling SDD

### About this task

The following procedure explains how to remove SDD. You must uninstall the current level of SDD before upgrading to a newer level.

Complete the following procedure to uninstall SDD:

### Procedure

1. Stop applications.
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. Before running the sam program, run script **vp2hd** to convert volume groups from SDD vpath devices to sdisks.
4. Run the **sam** program.
 

```
> sam
```
5. Click **Software Management**.
6. Click **Remove Software**.
7. Click **Remove Local Host Software**.
8. Click the **IBMsdd\_tag** selection.
  - a. From the Bar menu, click **Actions** → **Mark for Remove**.
  - b. From the Bar menu, click **Actions** → **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. Click **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. Click **Yes** and press **Enter**. The uninstallation of IBMsdd begins.
  - f. An Uninstall window opens showing the progress of the IBMsdd 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 : IBMsdd_tag,.....
```

The **Done** option is not available when the uninstallation process is in progress. It becomes available after the uninstallation process completes.

9. Click **Done**.

## Results

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 SDD” on page 99.

**Note:** The MC Service Guard cluster must be halted prior to uninstall. The primary node and the adoptive node or nodes must operate in a single-host environment. The shared volume groups in the adoptive nodes must be exported so that the volumes are not shared; the volume groups can be active in the primary node only.

---

## SDD server daemon

The SDD server (also referred to as `sddsrv`) is an integrated component of SDD 1.3.1.5 (or later). This component consists of a UNIX application daemon that is installed in addition to the SDD device driver. See Chapter 5, “Using the SDDDSM or the SDDPCM daemon,” on page 157 for more information about `sddsrv`.

**Note:** The SDD server is started from `/etc/inittab`. Because the environment variable `$TZ` is not exported at init time, you should modify `/etc/default/tz` to reflect the corresponding time zone so that `sddsrv.log` reflects the correct local time. See the man pages for the `ctime` command for more information.

## Verifying if the SDD server has started

After you have installed SDD, verify that the SDD server (`sddsrv`) has automatically started by entering `ps -ef | grep sddsrv`.

If the SDD server (`sddsrv`) has automatically started, the output will display the process number on which `sddsrv` has started.

If `sddsrv` has *not* started, you should uninstall SDD and then reinstall SDD. See “Installing SDD” on page 99 for more information.

## Starting the SDD server manually

### About this task

If the SDD server does not start automatically after you complete the SDD installation, or if you want to start it manually after stopping `sddsrv`, use the following process to start `sddsrv`:

1. Edit `/etc/inittab` and verify the `sddsrv` entry.

For example:

- ```
srv:23456:respawn:/sbin/sddsrv >/dev/null 2>&1
```
2. Save the file `/etc/inittab`.
 3. Issue **init q**.

Go to “Verifying if the SDD server has started” on page 112 for the steps to see if you successfully started the SDD server.

Changing to a different port number for the SDD server

To change to a different port number for the SDD server, see the instructions in “Changing the sddsrv or pcmsrv TCP/IP port number” on page 162.

Stopping the SDD server

About this task

To stop the SDD server, complete the following steps:

1. Edit `/etc/inittab` and comment out the SDD server entry:

```
#srv:23456:respawn:/sbin/sddsrv >/dev/null 2>&1 2
```

2. Save the file.
3. Issue **init q**.
4. Check if sddsrv is running by issuing **ps -ef | grep sddsrv**. If sddsrv is still running, issue **kill -9 pid** of sddsrv.

How to import and export volume groups

About this task

Use the HP CLI to manage SDD devices.

You can import volume groups that are created over SDD vpath devices using the **vgimport** command. The **vgimport** command is useful in conjunction with the **vgexport** command.

Before you can import the specified volume groups, you must complete the following tasks:

1. Export or move volume groups from one node to another node within a high availability cluster by using the **vgexport** command. See “Exporting volume groups.”
2. FTP the map file to the other node within a high-availability cluster. See “Moving the map file” on page 114.
3. Create the volume group device directory. See “Creating the volume group device directory” on page 114.
4. Create the group special file. See “Creating the group special file” on page 114.

For more information about the **vgimport** command, see “Importing volume groups” on page 114.

Exporting volume groups

The **vgexport** command recognizes the following options and arguments:

- p** The **-p** option previews the actions to be taken but does not update the `/etc/lvmtab` file or remove the devices file.

-v The **-v** option prints verbose messages including the names of the physical volumes associated with this volume group.

-s **-s** is the sharable option (Series 800 only). When you specify the **-s** option, you must also specify the **-p**, **-v**, and **-m** options. A mapfile is created that can be used to create volume group entries (with the **vgimport** command) on other systems in the high availability cluster.

-m mapfile

By default, a file named **mapfile** is created in your current directory. The mapfile contains a description of the volume group and its associated logical volumes. Use the **-m** option to specify a different name for the mapfile. The mapfile serves as input to **vgimport**; When the mapfile is used with the **-s** option, the volume group specified in the mapfile can be shared with the other systems in the high availability cluster.

vg_name

The **vg_name** is the path name of the volume group.

vgexport command example:

To export the specified volume group on node 1, enter:

```
vgexport -p -v -s -m /tmp/vgpath1.map vgpath1
```

where */tmp/vgpath1.map* represents your mapfile, and *vgpath1* represents the path name of volume group that you want to export.

Moving the map file

You must also FTP the map file to the other node.

For example, to FTP the *vgpath1.map* map file to node 2, enter:

```
rcp /tmp/vgpath1.map node2:/tmp/vgpath1.map
```

Creating the volume group device directory

You must also create the volume group device directory.

For example, to create the volume group device directory */dev/vgpath1* on node 2, enter:

```
mkdir /dev/vgpath1
```

Creating the group special file

You must also create the group special file on node 2.

For example, to create the *group c 64* file, enter:

```
mknod /dev/vgpath1/group c 64 n
```

where *n* is the same as that was given when */dev/vgpath1/group* was created on node 1.

Importing volume groups

The **vgimport** command recognizes the following options and arguments:

- p** The **-p** option previews the actions to be taken but does not update the `/etc/lvmtab` file or remove the devices file.
- v** The **-v** option prints verbose messages including the names of the logical volumes.
- s** **-s** is the sharable option (disk storage system Series 800 only). When you specify the **-s** option, you must specify the **-p**, **-v**, and **-m** options. The specified mapfile is the same mapfile specified by using the **vgexport** command also using the **-p**, **-m**, and **-s** options. The mapfile is used to create the volume groups on the importing systems.

-m mapfile

By default, a file named `mapfile` is created in your current directory. The mapfile contains a description of the volume group and its associated logical volumes. Use the **-m** option to specify a different name for the mapfile. The mapfile serves as input to **vgimport**; When the mapfile is used with the **-s** option, the volume group specified in the mapfile can be shared among the exporting system and the importing system.

vg_name

The `vg_name` is the path name of the volume group.

vgimport command example:

To import the specified volume group on node 2, enter:

```
vgimport -p -v -s -m /tmp/vgpath1.map vgopath1
```

where `/tmp/vgpath1.map` represents your mapfile, and `vgopath1` represents the path name of the volume group that you want to import.

Note: The **vgimport** command only imports the scsi pmlink devices. Issue the **hd2vp** command after issuing the **vgimport** command.

Exporting or importing MC Service Guard volume groups

The **vpcluster** script makes it easier to export or import MC Service Guard volume groups managed by SDD. The normal Service Guard configuration and SDD device configuration process remain the same. The sharable volume groups used by the HA clusters must be marked

For the primary node operation, **vpcluster** extracts the node and volume group information from the keywords `NODE_NAME` and `VOLUME_GROUP` as specified in the cluster configuration file. It ensures that the devices of these volumes groups are SDD-managed vpath devices, performs **vgexport** and creates **vpcluster** control files for the adoptive nodes to import. The input file to **vpcluster** does not have to be the same cluster configuration file for the SG cluster creation. It can be any ASCII file with the line entries that contain `NODE_NAME` and `VOLUME_GROUP` keywords without `#` as a comment. Optionally, the **vpcluster** control file can be copied to each adoptive node with the **rcp** command.

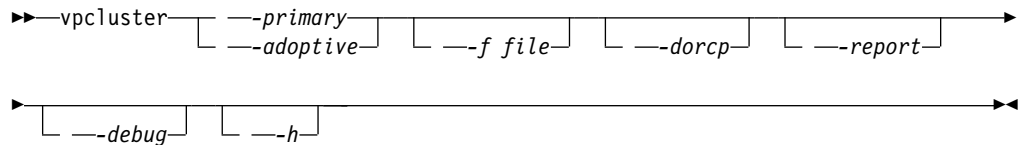
For the adoptive node operation, **vpcluster** uses the control file created by the primary node operation. Prior to volume group import, it validates that the adoptive node is included in the cluster configuration, ensures the importing volume groups are not active volume groups in the adoptive node, creates volume group nodes `/dev/vgXXXX` using the **mknod** command, and ensures that the same device serial and LUN-id are configured by SDD.

Note:

1. The device names, either vpath# or C#T#D#, might be different between the primary and adoptive nodes. However, the **vpcluster** process attempts to keep the volume group minor number consistent between the primary and adoptive nodes. In case the same minor number is in use, the next sequential number is assigned. Because the HP **vgimport** process only imports those device names with the standard name C#T#D#, **hd2vp** is invoked to convert sdisk devices to SDD devices after a successful **vgimport**.
2. Use the **cmquerycl** HP command to create the cluster configuration file. This command recognizes only the pvlink scsi devices on both nodes. If you are using the **cmquerycl** command to create the cluster configuration file, you should first issue **vp2hd** to convert vpath devices to pvlink devices.

In addition, the report option for adoptive node validates all volume groups exported by the primary node. A mismatch of volume group minor number or vpath device name is allowed. Other mismatches will be reported.

Syntax:



where,

-primary

Specifies primary node operation. You must specify **-primary** or **-adoptive**.

-adoptive

Specifies adoptive node operation. You must specify **-primary** or **-adoptive**.

-f file

For the primary node, specify the cluster configuration file, default is /etc/cmcluster/cmclconf.ascii.

For the adoptive node, specify the **vpcluster** control file created the primary node, default is /tmp/vpcluster/vpcluster.primary.tar

-dorcp

Specifies the vpcluster control tar file to be RCPed to the adoptive nodes. The default is no.

-report

Validates that the exported volume groups from the primary node are imported to the adoptive node and creates a report. This option is valid in the adoptive node.

-debug

Specifies that a debugging statement is to be printed during **vpcluster** run time.

-h Specifies that detailed help info about the **vpcluster** function is to be displayed.

There are more than one way to configure the SG cluster locking: quorum server, or lock disk. In case the lock disk is chosen, the SDD vpath device should not be used since it is not recognized by the FIRST_CLUSTER_LOCK_PV parameter. Furthermore, it is recommended that SDD vpath devices and sdisk pvlink should

not be mixed in the same volume group. The lock device should be excluded from the SDD configuration. See the information about the `/etc/vpathmanualexcl.cfg` text file on page 104.

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 DBMSs for use with SDD:

- Standard UNIX applications
- Network File System (NFS) file server

Standard UNIX applications

Note: The SDD path state change depends on the “positive” feedback from an I/O request. The positive feedback is an I/O response, either successful or failed condition, from an I/O request. Due to the standard and designed behavior of the SCSI driver on HP-UX 11i V2 and prior, the following conditions occur when access raw `sdisk` through SDD:

1. I/O errors are retried indefinitely because pre-HP-UX 11i v3 (B.11.31) has no way to distinguish between a non-volume-manager file system I/O and a raw access.
2. I/O errors returned on certain file system I/Os can result in panic.

SDD can still load balance with the raw device access but failover/failback is not possible. In most cases, an I/O error is likely to hang due to indefinite retries at the SCSI driver layer.

If you have not already done so, install SDD using the procedure in “Installing SDD” on page 99. When this is done, SDD resides above the HP-UX 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 you want to replace are replaced with the corresponding SDD device. Issue the **showvpath** command to list all SDD `vpath` devices and their underlying disks.

To use the SDD driver for an existing logical volume, you must run the `hd2vp` conversion script.

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

About this task

Use the following process to create a new logical volume to use SDD:

Note: You must have superuser privileges to complete these subtasks.

Procedure

1. Determine the major number of the logical volume device.
Enter 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 that you want to use.

2. Create a device node for the logical volume device.

Note: 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 step 3 on page 119.

- a. Create a subdirectory in the `/dev` directory for the volume group.
Enter 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.

- b. Change to the `/dev` directory.
Enter the following command to change to the `/dev` directory:

```
# cd /dev/vgIBM
```

- c. Create a device node for the logical volume device.
Enter the following command to re-create the physical volume:

```
# pvcreate /dev/rdisk/vpath1
```

A message similar to the following is displayed:

Physical volume "/dev/rdisk/vpath1" has been successfully created.

In this example, the SDD vpath device associated with the underlying disk is vpath1. Verify the underlying disk by entering the following **showvpath** command:

```
# /opt/IBMsdd/bin/showvpath
```

A message similar to the following is displayed:

```
vpath1:  
/dev/dsk/c3t4d0
```

3. Create a physical volume.

Enter the following command to create a physical volume:

```
# pvcreate /dev/rdisk/vpath1
```

4. Create a volume group.

Enter the following command to create a volume group:

```
# vgcreate /dev/vgIBM/dev/dsk/vpath1
```

5. Create a logical volume.

Enter the following command to create logical volume *lvvol1*:

```
# lvcreate -L 100 -n lvvol1 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.

6. Create a file system on the volume group.

Use the following process to create a file system on the volume group:

- a. If you are using an HFS file system, enter the following command to create a file system on the volume group:

```
# newfs -F HFS /dev/vgIBM/rlvol1
```

- b. If you are using a VXFS file system, enter the following command to create a file system on the volume group:

```
# newfs -F VXFS /dev/vgIBM/rlvol1
```

- c. Mount the logical volume.

This process assumes that you have a mount point called /mnt.

7. Mount the logical volume.

Enter the following command to mount the logical volume *lvvol1*:

```
# mount /dev/vgIBM/lvol1 /mnt
```

Attention: In some cases, it may be necessary to use standard HP-UX recovery procedures to fix a volume group that has become damaged or corrupted. For information about using recovery procedures, such as **vgscan**, **vgextend**, **vpchange**, or **vgreduce**, search for *Manuals for HP-UX 11i Volume Management (LVM/VxVM) Software* in the following website:

h20565.www2.hp.com/portal/site/hpsc/public/

Removing logical volumes

About this task

Use the following procedure to remove logical volumes:

1. Remove the existing logical volume.

Before the logical volume is removed, it must be unmounted. For example, enter the following command to unmount logical volume *lv01*:

```
# umount /dev/vgIBM/lv01
```

Next, remove the logical volume.

For example, enter the following command to remove logical volume *lv01*:

```
# lvremove /dev/vgIBM/lv01
```

A message similar to the following is displayed:

```
The logical volume "/dev/vgIBM/lv01" is not empty;
do you really want to delete the logical volume (y/n)
```

Enter **y** and press **Enter**. A message similar to the following is displayed:

```
Logical volume "/dev/vgIBM/lv01" 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, enter **y**.

2. Remove the existing volume group.

Enter 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, you can re-create the logical volume.

Re-creating the existing logical volumes

About this task

Use the following process to convert an existing logical volume to use SDD:

Note: You must have superuser privileges to complete these subtasks.

As an example, suppose you have a logical volume called *lv01* under a volume group *vgIBM*, which is currently using the disk directly, (for example, through path */dev* path */dev/dsk/c3t4d0*). You want to convert logical volume *lv01* to use SDD.

Procedure

1. Determine the size of the logical volume.

Enter the following command to determine the size of the logical volume:

```
# lvsdisplay /dev/vgIBM/lvol1 | 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.

2. Re-create the physical volume.

Enter the following command to re-create the physical volume:

```
# pvcreate /dev/rdisk/vpath1
```

A message similar to the following is displayed:

```
Physical volume "/dev/rdisk/vpath1" has been successfully created.
```

In this example, the SDD vpath device associated with the underlying disk is vpath1. Verify the underlying disk by entering the following command:

```
# /opt/IBMsdd/bin/showvpath
```

A message similar to the following is displayed:

```
vpath1:
/dev/dsk/c3t4d0
```

3. Re-create the volume group.

Enter the following command to re-create the volume group:

```
# vgcreate /dev/vgibm /dev/dsk/vpath1
```

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
```

4. Re-create the logical volume.

Re-creating the logical volume consists of a number of smaller steps:

- a. Re-creating the physical volume
- b. Re-creating the volume group
- c. Re-creating the logical volume

Enter the following command to re-create the logical volume:

```
# lvcreate -L 100 -n lvol1 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.

Attention: The re-created logical volume should be the same size as the original volume; otherwise, the re-created volume cannot store the data that was on the original.

5. Setting the proper timeout value for the logical volume manager.

The timeout values for the Logical Volume Manager must be set correctly for SDD to operate properly. This is particularly true if the concurrent firmware download has taken place. There are two timeout values: one for logical volume (LV) and one for physical volume (PV).

The LV timeout value is determined by the application. If the application has no specific timeout requirement, use the HP default value, which is 0 (forever).

The PV timeout value is recommended by the storage vendor. The HP default PV timeout value is 30 seconds. Generally, this is sufficient during normal operations.

However, during the concurrent firmware download, you must set the PV timeout value to a minimum of 90 seconds. You can set the timeout value to 90 seconds for normal operations as well. In addition, if you do not use the default LV timeout value, ensure that the LV timeout value is no less than the PV timeout value multiplied by the number of paths. For example, when the default is not used, if a vpath device has four underlying paths and the PV timeout value is 90, the LV timeout value must be at least 360.

To display the timeout value, use the **lvdisplay** or **pvdisplay** command.

To change the PV timeout value, use the **pvchange** command after **pvcreate**, and to change the LV timeout value, use the **lvchange** command after **lvcreate**.

For example:

- To change the timeout value of all underlying paths of vpathX to 90 seconds, enter **pvchange -t 90 /dev/dsk/vpathX**
- To change the timeout value for logical volume /dev/vgibm/lvolY to 360 seconds, enter **lvchange -t 360 /dev/vgibm/lvolY**

Attention: In some cases, it may be necessary to use standard HP-UX 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**, search for *Manuals for HP-UX 11i Volume Management (LVM/VxVM) Software* in the following website:

h20565.www2.hp.com/portal/site/hpsc/public/

Installing SDD on a NFS file server

The procedures in this section show how to install SDD for use with an exported file system (NFS file server).

Setting up NFS for the first time

About this task

Complete 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 SDD" on page 99.

2. Determine which SDD (vpathN) volumes that 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, enter the following command:

```
# newfs /dev/rdisk/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. In the **mount at boot** field, click **yes**.
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 NFS file server

About this task

Complete the following steps if you have the NFS 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

Procedure

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:
 - a. Passes the start time **fsck pass**
 - b. Mounts properly
 - c. 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 NFS service. Then review your steps and try again.

Chapter 4. Using SDDDSM on a Windows Server host system

You can use SDDDSM on a Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 host system.

Subsystem Device Driver Device Specific Module (SDDDSM) provides multipath I/O support based on the MPIO technology of Microsoft. SDDDSM is a device-specific module designed to provide support for supported storage devices.

This chapter provides procedures for you to install, configure, use, and remove SDDDSM on a Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 host system that is attached to a supported storage device.

Install the package from the %ProgramFiles%\IBM\SDDDSM directory of the SDDDSM CD-ROM or the location where SDDDSM package was saved.

For updated and additional information that is not included in this chapter, see the readme file on the CD-ROM or visit the SDDDSM website:

www-01.ibm.com/support/docview.wss?uid=ssg1S4000350

Verifying the hardware and software requirements

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

Hardware

The following hardware components are needed:

- Supported storage devices
- Host system
- Fibre-channel adapters and cables

Software

The following software components are needed:

- Operating system:
 - Windows Server 2008 (32-bit)
 - Windows Server 2008 (x64) Windows Server 2012 (x64), Windows Server 2016 (x64), or Windows Server 2019 (x64)
- Device driver for fibre-channel adapters (it must be a STORPORT-based miniport driver)
- SDDDSM installation package, which includes:
 - MPIO drivers. MPIO is shipped with Windows Server 2008 or later. On Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 the MPIO drivers that are shipped with the operating system are used.
 - SDDDSM driver: sdddsm.sys
 - SDDDSM installer: setup.exe
 - SDDDSM readme file
 - SDDDSM command windows shortcut

- The Microsoft Visual C++ 2012 or 2015 Redistributable package that can be downloaded from the Microsoft Corporation website. The HBAInfo utility requires this package.

Note: If you need to change any of the default parameters of your host adapter, see user documentation of the host adapter. For example, the **NodeTimeout** for Emulex host adapter is 3 seconds and it might need a change.

Unsupported environments

SDDDSM does not support the following environments:

- Single-path mode during code distribution and activation of LMC nor during any disk storage system concurrent maintenance that impacts the path attachment, such as a disk storage system host-bay-adapter replacement.
- DS8000 and DS6000 do not support SCSI connectivity.
- SDDDSM is not supported with Windows Server 2003 from version 2.4.5.0 onwards.

Host system requirements

To install SDDDSM, your Windows Server 2008 host must be an x86-based 32-bit system or an AMD-based 64-bit system. The Windows Server 2012, Windows Server 2016, or Windows Server 2019 host system must be an AMD-based 64-bit system. The host system can be a uniprocessor system or a multiprocessor system.

To support SDDDSM, your Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 host system must have the following installed:

- Any Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 hotfixes, when applicable
- Any HBA-required Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 hotfixes, when applicable

For additional information, see the SDDDSM readme and the HBA driver readme or release notes.

To install all components, you must have at least 10 MB (MB equals approximately 1 000 000 bytes) of disk space available on the drive where Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 is installed.

Fibre-channel requirements

To use the SDDDSM fibre-channel support, ensure that your host system meets the following requirements:

- No more than 32 fibre-channel adapters are attached.
- A fiber-optic cable connects each fibre-channel adapter to a disk storage system port.
- If you need the SDDDSM I/O load-balancing and failover features, ensure that a minimum of two fibre-channel adapters are installed.

Note: If your host has only one fibre-channel adapter, it requires you to connect through a switch to multiple disk storage system ports. You should have at least two fibre-channel adapters to prevent data loss due to adapter hardware failure or software failure.

For information about the fibre-channel adapters that can attach to your Windows Server 2008 Windows Server 2012, Windows Server 2016, or Windows Server 2019 host system, go to the following website:

www.ibm.com/servers/storage/support

Preparing for SDDDSM installation

About this task

Before installing SDDDSM, you must:

1. Ensure that all hardware and software requirements are met. For more information, see “Verifying the hardware and software requirements” on page 125.
2. Configure the fibre-channel adapters that are attached to your Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 host system. See “Configuring fibre-channel adapters” for more information.
3. Review the SDDDSM uninstallation and installation instructions. For more information, see “Uninstalling SDDDSM” on page 138 and “Installing SDDDSM.”

Configuring the supported storage device

Before you install SDDDSM, configure your supported storage device for single-port or multiport access for each LUN. To use the load-balancing and failover features, SDDDSM requires a minimum of two independent paths that share the same logical unit.

For information about configuring your supported storage device, see the Implementation Guide or Configuration Guide for your product.

Configuring fibre-channel adapters

You must configure the fibre-channel adapters that are attached to your Windows host system before you install SDDDSM. Follow the adapter-specific configuration instructions to configure the adapters attached to your Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 host systems.

Installing SDDDSM

You can install SDDDSM either from a CD-ROM or download.

Installing for the first time

The following section describes how to install SDDDSM on your system.

Note: Ensure that SDDDSM is installed *before* adding new paths to a device. Otherwise, the Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 server could cause data corruption on that device.

Installing SDDDSM from CD-ROM

About this task

Complete the following steps to install SDDDSM on your system:

Procedure

1. If this is a new installation, ensure that there is a single connection from your host to your storage. Multipath access to the storage can be added after SDDDSM is installed.
2. Log on as the administrator user.
If you plan to install SDDDSM from CD-ROM, continue with step 3; otherwise, go to step 9.
3. Insert the SDDDSM installation CD-ROM into the selected drive.
4. Start the Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 Explorer program.
5. Select the CD-ROM drive. A list of all the installed directories on the compact disc is displayed.
6. If you have the zip file for the SDDDSM package available, select the %ProgramFiles%\IBM\SDDDSM installation subdirectory and go to step 9.
7. If you still do not have the zip file for the SDDDSM package available, go to the SDD website and download and save it to a directory.
8. Extract the zip file for the SDDDSM package to a directory and go to that directory.
9. Select the 32-bit or 64-bit folder depending on the operating system of the host system.
10. Run the setup.exe program. Follow the instructions.
11. Shut down the host system.
12. Connect additional cables to your storage if needed.
13. Make any necessary zoning configuration changes.
14. Restart the host system.

Results

After completing the installation procedures and when you log on again, you will see an **SDDDSM** entry in your Program menu containing the following selections:

1. Subsystem Device Driver DSM
2. SDDDSM Technical Support website
3. README

Note:

1. You can verify that SDDDSM has been successfully installed by issuing the **datapath query device** command. You must issue the **datapath** command from the datapath directory. If the command runs, SDDDSM is installed.

You can also use the following operation to verify that SDDDSM has been successfully installed:

- a. Click **Start → Programs → Administrative Tools → Computer Management**.
- b. Double-click **Device Manager**.
- c. Expand **Disk drives** in the right pane.

Note: In Windows Server 2012, Windows Server 2016, or Windows Server 2019 Server Core CLI mode, run the **Get-Disk** command in Windows PowerShell to see the disk list.

In Figure 7 on page 129, there are eight SAN Volume Controller devices connected to the host and four paths to each of the SAN Volume Controller devices. The Device manager shows eight 2145 Multipath Disk Devices and

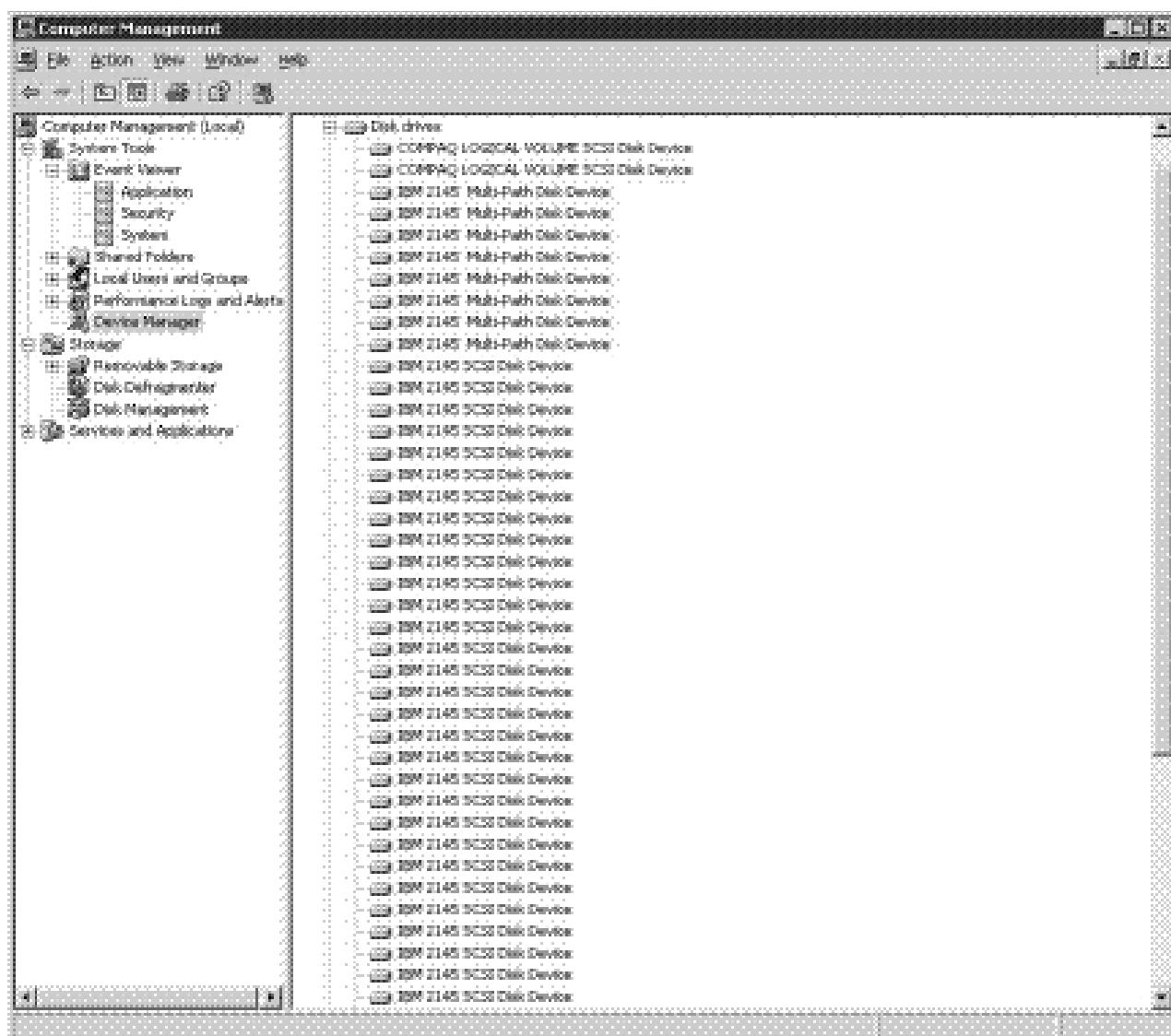


Figure 7. Example showing SAN Volume Controller devices to the host and path access to the SAN Volume Controller devices in a successful SDDDSM installation on a Windows Server host system

2. You can also verify the current version of SDDDSM. For more information, go to “Displaying the current version of SDDDSM” on page 130.

Installing SDDDSM from downloaded code

About this task

Use this procedure to install SDDDSM from downloaded code:

Procedure

1. Unzip the SDDDSM code to your installation subdirectory.
2. Select the 32-bit or 64-bit folder depending on the operating system of the system.
3. Run the setup.exe program and follow the instructions. **Tip:** The setup.exe program offers the following command line options for silent install:

```
--> setup -s : silent install  
--> setup -s -n : silent install; no reboot (requires SDDDSM 2.1.1.0 or later)
```

4. When the setup.exe program is finished, you will be asked if you want to reboot. If you answer **y**, the setup.exe program will restart your SDDDSM system immediately. Follow the instructions to restart. Otherwise, the setup.exe program exits, and you need to manually restart your SDDDSM system to activate the new installation.
5. Shut down your SDDDSM host system.
6. Reconnect all cables that connect the host bus adapters and the supported storage devices if needed.
7. Change any zoning information that needs to be updated.
8. Restart your SDDDSM host system.

Upgrading SDDDSM

About this task

Use the following procedure to upgrade SDDDSM.

Procedure

1. Log in as administrator.
2. Open Windows Explorer and go to the directory where the SDDDSM package is located.
3. Run the setup.exe program and follow the instructions to continue with the SDDDSM setup procedure.
4. When the upgrade is complete, SDDDSM will ask you to reboot. Answer yes to reboot the system and activate the new SDDDSM.

Results

You can check the SDDDSM version to verify that SDDDSM has been successfully upgraded. For more information, see “Displaying the current version of SDDDSM.”

Displaying the current version of SDDDSM

About this task

You can display the current version of SDDDSM on a Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 host system by viewing the sdddsm.sys file properties. Complete the following steps to view the properties of sdddsm.sys file:

Procedure

1. Click **Start → Programs → Accessories → Windows Explorer** to open Windows Explorer.
2. In Windows Explorer, go to the %SystemRoot%\system32\drivers directory, where %SystemRoot% is:
%SystemDrive%\Windows for Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019
If Windows is installed on the C: drive, %SystemDrive% is C:. If Windows is installed on the E: drive, %SystemDrive% is E:
3. Right-click the sdddsm.sys file, and then click **Properties**. The sdddsm.sys properties window opens.

4. In the sdddsm.sys properties window, click **Version**. The file version and copyright information about the sdddsm.sys file is displayed.

Results

If the SDDDSM version is 2.1.1.0 or later, you can use the **datapath query version** command:

1. Open the SDDDSM command window.
2. Issue the **datapath query version** command.

Configuring SDDDSM

Use these topics to configure SDDDSM.

Maximum number of LUNs

There is no physical limitation on the maximum number of devices that can be configured for SDDDSM. Any limitation exists on the host operating system.

Consult the *Host Attachment Guide* for your product.

Verifying the configuration

About this task

To activate SDDDSM, you need to restart your Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 system after it is installed.

Attention: Ensure that SDDDSM is installed and activated before you add new paths to a device. Otherwise, the Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 server could cause data corruption on that device.

Before adding any new hardware, review the configuration information for the adapters and devices currently on your Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 server. Complete the following steps to display information about the adapters and devices:

1. You must log on as an administrator user.
2. Open the DOS prompt window.
 - On a Windows Server 2008: Click **Start → Program → Subsystem Device Driver DSM → Subsystem Device Driver DSM**.
 - On a Windows Server 2012: Click **Start Screen → Apps → Subsystem Device Driver DSM**.
 - On a Windows Server 2016 or a Windows Server 2019: Click **Start → Subsystem Device Driver DSM → Subsystem Device Driver DSM**.

On a Windows Server 2012, Windows Server 2016, or Windows Server 2019 Server Core CLI: Go to %PROGRAMFILES% \IBM\SDDDSM.

3. Enter **datapath query adapter** and press **Enter**. The output includes information about all the installed adapters. In the following example, the output shows that one HBA is installed:

Active Adapters : 1

Adpt#	Name	Interface	State	Mode	Select	Errors	Paths	Active
0	Scsi Port6	Bus0 FC	NORMAL	ACTIVE	1099	1	112	112

4. Enter **datapath query device** and press **Enter**. In the following example, the output shows that three devices are attached to the SCSI path:

Total Devices : 3

DEV#: 0 DEVICE NAME: Disk1 Part0 TYPE: 2145 POLICY: ROUND ROBIN SUB SET
SERIAL: 60050768019B02A810000000000001A1 Reserved: No LUN SIZE: 20.0GB
HOST INTERFACE: FC

Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0 *	Scsi Port6 Bus0/Disk1 Part0	OPEN	NORMAL	51	1
1 *	Scsi Port6 Bus0/Disk1 Part0	OPEN	NORMAL	0	0
2	Scsi Port6 Bus0/Disk1 Part0	OPEN	NORMAL	0	0
3	Scsi Port6 Bus0/Disk1 Part0	OPEN	NORMAL	0	0

DEV#: 1 DEVICE NAME: Disk2 Part0 TYPE: 2145 POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A2 Reserved: No LUN SIZE: 20.0GB
HOST INTERFACE: FC

Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0	Scsi Port6 Bus0/Disk2 Part0	OPEN	NORMAL	16	0
1	Scsi Port6 Bus0/Disk2 Part0	OPEN	NORMAL	9	0
2 *	Scsi Port6 Bus0/Disk2 Part0	OPEN	NORMAL	0	0
3 *	Scsi Port6 Bus0/Disk2 Part0	OPEN	NORMAL	0	0

DEV#: 2 DEVICE NAME: Disk3 Part0 TYPE: 2145 POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A3 Reserved: No LUN SIZE: 20.0GB
HOST INTERFACE: FC

Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0 *	Scsi Port6 Bus0/Disk3 Part0	OPEN	NORMAL	14	0
1 *	Scsi Port6 Bus0/Disk3 Part0	OPEN	NORMAL	10	0
2	Scsi Port6 Bus0/Disk3 Part0	OPEN	NORMAL	0	0
3	Scsi Port6 Bus0/Disk3 Part0	OPEN	NORMAL	0	0

Activating additional paths

About this task

Complete the following steps to activate additional paths to an SDDDSM device:

1. Install any new hardware on the Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 or the SAN Volume Controller.
2. Open the DOS prompt window.
 - On a Windows Server 2008: Click **Start** → **Program** → **Administrative Tools** → **Computer Management**.
 - On a Windows Server 2012, Windows Server 2016, or Windows Server 2019: Click **Server Manager** → **Tools** → **Computer Management**.
3. Click **Device Manager**.
4. Right-click **Disk drives**.
5. Click **Scan for hardware changes**.

Note: To obtain the latest information about disks in the Windows Server 2012, Windows Server 2016, or Windows Server 2019Server Core CLI, run the **Get-Disk** command in the Windows PowerShell.

6. Verify that the path is added correctly. See “Verifying that additional paths are installed correctly” on page 133.

Note: You can also scan the device using a datapath command and recover paths.

Verifying that additional paths are installed correctly

About this task

After installing additional paths to SDDDSM devices, verify that the additional paths have been installed correctly.

Complete the following steps to verify that the additional paths are installed correctly:

1. Open the DOS prompt window.
 - On Windows Server 2008: Click **Start** → **Program** → **Subsystem Device Driver DSM** → **Subsystem Device Driver DSM**.
 - On a Windows Server 2012: Click **Start** → **Apps** → **Subsystem Device Driver DSM**.
 - On a Windows Server 2016 or Windows Server 2019: Click **Start** → **Subsystem Device Driver DSM** → **Subsystem Device Driver DSM**.
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 HBA has been installed:

Active Adapters :2

Adpt#	Name	Interface	State	Mode	Select	Errors	Paths	Active
0	Scsi Port6 Bus0	FC	NORMAL	ACTIVE	1099	1	112	112
1	Scsi Port7 Bus0	FC	NORMAL	ACTIVE	813	0	112	112

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 HBA and the new device numbers that were assigned. The following output is displayed:

Total Devices : 3

DEV#: 0 DEVICE NAME: Disk1 Part0 TYPE: 2145 POLICY: ROUND ROBIN SUB SET
SERIAL: 60050768019B02A810000000000001A1 Reserved: No LUN SIZE: 20.0GB
HOST INTERFACE: FC

Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0 *	Scsi Port6 Bus0/Disk1 Part0	OPEN	NORMAL	51	1
1 *	Scsi Port6 Bus0/Disk1 Part0	OPEN	NORMAL	0	0
2 *	Scsi Port7 Bus0/Disk1 Part0	OPEN	NORMAL	0	0
3 *	Scsi Port7 Bus0/Disk1 Part0	OPEN	NORMAL	0	0
4	Scsi Port6 Bus0/Disk1 Part0	OPEN	NORMAL	0	0
5	Scsi Port6 Bus0/Disk1 Part0	OPEN	NORMAL	0	0
6	Scsi Port7 Bus0/Disk1 Part0	OPEN	NORMAL	0	0
7	Scsi Port7 Bus0/Disk1 Part0	OPEN	NORMAL	0	0

DEV#: 1 DEVICE NAME: Disk2 Part0 TYPE: 2145 POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A2 Reserved: No LUN SIZE: 20.0GB
HOST INTERFACE: FC

Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0	Scsi Port6 Bus0/Disk2 Part0	OPEN	NORMAL	16	0
1	Scsi Port6 Bus0/Disk2 Part0	OPEN	NORMAL	9	0
2	Scsi Port7 Bus0/Disk2 Part0	OPEN	NORMAL	12	0
3	Scsi Port7 Bus0/Disk2 Part0	OPEN	NORMAL	13	0
4 *	Scsi Port6 Bus0/Disk2 Part0	OPEN	NORMAL	0	0
5 *	Scsi Port6 Bus0/Disk2 Part0	OPEN	NORMAL	0	0
6 *	Scsi Port7 Bus0/Disk2 Part0	OPEN	NORMAL	0	0
7 *	Scsi Port7 Bus0/Disk2 Part0	OPEN	NORMAL	0	0

DEV#: 2 DEVICE NAME: Disk3 Part0 TYPE: 2145 POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A3 Reserved: No LUN SIZE: 20.0GB
HOST INTERFACE: FC

Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0 *	Scsi Port6 Bus0/Disk3 Part0	OPEN	NORMAL	14	0
1 *	Scsi Port6 Bus0/Disk3 Part0	OPEN	NORMAL	10	0
2 *	Scsi Port7 Bus0/Disk3 Part0	OPEN	NORMAL	16	0
3 *	Scsi Port7 Bus0/Disk3 Part0	OPEN	NORMAL	10	0
4	Scsi Port6 Bus0/Disk3 Part0	OPEN	NORMAL	0	0
5	Scsi Port6 Bus0/Disk3 Part0	OPEN	NORMAL	0	0
6	Scsi Port7 Bus0/Disk3 Part0	OPEN	NORMAL	0	0
7	Scsi Port7 Bus0/Disk3 Part0	OPEN	NORMAL	0	0

Removing additional paths

About this task

Complete the following steps to remove additional paths to an SDDDSM device:

1. Uninstall any additional hardware on the Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 server or the SAN Volume Controller. Alternatively, you can change the zoning configuration.
2. Open Computer Management window.
 - On a Windows Server 2008: Click **Start** → **Program** → **Administrative Tools** → **Computer Management**.
 - On a Windows Server 2012, Windows Server 2016, or Windows Server 2019: Click **Server Manager** → **Tools** → **Computer Management**.
3. Click **Device Manager**.
4. Right-click **Disk drives**.
5. Click **Scan for hardware changes**.

Note: To get latest information about disks in Windows Server 2012, Windows Server 2016, or Windows Server 2019 Core CLI, run **Get-Disk** command in the Windows PowerShell.

6. Verify that the path is removed correctly. See “Verifying that additional paths are removed correctly.”

Verifying that additional paths are removed correctly

About this task

After removing additional paths to SDDDSM devices, verify that the additional paths have been removed correctly.

Complete the following steps to verify that the additional paths are removed correctly:

1. Open the DOS prompt window.
 - On a Windows Server 2008 server: Click **Start → Program → Subsystem Device Driver DSM → Subsystem Device Driver DSM**.
 - On a Windows Server 2012 server: Click **Start → Apps → Subsystem Device Driver DSM**.
 - On a Windows Server 2016, or Windows Server 2019 server: Click **Start → Subsystem Device Driver DSM → Subsystem Device Driver DSM**.
 - On a Windows Server 2012, Windows Server 2016, or Windows Server 2019 Core CLI server: Go to %PROGRAMFILES%\IBM\SDDDSM.
2. Type **datapath query adapter** and press **Enter**. The output includes information about any additional adapters that were installed. In the following example, the output shows that an additional HBA is installed:

Active Adapters :2

Adpt#	Name	Interface	State	Mode	Select	Errors	Paths	Active
0	Scsi Port6 Bus0	FC	NORMAL	ACTIVE	1099	1	112	112
1	Scsi Port7 Bus0	FC	NORMAL	ACTIVE	813	0	112	112

3. Type **datapath query device** and press **Enter**. Continuing with the earlier example, the output includes information about three devices that are attached to the SCSI path:

```

DEV#: 0  DEVICE NAME: Disk1 Part0      TYPE: 2145    POLICY: ROUND ROBIN SUB SET
SERIAL: 60050768019B02A810000000000001A1  Reserved: No  LUN SIZE: 20.0GB
HOST INTERFACE: FC
=====
Path#   Adapter/Hard Disk                State  Mode    Select  Errors
0 *    Scsi Port6 Bus0/Disk1 Part0    OPEN   NORMAL  51      1
1 *    Scsi Port6 Bus0/Disk1 Part0    OPEN   NORMAL  0      0
2 *    Scsi Port7 Bus0/Disk1 Part0    OPEN   NORMAL  0      0
3 *    Scsi Port7 Bus0/Disk1 Part0    OPEN   NORMAL  0      0
4      Scsi Port6 Bus0/Disk1 Part0    OPEN   NORMAL  0      0
5      Scsi Port6 Bus0/Disk1 Part0    OPEN   NORMAL  0      0
6      Scsi Port7 Bus0/Disk1 Part0    OPEN   NORMAL  0      0
7      Scsi Port7 Bus0/Disk1 Part0    OPEN   NORMAL  0      0

DEV#: 1  DEVICE NAME: Disk2 Part0      TYPE: 2145    POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A2  Reserved: No  LUN SIZE: 20.0GB
HOST INTERFACE: FC
=====
Path#   Adapter/Hard Disk                State  Mode    Select  Errors
0      Scsi Port6 Bus0/Disk2 Part0    OPEN   NORMAL  16      0
1      Scsi Port6 Bus0/Disk2 Part0    OPEN   NORMAL  9      0
2      Scsi Port7 Bus0/Disk2 Part0    OPEN   NORMAL  12     0
3      Scsi Port7 Bus0/Disk2 Part0    OPEN   NORMAL  13     0
4 *    Scsi Port6 Bus0/Disk2 Part0    OPEN   NORMAL  0      0
5 *    Scsi Port6 Bus0/Disk2 Part0    OPEN   NORMAL  0      0
6 *    Scsi Port7 Bus0/Disk2 Part0    OPEN   NORMAL  0      0
7 *    Scsi Port7 Bus0/Disk2 Part0    OPEN   NORMAL  0      0

DEV#: 2  DEVICE NAME: Disk3 Part0      TYPE: 2145    POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A3  Reserved: No  LUN SIZE: 20.0GB
HOST INTERFACE: FC
=====
Path#   Adapter/Hard Disk                State  Mode    Select  Errors
0 *    Scsi Port6 Bus0/Disk3 Part0    OPEN   NORMAL  14      0
1 *    Scsi Port6 Bus0/Disk3 Part0    OPEN   NORMAL  10      0
2 *    Scsi Port7 Bus0/Disk3 Part0    OPEN   NORMAL  16      0
3 *    Scsi Port7 Bus0/Disk3 Part0    OPEN   NORMAL  10      0
4      Scsi Port6 Bus0/Disk3 Part0    OPEN   NORMAL  0      0
5      Scsi Port6 Bus0/Disk3 Part0    OPEN   NORMAL  0      0
6      Scsi Port7 Bus0/Disk3 Part0    OPEN   NORMAL  0      0
7      Scsi Port7 Bus0/Disk3 Part0    OPEN   NORMAL  0      0

```

4. Remove four paths and run the **datapath query device** command. Continuing with the earlier example, the output shows that three devices are attached to the SCSI path. The output includes information about the paths that are not removed.

```

DEV#: 0  DEVICE NAME: Disk1 Part0      TYPE: 2145    POLICY: ROUND ROBIN SUB SET
SERIAL: 60050768019B02A810000000000001A1  Reserved: No  LUN SIZE: 20.0GB
HOST INTERFACE: FC
=====
Path#    Adapter/Hard Disk                State    Mode      Select    Errors
  0      Scsi Port6 Bus0/Disk1 Part0    OPEN     NORMAL    23        0
  1 *    Scsi Port6 Bus0/Disk1 Part0    OPEN     NORMAL    0         0
  2      Scsi Port7 Bus0/Disk1 Part0    OPEN     NORMAL    23        0
  3 *    Scsi Port7 Bus0/Disk1 Part0    OPEN     NORMAL    0         0

DEV#: 1  DEVICE NAME: Disk2 Part0      TYPE: 2145    POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A2  Reserved: No  LUN SIZE: 20.0GB
HOST INTERFACE: FC
=====
Path#    Adapter/Hard Disk                State    Mode      Select    Errors
  0 *    Scsi Port6 Bus0/Disk2 Part0    OPEN     NORMAL    0         0
  1      Scsi Port6 Bus0/Disk2 Part0    OPEN     NORMAL    22        0
  2 *    Scsi Port7 Bus0/Disk2 Part0    OPEN     NORMAL    0         0
  3      Scsi Port7 Bus0/Disk2 Part0    OPEN     NORMAL    24        0

DEV#: 2  DEVICE NAME: Disk3 Part0      TYPE: 2145    POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A3  Reserved: No  LUN SIZE: 20.0GB
HOST INTERFACE: FC
=====
Path#    Adapter/Hard Disk                State    Mode      Select    Errors
  0      Scsi Port6 Bus0/Disk3 Part0    OPEN     NORMAL    25        0
  1 *    Scsi Port6 Bus0/Disk3 Part0    OPEN     NORMAL    0         0
  2      Scsi Port7 Bus0/Disk3 Part0    OPEN     NORMAL    21        0
  3 *    Scsi Port7 Bus0/Disk3 Part0    OPEN     NORMAL    0         0

```

5. Add the four paths again and run the **datapath query device** command. Continuing with the earlier example, the output shows that three devices are attached to the SCSI path. The path numbers for the existing paths do not change. The old path numbers are reassigned to the paths that you added in this step.

```

DEV#: 0  DEVICE NAME: Disk1 Part0      TYPE: 2145    POLICY: ROUND ROBIN SUB SET
SERIAL: 60050768019B02A810000000000001A1  Reserved: No  LUN SIZE: 20.0GB
HOST INTERFACE: FC

```

```

=====
Path#   Adapter/Hard Disk      State  Mode      Select  Errors
0 *     Scsi Port6 Bus0/Disk1 Part0  OPEN   NORMAL    51      1
1 *     Scsi Port6 Bus0/Disk1 Part0  OPEN   NORMAL     0      0
2 *     Scsi Port7 Bus0/Disk1 Part0  OPEN   NORMAL     0      0
3 *     Scsi Port7 Bus0/Disk1 Part0  OPEN   NORMAL     0      0
4       Scsi Port6 Bus0/Disk1 Part0  OPEN   NORMAL     0      0
5       Scsi Port6 Bus0/Disk1 Part0  OPEN   NORMAL     0      0
6       Scsi Port7 Bus0/Disk1 Part0  OPEN   NORMAL     0      0
7       Scsi Port7 Bus0/Disk1 Part0  OPEN   NORMAL     0      0

```

```

DEV#: 1  DEVICE NAME: Disk2 Part0      TYPE: 2145    POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A2  Reserved: No  LUN SIZE: 20.0GB
HOST INTERFACE: FC

```

```

=====
Path#   Adapter/Hard Disk      State  Mode      Select  Errors
0       Scsi Port6 Bus0/Disk2 Part0  OPEN   NORMAL    16      0
1       Scsi Port6 Bus0/Disk2 Part0  OPEN   NORMAL     9      0
2       Scsi Port7 Bus0/Disk2 Part0  OPEN   NORMAL    12      0
3       Scsi Port7 Bus0/Disk2 Part0  OPEN   NORMAL    13      0
4 *     Scsi Port6 Bus0/Disk2 Part0  OPEN   NORMAL     0      0
5 *     Scsi Port6 Bus0/Disk2 Part0  OPEN   NORMAL     0      0
6 *     Scsi Port7 Bus0/Disk2 Part0  OPEN   NORMAL     0      0
7 *     Scsi Port7 Bus0/Disk2 Part0  OPEN   NORMAL     0      0

```

```

DEV#: 2  DEVICE NAME: Disk3 Part0      TYPE: 2145    POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A810000000000001A3  Reserved: No  LUN SIZE: 20.0GB
HOST INTERFACE: FC

```

```

=====
Path#   Adapter/Hard Disk      State  Mode      Select  Errors
0 *     Scsi Port6 Bus0/Disk3 Part0  OPEN   NORMAL    14      0
1 *     Scsi Port6 Bus0/Disk3 Part0  OPEN   NORMAL    10      0
2 *     Scsi Port7 Bus0/Disk3 Part0  OPEN   NORMAL    16      0
3 *     Scsi Port7 Bus0/Disk3 Part0  OPEN   NORMAL    10      0
4       Scsi Port6 Bus0/Disk3 Part0  OPEN   NORMAL     0      0
5       Scsi Port6 Bus0/Disk3 Part0  OPEN   NORMAL     0      0
6       Scsi Port7 Bus0/Disk3 Part0  OPEN   NORMAL     0      0
7       Scsi Port7 Bus0/Disk3 Part0  OPEN   NORMAL     0      0

```

Uninstalling SDDDSM

About this task

Attention: If you are not planning to reinstall SDDDSM after the uninstallation, ensure that there is a single-path connection from the system to the storage device before performing a restart to avoid any potential data loss.

Complete the following steps to uninstall SDDDSM on a Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 host system:

1. Log on as the administrator user.
2. Uninstall SDDDSM.
 - On Windows Server 2008:
 - a. Click **Start → Settings → Control Panel**. The Control Panel opens.
 - b. Double-click **Add/Remove Programs**. The Add/Remove Programs window opens.
 - c. In the Add/Remove Programs window, select **Subsystem Device Driver DSM** from the currently installed programs selection list.
 - d. Click **Add/Remove**. You will be asked to confirm that you want to uninstall.

- On Windows Server 2012, Windows Server 2016, or Windows Server 2019:
 - a. Click **Start Screen** → **Control Panel**. The Control Panel opens.
 - b. Click **Programs** → **Program and Features** → **Uninstall a program**.
 - c. From the list of programs, select **Subsystem Device Driver DSM** and in the Confirm dialog box, click **OK**.
- On Windows Server 2012, Windows Server 2016, or Windows Server 2019 Server Core CLI:
 - a. Go to %PROGRAMFILES%\IBM\SDDDSM.
 - b. Run **setup -u**.
- 3. Shut down the host system after the uninstallation process completes.
- 4. Change the zoning configuration or cable connections to ensure that there is only single-path connection from the system to the storage device.
- 5. Power on the host system.

Note: On Windows Server 2012, Windows Server 2016, or Windows Server 2019, You might have to manually delete the file C:/Windows/System32/drivers/sdddsm.sys.

SAN boot support

About this task

Use the following procedures for SAN boot support.

Remote boot support for 32-bit Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 using a QLogic HBA

Complete the following steps to install SDDDSM :

1. Configure the SAN Environment so that both Qlogic HBAs in the server can see the SAN boot device.
2. Start the server with 2 fibre-channel cables connected to both HBAs.
3. Press **Ctrl+Q** to go to Qlogic Bios Fast Utilities.
4. Select the first HBA.
5. Select **Configuration Settings**.
6. Select **Host Adapter Setting**. Enable the BIOS.
7. Press **ESC**.
8. Select **Selectable Boot Settings**.
9. Enable **Selectable Boot**.
10. Select **first (primary) boot** and press **Enter**.
11. Select **IBM storage device** and press **Enter**.
12. At the **Select LUN** prompt, select the first supported LUN, which is LUN 0.
13. Press **Esc** and select **Save Changes**.
14. Select the second HBA and repeat steps 5-13.
15. Remove the fibre-channel cable from the second HBA so that you have only a single path to first HBA.
16. Restart the Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 with the latest Service Pack CD-ROM.

17. Continue with the Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 installation process. Remember to select the SAN device that is seen by Qlogic HBA as the device to install Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019. Continue with the OS installation.
18. After Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 is installed on the SAN boot device, shut down the system.
19. Unplug the Fibre Channel cable from the first HBA and plug the Fibre Channel cable into the second HBA so that you have a single path from the second HBA to the SAN device.
20. Restart the server. The system should come up in SAN Boot mode.
21. Install the latest SDDDSM and restart.
22. To add multipath support to a SAN boot device:
 - a. Shut down the server.
 - b. Plug in the fibre-channel cable to the other HBA.
 - c. Configure the SAN to have more paths to SAN boot device if needed.
23. Restart the server.

Booting from a SAN device with Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 and the SDDDSM using an Emulex HBA

About this task

Note: The **Automatic LUN Mapping** checkbox of the Emulex Configuration Settings should be selected so that both HBA ports can see all assigned LUNs.

Complete the following steps.

Procedure

1. Configure the SAN Environment so that both Emulex HBAs in the server can see the SAN boot device.
2. Boot the server with 2 fibre-channel cables connected to both HBAs.
3. Press **Alt+E** to go to the Emulex BIOS Utilities.
4. Select the first HBA.
5. Select **Configure HBA Parameter Settings**.
6. Select **Option 1** to enable BIOS for this HBA.
7. Press **Page Up** to go back. Then select **Configure Boot Device**.
8. Select the first unused boot device for **Select Boot Entry** from the **List Of Saved Boot Devices**.
9. Select **01** for **Select The Two Digit Number Of The Desired Boot Device**.
10. Enter **00** for **Enter Two Digit Of Starting LUNs (hexadecimal)**.
11. Select device number **01** for **Enter Selection For Starting LUN**.
12. Select **Boot Device Via WWPN**.
13. Page up. Then select the second HBA. Repeat steps 5-12 to configure boot support for this HBA.
14. Unplug the fibre-channel cable from second HBA and plug the fibre-channel cable to the first HBA so that you have a single path from first HBA to the SAN device.

15. Restart the Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 with the latest Service Pack CD-ROM.
16. Continue with the Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 installation process.
17. After Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 is installed on the SAN Boot device, shut down the system.
18. Unplug the fibre-channel cable from the first HBA and plug in the fibre-channel cable to the second HBA so that you have a single path from second HBA to SAN device.
19. Restart the server. The system should be up in SAN boot mode.
20. Install the latest SDDDSM and restart.
21. To add multipath support to a SAN boot device:
 - a. Shut down the server.
 - b. Plug in the fibre-channel cable to the other HBA.
 - c. Configure the SAN to have more paths to the SAN boot device if needed.
22. Restart the server.

Support for Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 clustering

Configuring Support for Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 cluster with SDDDSM installed

About this task

The following variables are used in this procedure:

server_1

Represents the first server with two HBAs.

server_2

Represents the second server with two HBAs.

Complete the following steps to configure a Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 cluster with SDDDSM:

1. On both *server_1* and *server_2*, configure SAN devices on supported storage as shared for all HBAs.
2. Install the latest SDDDSM on *server_1*. For installation instructions, see “Installing SDDDSM” on page 127.
3. Connect fibre-channel cables from *server_1* to the supported storage, and restart *server_1*.
4. Use the **datapath query adapter** and **datapath query device** commands to verify the correct number of SAN devices and paths on *server_1*.
5. Click **Start** → **All Programs** → **Administrative Tools** → **Computer Management**. From the Computer Management window, select **Storage** and then select **Disk Management** to work with the storage devices attached to the host system.
6. Format the raw devices with NTFS and assign drive letters for all SAN devices that are going to be used as MSCS resources. Ensure that you keep track of the assigned drive letters on *server_1*.

7. Shut down *server_1*.
8. Install the latest SDDDSM on *server_2* . For installation instructions, see “Installing SDDDSM” on page 127.
9. Connect fibre-channel cables from *server_2* to the supported storage, and restart *server_2*.
10. Use the **datapath query adapter** and **datapath query device** commands to verify the correct number of SAN devices and paths on *server_2*.
11. Click **Start** → **All Programs** → **Administrative Tools** → **Computer Management**. From the Computer Management window, select **Storage** and then select **Disk Management** to work with the storage devices attached to the host system. Verify that the assigned drive letters for MSCS resources on *server_2* match the assigned drive letters on *server_1*.
12. Enable the “Failover Clustering” feature and configure MSCS on *server_2*.
13. Restart *server_1*.
14. Enable the “Failover Clustering” feature and configure MSCS on *server_1* as the second node of the MSCS cluster.
15. Use the **datapath query adapter** and **datapath query device** commands to verify that 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 shows only the physical volumes and the logical volumes that it owns.

Removing SDDDSM in a two-node cluster environment

About this task

Use the following steps if you intend to remove the multipathing functions to a SAN device in a two-node cluster environment.

Complete the following steps to remove SDDDSM in a two-node cluster environment:

1. Move all cluster resources from node A to node B.
2. Ensure that there is a single-path connection from the system to the storage device which may include the following activities:
 - a. Disable access of the second HBA to the storage device.
 - b. Change the zoning configuration to allow only one port accessed by this host.
 - c. Remove shared access to the second HBA through the IBM TotalStorage Expert V.2.1.0 Specialist.
 - d. Remove multiple SAN Volume Controller port access, if applicable.
3. Uninstall SDDDSM. See “Uninstalling SDDDSM” on page 138 for instructions.
4. Restart your system.
5. Move all cluster resources from node B to node A.
6. Complete steps 2 - 5 on node B.

About I/O timeout errors

When you are troubleshooting issues with storage performance, application hangs, and unexpected I/O timeout errors, check whether settings related to application timeout, Windows default disk I/O timeout, and adapter timeout values meet the operational requirements.

Contact technical support teams of Microsoft and other vendors for any queries related to timeout settings.

SDDDSM datapath command support

SDDDSM supports the following **datapath** commands:

```
Usage: datapath query adapter [<n>] [-itype <iscsi/fc>]
      datapath query device [<n>]/[<m> <n>] [-d <device_model>] [-i <x>/(<x> <y>)]
      [-s] [-c] [-a] [-tpgs] [-itype <iscsi/fc>] [-k]
      datapath query adaptstats [<n>]
      datapath query devstats [<n>]/[<m> <n>] [-d <device_model>] [-i <x>/(<x> <y>)] [-c]
      datapath query wwpn
      datapath query port
      datapath query version
      datapath query portmap
      datapath query essmap
      datapath set adapter <n> online/offline/pathcountref
      datapath set device <n> path <m> online/offline
      datapath set device <n> path <m> preferred <0/1>
      datapath set device <n>/(<m> <n>) policy fo/lb/sqst/lqd/lbytes/rr/rrss/df
      fo      - failover(no load balance)
      lb      - least number of I/O and adapter weight
      sqst    - shortest queue service time
      lqd     - least queue depth
      lbytes  - least bytes
      rr      - round robin
      rrss    - round robin with subset
      df      - default(uses lb)

      optNodes - I/O routed to Optimized Nodes
      allNodes - I/O routed to All Nodes

      optNodes/allNodes applicable only to sqst, lqd, and lbytes.
      For rr I/O routes to allNodes.
      For rrss, lb I/O routed to Optimized nodes.

      datapath rescnwh [-f] [device <device_id>][<n>]
      datapath set performance [on/off] [device <n>]
      datapath clear adapter <n>/(<m> <n>) adaptstats all
      datapath clear device <n>/(<m> <n>) count error/all
      datapath disable/enable ports <connection> ess <essid>
      Supported connection format:
      single port      = R1-Bx-Hy-Zz
      all ports on card = R1-Bx-Hy
      all ports on bay  = R1-Bx
      refer portmap output for the connection string and ESS serial number

      Examples of valid device model include:
      2145 - Displays all 2145 devices (SVC)
      2107 - Displays all 2107 devices (DS 8000)
```

Note: For RSSM devices, even when two or more serial-attached SCSI (SAS) HBAs are installed on the host, SDDDSM finds only a single HBA, and the output of datapath query adapter shows only one adapter.

IBM does not support RSSM. For more information, contact the IBM Support team.

For additional information about the **datapath** commands, see Chapter 6, “Using the datapath commands,” on page 163.

SDDDSM server daemon

The SDDDSM server (also referred to as `sddsrv`) is an integral component of SDDDSM. This component consists of a Windows application daemon that is installed in addition to the SDDDSM device driver.

Verifying if the SDDDSM server has started

About this task

After you have installed SDDDSM, complete the following steps to verify that the SDDDSM server (`sddsrv`) has automatically started:

1. Click **Start** → **Programs** → **Administrative Tools** → **Computer Management**.
2. Expand the Services and Applications tree.
3. Click **Services**.
4. Right-click **SDD Service**.
5. Verify that the status of the SDD Service has *Started*.

Starting the SDDDSM server manually

About this task

If the SDDDSM server did not start automatically after you performed the SDDDSM installation, complete the following steps to start `sddsrv`:

1. Click **Start** → **Programs** → **Administrative Tools** → **Computer Management**.
2. Expand the Services and Applications tree.
3. Click **Services**.
4. Right-click **SDD Service**.
5. Click **Start**.

Note: Alternatively, to start the SDD service, run **net start SDD_Service** on the command prompt.

Changing to a different port number for the SDDDSM server

To change to a different port number for the SDDDSM server, see the instructions in the “Changing the `sddsrv` or `pcmsrv` TCP/IP port number” on page 162.

Stopping the SDDDSM server

About this task

To stop the SDDDSM server, complete the following steps:

Procedure

1. Click **Start** → **Programs** → **Administrative Tools** → **Computer Management**.
2. Expand the Services and Applications tree.
3. Click **Services**.
4. Right-click **SDD Service**.
5. Click **Stop**.

Note: Alternatively, to stop the SDD service, run **net stop SDD_Service** on the command prompt.

SDDDSM release 2.4.5.0 features

The SDDDSM 2.4.5.0 release includes the following features.

Additional load balance policies in SDDDSM 2.4.5.0

Apart from the Round Robin and Optimized load balance policies, SDDDSM now includes additional load balance policies to enhance the I/O performance and to provide the user with an option to choose the policy that better suits their current SAN configuration.

Note: SVC recommends using only Active-Optimized paths for I/O as long as they are available. This is done with least number of I/O and adapter weight (lb) and Round Robin with Subset (rrss) policies. Rest of the load balance policies use all the Active-Optimized and Active-UnOptimized paths. Choose the one which suits your SAN configuration for enhanced I/O Performance. The default is set to least number of I/O and adapter weight(lb) which used to be the same as Load Balance(lb) in the earlier releases of SDDDSM.

The following are the additional load balance policies available in SDDDSM 2.4.5.0 and later releases.

Shortest Queue Service Time (sqst)

This load balance policy selects the most optimal path for the multipath device (mpdInfo) based on the pending I/O service time which is cumulative for all the outstanding I/Os together on this pathInfo. Service time for an I/O is the time taken to serve it. It is the difference of the time since MPIO has submitted the I/O to the lower driver in the device stack and the time when this I/O comes back to MPIO from storage device. **GmLBalanceShortestQueueServiceTime()** selects the new path with the least pending I/O service time.

Least Queue Depth (lqd)

This load balance policy selects the most optimal path for the multipath device (mpdInfo) based on the least queue depth which is maintained per failover group or per path id. Queue depth is the number of outstanding I/Os currently waiting in the queue to be served on this fail over group. **GmLBalanceLeastQueueDepth()** selects the new path with the least queue depth.

Least Bytes (lbytes)

This load balance policy selects the most optimal path for the multipath device (mpdInfo) based on the the least current outstanding bytes in the I/O queue for each path. Total bytes is considered for all the I/Os together on this device path. **GmLBalanceLeastBytes()** selects the new path with the least bytes.

Round Robin (rr)

This load balance policy selects the new path in a round robin manner. The last path used is not selected next.

Round Robin with Subset (rrss)

This load balance policy selects the most optimal path for the multipath device (mpdInfo) in a round robin manner within a subset of paths. The paths can be only from the active-optimized controller. The last path used is not selected next.

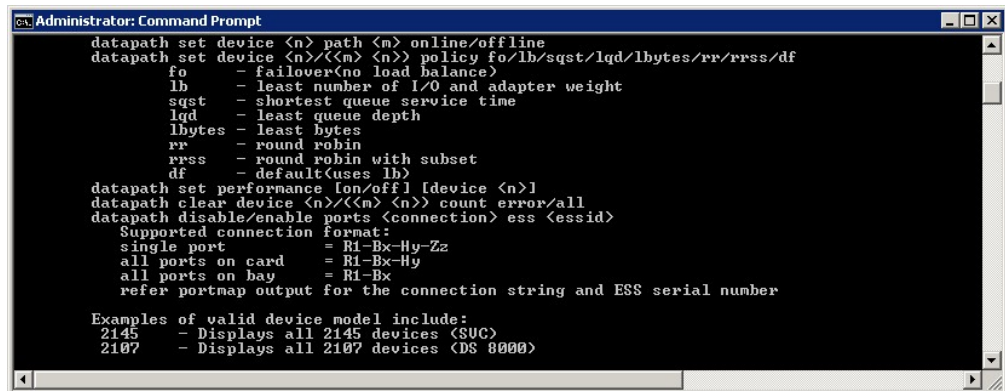
least number of I/O and adapter weight (lb)

This load balance policy selects the most optimal path for the multipath device (mpdInfo) based on a path with no pending I/O and that has the least accumulated path weight on that adapter. **GmLBalanceOptimized()** selects path with no I/O and the least adapter path weight.

Changes in datapath command

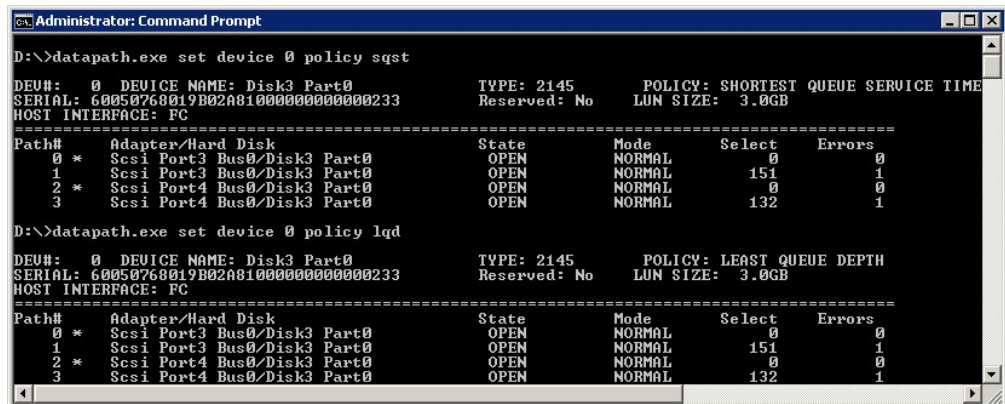
The **datapath** command changes for the additional load balance policies included in SDDDSM 2.4.5.0 are as follows.

```
datapath set device <n>/(<m> <n>) policy fo/lb/sqst/lqd/lbytes/rr/rrss/df\n
fo      - failover(no load balance)\n
lb      - least number of I/O and adapter weight\n
sqst    - shortest queue service time\n
lqd     - least queue depth\n
lbytes  - least bytes\n
rr      - round robin\n
rrss    - round robin with subset\n
df      - default(uses lb)\n
```



```
Administrator: Command Prompt
datapath set device <n> path <m> online/offline
datapath set device <n>/(<m> <n>) policy fo/lb/sqst/lqd/lbytes/rr/rrss/df
fo      - failover(no load balance)
lb      - least number of I/O and adapter weight
sqst    - shortest queue service time
lqd     - least queue depth
lbytes  - least bytes
rr      - round robin
rrss    - round robin with subset
df      - default(uses lb)
datapath set performance [on/off] [device <n>]
datapath clear device <n>/(<m> <n>) count error/all
datapath disable/enable ports <connection> ess <essid>
Supported connection format:
single port      = R1-Bx-Hy-Zz
all ports on card = R1-Bx-Hy
all ports on bay  = R1-Bx
refer portmap output for the connection string and ESS serial number

Examples of valid device model include:
2145 - Displays all 2145 devices <SUC>
2107 - Displays all 2107 devices <DS 8000>
```



```
Administrator: Command Prompt
D:\>datapath.exe set device 0 policy sqst
DEU#: 0 DEVICE NAME: Disk3 Part0 TYPE: 2145 POLICY: SHORTEST QUEUE SERVICE TIME
SERIAL: 60050768019B02A810000000000000233 Reserved: No LUN SIZE: 3.0GB
HOST INTERFACE: FC
=====
Path# Adapter/Hard Disk State Mode Select Errors
0 * Scsi Port3 Bus0/Disk3 Part0 OPEN NORMAL 0 0
1 Scsi Port3 Bus0/Disk3 Part0 OPEN NORMAL 151 1
2 * Scsi Port4 Bus0/Disk3 Part0 OPEN NORMAL 0 0
3 * Scsi Port4 Bus0/Disk3 Part0 OPEN NORMAL 132 1

D:\>datapath.exe set device 0 policy lqd
DEU#: 0 DEVICE NAME: Disk3 Part0 TYPE: 2145 POLICY: LEAST QUEUE DEPTH
SERIAL: 60050768019B02A810000000000000233 Reserved: No LUN SIZE: 3.0GB
HOST INTERFACE: FC
=====
Path# Adapter/Hard Disk State Mode Select Errors
0 * Scsi Port3 Bus0/Disk3 Part0 OPEN NORMAL 0 0
1 Scsi Port3 Bus0/Disk3 Part0 OPEN NORMAL 151 1
2 * Scsi Port4 Bus0/Disk3 Part0 OPEN NORMAL 0 0
3 Scsi Port4 Bus0/Disk3 Part0 OPEN NORMAL 132 1
```

iSCSI support

SDDDSM has limited iSCSI support from the 2.4.5.0 release. Administrators can use iSCSI Initiator to configure iSCSI LUNs from storage and use MPIO/SDDDSM load balance I/O.

SDDDSM works with iSCSI LUNs exactly similar how it works with FC.

Changes in datapath command

```
datapath query adapter [<n>] [-itype <iscsi/fc>]\n\  
datapath query device [<n>]/[<m> <n>] [-d <device_model>] \n\  
[-i <x>/(<x><y>)] [-s] [-c] [-a] [-tpgs] [-itype <iscsi/fc>]\n\  
|
```

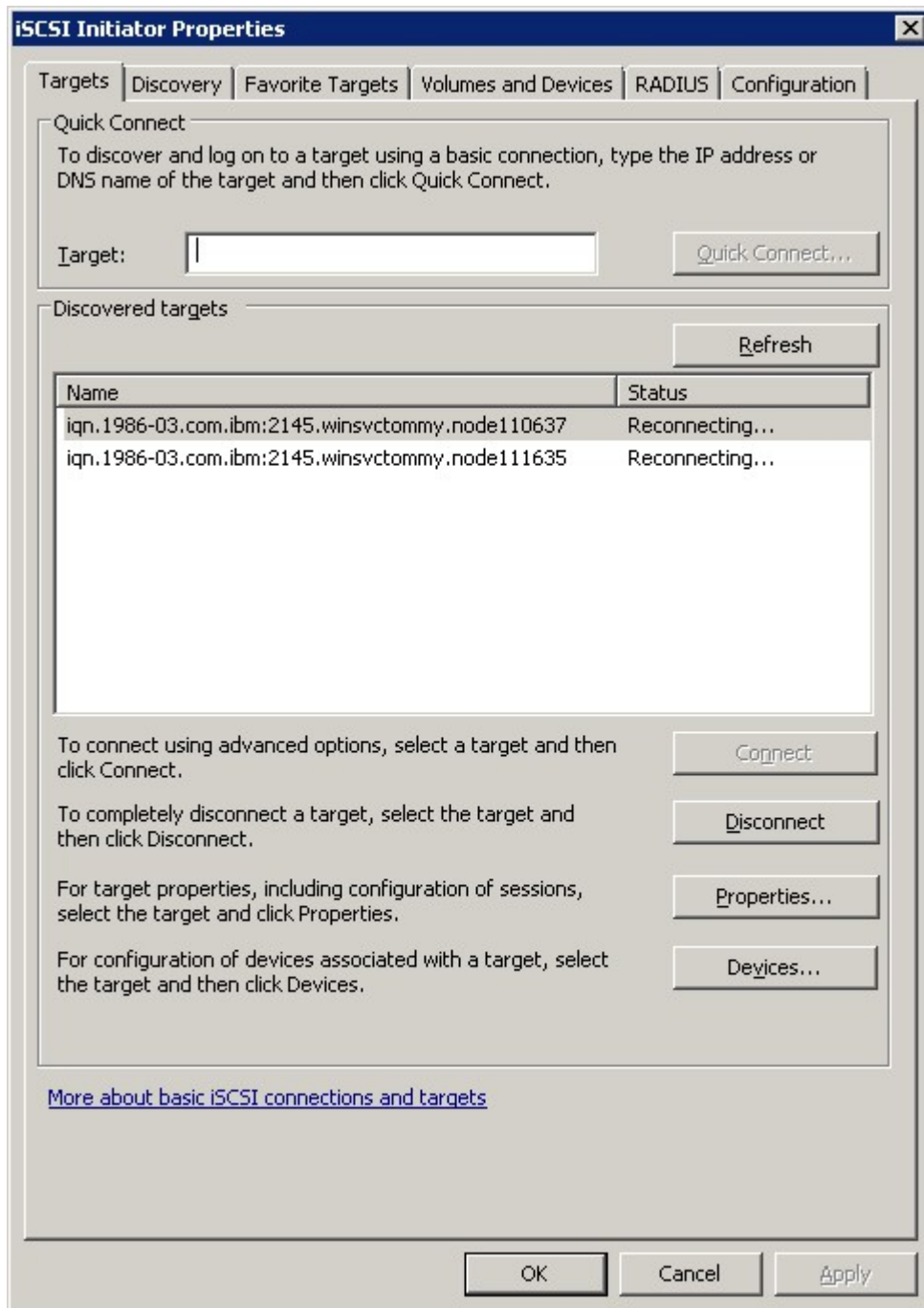
Supported platforms

The following platforms are supported.

- Windows Server 2008 R2 (64-bit)
- Windows Server 2008 R2 (32-bit)
- Windows Server 2012 (64-bit)
- Windows Server 2012 R2 (64-bit)
- Windows Server 2016 (64-bit)
- Windows Server 2019 (64-bit)

Mapping of LUNs

Mapping of the LUNs can be done using software iSCSI initiator which comes with operating system. iSCSI hardware initiator is not supported.



iSCSI in Hyper-V support

Microsoft supports iSCSI in Hyper-V with Windows Server 2012, Windows Server 2016, or Windows Server 2019. The same iSCSI Initiator can be used to configure LUNs for I/O.

Changes in datapath command

```
datapath query adapter [<n>] [-itype <iscsi/fc>]\n\
datapath query device [<n>]/[<m> <n>] [-d <device_model>] \n\
                    [-i <x>/(<x><y>)] [-s] [-c] [-a] [-tpgs] [-itype <iscsi/fc>]\n\
```

Supported platforms

The following platforms are supported.

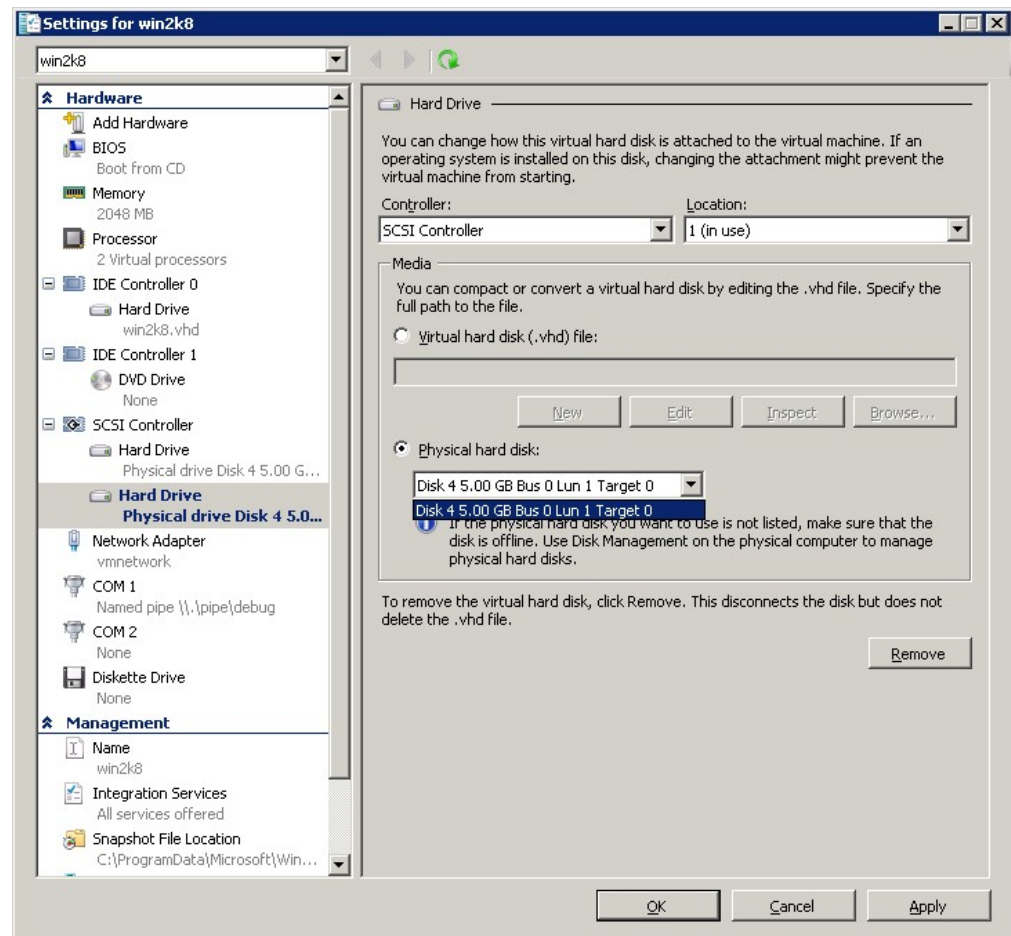
- Windows Server 2008 R2 (64-bit)
- Windows Server 2008 R2 (32-bit)
- Windows Server 2012 (64-bit)
- Windows Server 2012 R2 (64-bit)
- Windows Server 2016 (64-bit)
- Windows Server 2019 (64-bit)

Mapping of the LUNs

Direct mapping of the LUNs can be done using software iSCSI initiator which comes with the operating system. iSCSI hardware initiator is not supported. Pass-through LUNs come through iSCSI.

The VM location is as follows.

- VMs are installed on SAN disks.
- VMs are installed on CSVs.



FC in Hyper-V support

Microsoft supports FC in Hyper-V with MPIO from Windows Server 2008 R2 onwards. SDDDSM now supports FC in Hyper-V from the 2.4.5.0 release.

For NPIV support, refer to the HBA documentation.

Supported platforms

The following platforms are supported.

- Windows Server 2008 R2 (64-bit)
- Windows Server 2008 R2 (32-bit)
- Windows Server 2012 (64-bit)
- Windows Server 2012 R2 (32-bit)
- Windows Server 2016 (64-bit)
- Windows Server 2019 (64-bit)

Mapping of the LUNs

Direct mapping of the LUNs can be done using Hyper-V WWPNS from SVC. Pass-through LUNs come through the base operating system.

The VM location is as follows.

- VMs are installed on SAN disks.
- VMs are installed on CSVs and I/Os are started from them.

The following HBAs can be used.

- Emulex
- Qlogic

Note: Windows Server 2008 Hyper-V does not support FC connectivity.

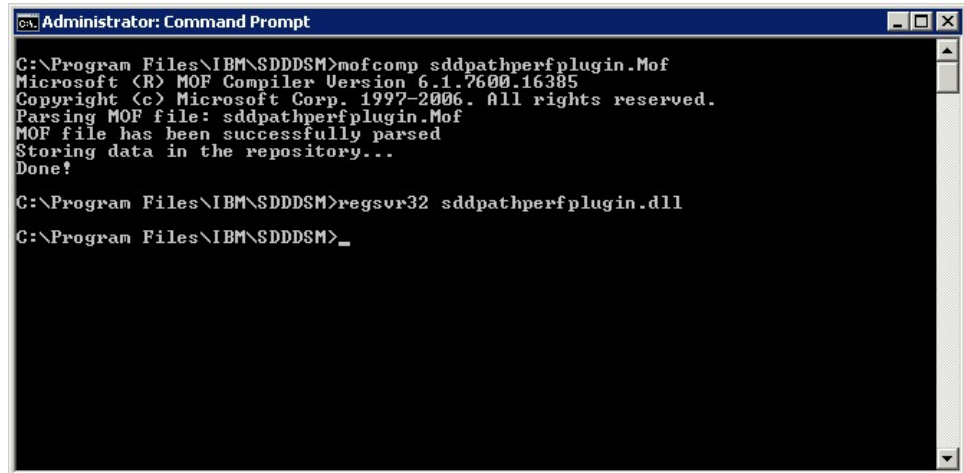
Path Performance Plug-in

Path Performance Plug-In provides I/O statistics per individual path for any storage LUN supported by the SDDDSM driver.

SDDDSM driver is modified to gather and provide all the I/O statistics to the user mode plug-in. This plug-in comes as a DLL library and it must be registered with regsvr32. The Managed Object Format (MOF) file that is a part of it must be compiled with MOF compiler (mofcomp). Once this is done, the plug-in can interact with **PerfMon** of the Windows operating system.

Before you can view the path performance statistics using **PerfMon**, you must complete the following steps.

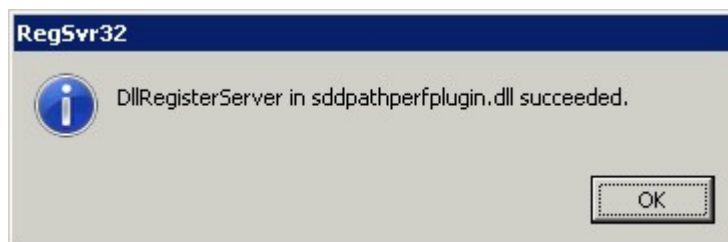
1. Run **mofcomp sddpathperfplugin.MOF**.
2. Run **regsvr32 sddpathperfplugin.dll** to register the new DLL or **regsvr32 -u sddpathperf-plugin.dll** to unregister the previous DLL.



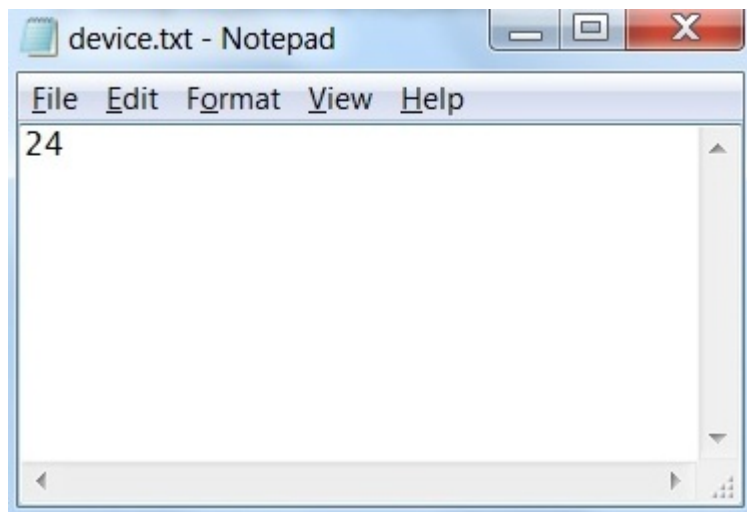
```
C:\Program Files\IBM\SDDDSM>mofcomp sddpathperfplugin.Mof
Microsoft (R) MOF Compiler Version 6.1.7600.16385
Copyright (c) Microsoft Corp. 1997-2006. All rights reserved.
Parsing MOF file: sddpathperfplugin.Mof
MOF file has been successfully parsed
Storing data in the repository...
Done!

C:\Program Files\IBM\SDDDSM>regsvr32 sddpathperfplugin.dll

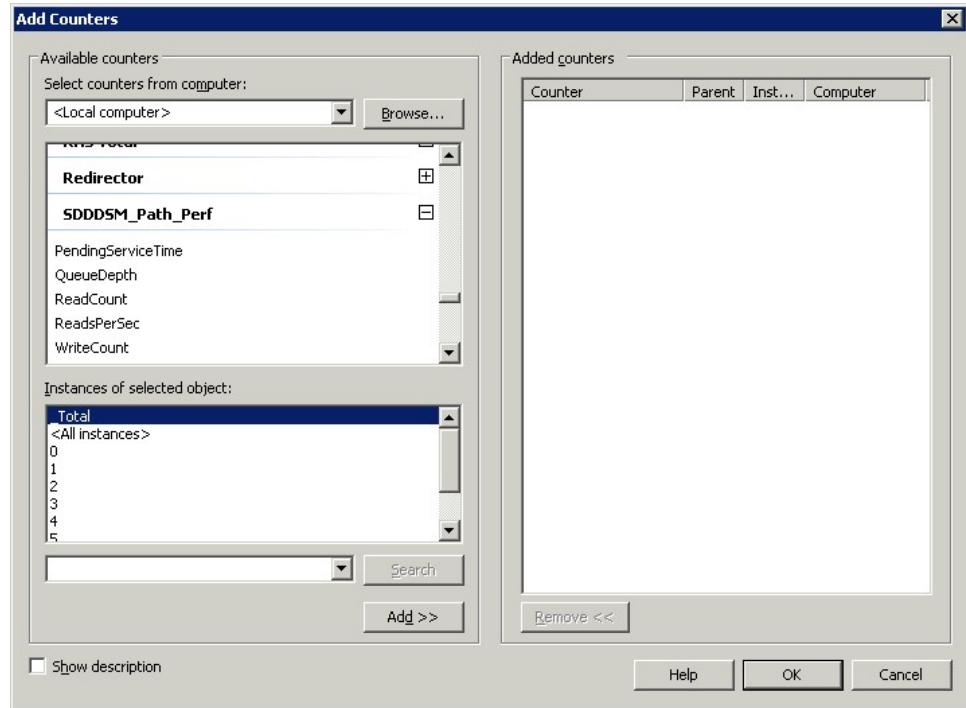
C:\Program Files\IBM\SDDDSM>_
```



3. Issue the **datapath set performance on** command.
4. Issue the **datapath set performance device <n>** command to start generating the performance statistics for disk *n*.
5. Manually add the device number used in the preceding step to the device.txt file.



6. Open **PerfMon** and select **SDDDSM_Path_Perf** and its counters.



Enhancement of failover group limit per adapter

SDDDSM releases before 2.4.5.0 limited the number of failover groups (unique SCSI addresses) per adapter to 32.

This enhancement removes this limitation and users can configure any number of unique initiator-target paths through only one of the adapter. However, it is recommended to distribute I/Os between multiple adapters for better performance.

SDDDSM release 2.4.6.0 features

SDDDSM release 2.4.6.0 offers the following features:

Quick failover to active node during SVC code upgrade

During SVC code upgrade, the NODE logo is identified during path verification. SDD seeks the NTSTATUS of STATUS_DEVICE_NOT_CONNECTED which the PORT/MIPORT drivers indicates, to identify the NODE logo.

Support for T2 recovery

SDD performs a TUR retry every 6 seconds unto 10 times, which helps in T2 recovery. After T2 recovery, the TUR appear to fail with an error code for a specific time. The time generally is T2 recovery time and an additional 60 seconds (T2Delay). After this time elapse, VDISKS run normally. The T2Delay value is 60 seconds and you can modify this registry(dword) value, if 60 seconds is not sufficient.

Support for extended SRB type

SDD supports STORAGE_REQUEST_BLOCK (extended SRB) that was introduced with Windows 2012. SCSI_REQUEST_BLOCK support still continues.

Note: From Windows 2012 onwards, Multipath I/O (MPIO) supports extended SRBs and allows Device Specific Modules (DSMs) to specify extended SRB support as well. However, in order for a multipath device's storage stack to use extended SRBs, **all components in the stack must support extended SRBs, including the DSM.**

Automatic NDVM re-scan

If during Non-disruptive Vdisk Movement (NDVM) the SCSI ID changes, the system forces a re-scan on the host and all paths are recovered.

Support for hardware re-scan using a datapath command

You can perform a hardware re-scan using a datapath command. See "datapath hardware re-scan" on page 168 for details.

SDDDSM release 2.4.7.0 and 2.4.7.1 features

SDDDSM release 2.4.7.0 and 2.4.7.1 offers the following features:

GUI Enhancement and Support the SCSI 3 PR commands

The PR Management Tool GUI enhanced to register and reserve the Device with the user-defined keys and supports all the SCSI 3 PR commands. The GUI has the status window that provides all the SCSI/NT status responses along with the PR key details.

Enhanced datapath query adapter -a

A new argument **-a** has been added to the **datapath query adapter** command. You can reference the number of discovered paths at certain point of time using the **datapath** command so that the **datapath query adapter -a** command shows adapter state "DEGRADED" if paths via the adapter go below the reference count set by the **datapath set adapter pathcountref** command.

If the Active path count is reduced due to a path failure or to vdisk removal on the target side, and the count goes below the reference path count, you can set the reference path count using the **pathcountref** option. The **pathcountref** option keeps a record of the available discovered paths.

sddShowCSVLuns.ps1 Power Shell Script

The Power Shell Script shows details related to all of the Clustered Shared Volumes on that host.

SDDDSM release 2.4.8.0 features

SDDDSM release 2.4.8.0 offers the following features:

Enhanced Path Failover Mechanism

Path failover design enhanced to quickly failover retry I/O's on the available paths.

New I/O Routing Options for SQST/LQD/LBYTES LB policies

New I/O Routing Options to help route I/O's on both controllers or only to the preferred controller.

New preferred path option

New preferred path option to help send I/O's on user defined single path.

New query port option with datapath

New datapath option to query attached target port details.

SDDDSM release 2.5.0.0 features

SDDDSM release 2.5.0.0 offers the following features:

SCSI behavior change for Spectrum Virtualize

Spectrum Virtualize enhanced to issue asymmetric access state changed unit attention 30 seconds before a graceful shutdown of a node on any volumes that are accessed through the node that is shutting down.

SDDDSM issues RTPG command on this unit attention. The node that is about to shutdown has its target port group reported as Active/Non-Optimized state and another (usually the partner node) has its target port group reported as Active/Optimized state. This reduces the in-flight I/Os to the node when it shuts down, thus avoiding expensive error recovery at the Storage.

The optimized path changes can be observed using datapath query commands.

Stand-alone SAS support

SDDDSM offers support with a SAS interface on a stand-alone Windows operating systems.

Enhanced SDDGETDATA.BAT to capture additional data

Added the following to SDDGETDATA.BAT:

- additional datapath command outputs.
- verbose debug trace data generated using the **pathtest.exe** tool for about 30 second while this script is being run.
- command outputs of mpclaim, mpiolist, diskpart and CSV LUNs

Increased SDD Log retention period

To retain the trace data for a longer duration, a new mechanism and parameters added to the sddsrv service.

The following configurable parameters added:

- max_log_size
- max_log_count
- RETAIN_LOG
- RETAIN_LOG_PATH

Enhanced `pathtest.exe` tool for SDD Verbose log/debug

User Interface of the `pathtest.exe` tool modified for better User Experience.

The tool captures detailed sdd trace data during host issue, or when `sddgetdata.bat` file is run.

SDDDSM release 2.5.1.0 features

SDDDSM release 2.5.1.0 offers no new features.

SDDDSM release 2.5.2.0 features

SDDDSM release 2.5.2.0 offers the following features:

Collect SetupAPI logs

Improved `sddgetdata.bat` now collects SetupAPI logs (`setupapi.dev.log` and `setupapi.api.log`).

datapath query version enhancement

The **datapath query version** command prints the version of FILE `sdddsm.sys`. However, this version might not be identical to the SDDDSM version that is running in the windows kernel. (For example, if you do not reboot the system after upgrading the SDDDSM.) An easy method to get the version of the running SDDDSM now exists when using the new `-r` parameter.

SDDDSM release 2.5.3.0 features

SDDDSM release 2.5.3.0 offers the following features:

datapath rescanshw enhancement

The **datapath rescanshw** command sends the **RTPG** command and scans hardware changes. The command is enhanced to support the use of the **Inquiry** command before issuing the **RTPG** command by using the new `-f` parameter. Also new is the **device** *device_id* parameter to target a specific device instead of the default action of rescanning all devices.

Chapter 5. Using the SDDDSM or the SDDPCM daemon

The SDD server (sddsrv) is an application program that is installed in addition to SDD.

SDDPCM server (pcmsrv) is an integrated component of SDDPCM 2.0.1.0 (or later).

SDD server daemon

The SDD server daemon (sddsrv) starts automatically after the SDD driver package is installed. The sddsrv daemon runs in the background at all times. The daemon scans to find failing paths (INVALID, CLOSE_DEAD, or DEAD) at regular intervals between two and five minutes unless otherwise indicated for a specific platform. The daemon probes idle paths that are in the CLOSE or OPEN states at regular, one-minute intervals unless otherwise indicated for a specific platform. See the appropriate chapter in this guide for the specific platform modifications to sddsrv operation.

The server daemon also provides the First Time Data Capture (FTDC) function, which periodically saves the SDD driver internal trace into a log file. Stopping the SDD server daemon loses this FTDC function, which makes debugging much harder.

Note: The sddsrv daemon is not available on NetWare host systems.

Understanding how the SDD server daemon works

The sddsrv daemon provides path reclamation and path probing.

Path reclamation

The SDD server regularly tests and recovers broken paths that have become operational. It tests invalid, close_dead, or dead paths and detects if these paths have become operational. The daemon sleeps for three-minute intervals between consecutive runs unless otherwise specified for a specific platform. If the test succeeds, sddsrv reclaims these paths and changes the states of these paths according to the following characteristics:

- If the state of the SDD vpath device is OPEN, sddsrv changes the states of INVALID and CLOSE_DEAD paths of that SDD vpath device to OPEN.
- If the state of the SDD vpath device is CLOSE, sddsrv changes the states of CLOSE_DEAD paths of that SDD vpath device to CLOSE.
- The sddsrv daemon changes the states of dead paths to OPEN.

Path probing

The SDD server regularly tests close paths and open paths that are idle to see if they are operational or have become not operational. The daemon sleeps for one-minute intervals between consecutive runs unless otherwise specified for a specific platform. If the test fails, sddsrv then changes the states of these paths according to the following characteristics:

- If the SDD vpath device is in the OPEN state and the path is not working, sddsrv changes the state of the path from OPEN to DEAD.

- If the SDD vpath device is in the CLOSE state and the path is not working, sddsrv changes the state of the path from CLOSE to CLOSE_DEAD.
- The sddsrv daemon will set the last path to DEAD or CLOSE_DEAD depending upon the state of the SDD vpath device.

Note: The sddsrv daemon will not test paths that are manually placed offline.

In SDD 1.5.0.x (or earlier), sddsrv by default was binding to a TCP/IP port and listening for incoming requests. In SDD 1.5.1.x (or later), sddsrv does not bind to any TCP/IP port by default, but allows port binding to be dynamically enabled or disabled. For all platforms except Linux, the SDD package ships a template file of sddsrv.conf that is named sample_sddsrv.conf. On all UNIX platforms except Linux, the sample_sddsrv.conf file is located in the /etc directory. On Windows platforms, the sample_sddsrv.conf file is in the directory where SDD is installed. You must use the sample_sddsrv.conf file to create the sddsrv.conf file in the same directory as sample_sddsrv.conf by copying it and naming the copied file sddsrv.conf. You can then dynamically change port binding by modifying parameters in sddsrv.conf.

Because the TCP/IP interface of sddsrv is disabled by default, you cannot get sddsrv traces from a Web browser like you could in SDD releases earlier than 1.5.1.0. Starting with SDD 1.5.1.x, the sddsrv trace is saved in the sddsrv log files.

The sddsrv trace log files are wrap-around files. The sddsrv daemon collects the SDD driver trace and puts it in log files. You can choose to have up to four log files with a size of up to 15 MB each or 10 log files of 25 MB each.

You can find sddsrv and sdd log files in the following directories based on your host system platform:

- AIX: /var/adm/ras
- HP-UX: /var/adm/IBMsdd
- Linux: /var/log
- Solaris: /var/adm
- Windows: %windir%\system32

See Appendix A, “SDD, SDDPCM, and SDDDSM data collection for problem analysis,” on page 189 for information about reporting SDD problems.

sddsrv and the IBM TotalStorage Expert V.2.1.0

The IBM TotalStorage Expert V.2.1.0 needs to communicate with sddsrv through a TCP/IP socket on the port on which sddsrv is running. The sddsrv TCP/IP port must be enabled to listen over the network when the IBM TotalStorage Expert V.2.1.0 is collecting host volume data. Apply your corporate security rules to this port.

sddsrv and IBM TotalStorage support for Geographically Dispersed Sites for Microsoft Cluster Service

The sddsrv TCP/IP port must be enabled to listen over the network if you are using IBM TotalStorage Support for Geographically Dispersed Sites for Microsoft Cluster Service (MSCS). Apply your corporate security rules to this port.

SDDPCM server daemon

The SDDPCM server daemon (pcmsrv) component consists of a UNIX application daemon that is installed in addition to the SDDPCM path control module.

The pcmsrv daemon only provides the path-reclamation function for SDDPCM. It regularly tests and recovers broken paths that have become operational. By default, it tests CLOSE_FAILED paths for devices that are in the CLOSED state. It also tests OPEN_FAILED paths when a device internal healthcheck is turned off.

Note: For RSSM devices, pcmsrv will not test CLOSED_FAILED paths and always change the path state from CLOSED_FAILED to CLOSED regardless of whether the path is operational or not.

Starting with SDDPCM v2123, the pcmsrv path healthcheck adds an enhancement that automatically starts or stops the path healthcheck of a device when you issue the **pcmpath set device hc_interval** command to disable or enable a device's internal healthcheck function. However, the pcmsrv path healthcheck function does not check the path that is in good open state, which the internal path healthcheck function does. The pcmsrv daemon sleeps for one-minute intervals between consecutive runs. If the test succeeds, the pcmsrv daemon reclaims the path and changes the state of the path according to the following characteristics:

- If the state of the device is OPEN and the healthcheck function is turned off, pcmsrv changes the state of OPEN_FAILED path of that device to OPEN.
- If the state of the device is CLOSE, pcmsrv changes the state of CLOSE_FAILED path of the device to CLOSE.

The pcmsrv daemon also provides the First Time Data Capture (FTDC) function, which periodically saves the SDDPCM internal trace into a log file. When you stop the pcmsrv daemon, the FTDC function is lost, which makes debugging much harder.

The pcmsrv daemon does not bind to any TCP/IP port by default but allows port binding to be dynamically enabled or disabled. The SDDPCM package ships a template file of pcmsrv.conf that is named as sample_pcmsrv.conf. The sample_pcmsrv.conf file is located in the /etc directory. You must use the sample_pcmsrv.conf file to create the pcmsrv.conf file in the /etc directory by copying sample_pcmsrv.conf and naming the copied file pcmsrv.conf. You can then dynamically change port binding by modifying parameters in pcmsrv.conf. The trace for the pcmsrv daemon is saved in the pcmsrv log files. These are wrap-around files, and the size of each file can be a maximum of 4 MB. Trace files are located in the /var/adm/ras directory.

Starting with SDDPCM 2.6.4.x on AIX, the logging feature is enhanced. The maximum size of a pcm or pcmsrv log file is 25 MB and the maximum log file count is four. The default size of a pcm or pcmsrv log file is 4 MB and the default count is two.

With SDDPCM 2.6.9.0 or later on AIX, the frequency after which the pcm.log file gets updated is enhanced. The minimum allowed interval is 1 minute, and the maximum allowed interval is 2 hours.

sddsrv.conf file format

The sddsrv.conf file contains the following parameters:

enableport

Use this parameter to enable or disable sddsrv to bind to a TCP/IP port. The default value of this parameter is set to *false* (disabled). You can set this parameter to *true* if you want to enable the TCP/IP interface of sddsrv.

loopbackbind

If you set the `enableport` parameter to *true*, the `loopbackbind` parameter specifies whether `sddsrv` listens to any Internet address or the loopback (127.0.0.1) address. To enable `sddsrv` to listen to any Internet address, set the `loopbackbind` parameter to *false*. To enable `sddsrv` to listen only to the loopback address 127.0.0.1, the `loopbackbind` parameter must be set to *true*.

max_log_count

This parameter specifies the number of log files. Valid range of **max_log_count** is 4 to 10. You can comment out the **max_log_count** to use the default value of 4. You can uncomment this parameter to change the file count to a value in the range 4 - 10. If you specify a value smaller than 4, `sddsrv` uses the default value of 4. If you specify a value greater than 10, `sddsrv` uses 10.

max_log_size

This parameter specifies the size of the log file in MB. Valid range of **max_log_size** is 15 to 25. You can comment out the **max_log_size** parameter to use the default value of 15. You can uncomment this parameter to change the file size to a value in the range 15 - 25. If you specify a value smaller than 15, `sddsrv` uses the default value of 15. If you specify a value greater than 25, `sddsrv` uses 25.

portnumber

This parameter specifies the port number that `sddsrv` binds to. The default value of this parameter is 20001. You can modify this parameter to change the port number. If the `enableport` parameter is set to *true*, you must set this parameter to a valid port number to which `sddsrv` can bind. Use a port number that is not used by any other application.

probeinterval

This parameter specifies the probe interval for `sddsrv` probing in minutes. You can leave the `probeinterval` parameter commented to use the default probe interval, which is documented in the `sample_sddsrv.conf` file. You can uncomment this parameter to change the default probe interval to a value from 0 to 65535. If you specify a value less than 0, `sddsrv` uses the default value. If you specify a value greater than 65535, `sddsrv` uses 65535.

probe_retry

This parameter specifies the number of additional retries after a SCSI inquiry by `sddsrv` fails while probing inquiries. The `probe_retry` parameter is only available for Solaris SDD. You can leave the `probe_retry` parameter commented to use the default value of 2. You can uncomment this parameter to change the number of probe retries to a value from 2 to 5. If you specify a value below 2, `sddsrv` uses the default value of 2. If you specify a value greater than 5, `sddsrv` uses 5.

retain_log

This parameter if set to 1, retains/backs up the `sdd` log data to the user-specified location.

retain_log_path

This parameter specifies the path of the file to retain/back up the `sdd` log data. The maximum file size can be 1 GB. The file is wrapped up after the file size crosses 1 GB. You can use common slash to specify the path to the file. (For example: `RETAIN_LOG_PATH = C:/SDD_LOGS/sdd.log`)

You can modify these parameters while `sddsrv` is running. Your changes take effect dynamically within 30 seconds.

pcmsrv.conf file format

The pcmsrv.conf file contains the following parameters:

enableport

Use this parameter to enable or disable pcmsrv to bind to a TCP/IP port. The default value of this parameter is set to *false* (disabled). To enable the TCP/IP interface of pcmsrv, set this parameter to *true*.

max_log_count

This parameter specifies the number of log files. You can comment out the max_log_count parameter to use the default value of 1. You can uncomment this parameter to change the file count to a value in the range 1 - 3. If you specify a value smaller than 1, pcmsrv uses the default value of 1. If you specify a value greater than 3, pcmsrv uses 3.

max_log_size

This parameter specifies the size of the log file in MB. You can comment out the max_log_size parameter to use the default value of 4. You can uncomment this parameter to change the file size to a value in the range 4 - 25. If you specify a value smaller than 4, pcmsrv uses the default value of 4. If you specify a value greater than 25, pcmsrv uses 25.

loopbackbind

If you set the enableport parameter to *true*, the loopbackbind parameter specifies whether pcmsrv listens to any Internet address or the loopback (127.0.0.1) address. To enable pcmsrv to listen to any Internet address, set the loopbackbind parameter to *false*. To enable pcmsrv to listen only to the loopback address 127.0.0.1, set the loopbackbind parameter to *true*.

portnumber

This parameter specifies the port number that pcmsrv binds to. The default value of this parameter is 20001. You can modify this parameter to change the port number. If the enableport parameter is set to *true*, set this parameter to a valid port number to which pcmsrv can bind. Use a port number that is not used by any other application.

log_trace_interval

This parameter specifies the time interval after which the pcm.log file gets updated. You can disable the log_trace_interval parameter to use the default value of 900 seconds. You can enable this parameter to change the interval value in the range of 60 - 7200 seconds. pcmsrv uses the default value of 900, if the value you specify is not within 60 - 7200 seconds.

You can modify these parameters while pcmsrv is running. Your changes take effect dynamically.

Enabling or disabling the sddsrv or pcmsrv TCP/IP port

By default, sddsrv and pcmsrv do not bind to any TCP/IP port because the enableport parameter defaults to a value of *false*. However, you can enable or disable port binding by changing the enableport parameter in the sddsrv.conf/pcmsrv.conf file.

enableport = *true* enables sddsrv or pcmsrv to bind to a TCP/IP port.

enableport = *false* disables sddsrv or pcmsrv from binding to a TCP/IP port.

Changing the sddsrv or pcmsrv TCP/IP port number

You can modify the `portnumber` parameter in the configuration file to change the port number to which `sddsrv` or `pcmsrv` can bind. Use a port number that is not used by any other application. If the `enableport` parameter is set to *true*, only `sddsrv` or `pcmsrv` will bind to the port number specified. The default value of this parameter is 20001.

Disabling the probing function in sddsrv

By default, `sddsrv` probing is enabled. If you want to disable probing in `sddsrv`, uncomment the `probeinterval` parameter and set it to 0, as shown in the following example:

```
probeinterval = 0
```

If you disable `sddsrv` probing, `sddsrv` is not able to mark bad ideal paths to the DEAD or CLOSED_DEAD state, which might lengthen cluster failover. Also, it takes more time to open SDD devices with bad paths.

Changing the probing interval in sddsrv

By default, `sddsrv` probing is enabled with the default value as documented in the `sample_sddsrv.conf` file. To change the `sddsrv` probing interval, uncomment the `probeinterval` parameter and set it to a valid value. The following example shows how to set the interval to 5 minutes.

```
probeinterval = 5
```

Note: `pcmsrv` and `sddsrv` in SDDDSM do not have a probing function.

Chapter 6. Using the datapath commands

SDD provides commands that you can use to complete the following tasks:

- Display the status of adapters that are used to access managed devices.
- Display the status of devices that the device driver manages.
- Dynamically set the status of paths or adapters to *online* or *offline*.
- Dynamically remove paths or adapters.
- Open an invalid or close_dead path.
- Change the path selection algorithm policy of a device.
- Run the essutil Product Engineering tool.
- Dynamically clear the select counter or error counter.
- Send RTPG command and scan for hardware changes.

This chapter includes descriptions of these commands. Table 9 provides an alphabetical list of these commands, a brief description, and where to go in this chapter for more information.

Table 9. Commands

Command	Description	Page
datapath clear adapter adaptstats all	Dynamically clears the active read and write I/O adapter statistics.	“datapath clear adapter adaptstats” on page 165
datapath clear device count	Dynamically clears the select counter or error counter.	“datapath clear device count” on page 164
datapath disable ports	Places paths connected to certain ports offline.	“datapath disable ports” on page 166
datapath enable ports	Places paths connected to certain ports online.	“datapath enable ports” on page 167
datapath hardware re-scan	Sends the RTPG command to rescan hardware changes.	“datapath hardware re-scan” on page 168
datapath open device path	Dynamically opens a path that is in an invalid or close_dead state.	“datapath open device path” on page 168
datapath query adapter	Displays information about adapters.	“datapath query adapter” on page 170
datapath query adaptstats	Displays performance information for all SCSI and FCS adapters that are attached to SDD devices.	“datapath query adaptstats” on page 171
datapath query device	Displays information about devices.	“datapath query device” on page 172

Table 9. Commands (continued)

Command	Description	Page
datapath query devstats	Displays performance information for a single SDD vpath device or all SDD vpath devices.	"datapath query devstats" on page 175
datapath query essmap	Displays each SDD vpath device, path, location, and attributes.	"datapath query essmap" on page 177
datapath query port	Displays the attached target port details.	"datapath query port" on page 178
datapath query portmap	Displays the status of the logic paths that are managed by SDD between the host and the storage ports.	"datapath query portmap" on page 179
datapath query version	Displays the version of SDD that is installed.	"datapath query port" on page 178
datapath query wwpn	Displays the World Wide Port Name (WWPN) of the host fibre-channel adapters.	"datapath query wwpn" on page 180
datapath remove adapter	Dynamically removes an adapter.	"datapath remove adapter" on page 181
datapath remove device path	Dynamically removes a path of an SDD vpath device.	"datapath remove device path" on page 182
datapath set adapter	Sets all device paths that are attached to an adapter to online or offline.	"datapath set adapter" on page 183
datapath set device policy	Dynamically changes the path-selection policy of a single or multiple SDD vpath devices.	"datapath set device policy" on page 184
datapath set device path	Sets the path of an SDD vpath device to online or offline.	"datapath set device path" on page 185
datapath set device preferred path	Sets a single preferred path for the device to route I/Os	"datapath set device preferred path" on page 186
datapath set performance	Initiates or terminates the performance statistics collection in the SDDDSM driver.	"datapath set performance" on page 186
datapath set qdepth	Dynamically enables or disables queue depth of an SDD vpath device.	"datapath set qdepth" on page 187

datapath clear device count

The **datapath clear device count** command dynamically sets the select counter or error counter to zero.

Syntax

```

▶▶—datapath clear—device number 1—┐——count——┐——error——▶▶
                                   └──device number 2──┘ └──all──┘

```

Parameters

device number 1 <*device number 2*>

When two device numbers are entered, this command applies to all the devices whose index numbers fit within the range of these two device index numbers.

count *error*

Clears only the error counter of the SDD vpath device or range of devices specified.

count *all*

Clears both the select counter and the error counter of the SDD vpath device or devices in the specified range.

Examples

If you have a nonzero select counter or error counter and enter the **datapath query device** command, the following output is displayed:

```

DEV#: 0 DEVICE NAME: vpath0 TYPE: 2145 POLICY: Optimized
SERIAL: 600507680181006B200000000000000D1
=====
Path#    Adapter/Hard Disk    State    Mode    Select    Errors
  0      fscsi0/hdisk15      CLOSE    NORMAL    53020      47
  1      fscsi0/hdisk20      CLOSE    NORMAL     0         0
  2      fscsi1/hdisk55      CLOSE    NORMAL   365742      0
  3      fscsi1/hdisk60      CLOSE    NORMAL     0         0

```

If you enter the **datapath clear device 0 count all** command and then enter the **datapath query device** command, the following output is displayed:

```

DEV#: 0 DEVICE NAME: vpath0 TYPE: 2145 POLICY: Optimized
SERIAL: 600507680181006B200000000000000D1
=====
Path#    Adapter/Hard Disk    State    Mode    Select    Errors
  0      fscsi0/hdisk15      CLOSE    NORMAL     0         0
  1      fscsi0/hdisk20      CLOSE    NORMAL     0         0
  2      fscsi1/hdisk55      CLOSE    NORMAL     0         0
  3      fscsi1/hdisk60      CLOSE    NORMAL     0         0

```

datapath clear adapter adaptstats

datapath clear adapter adaptstats all dynamically clears the active read and write counts for I/O and sector. These counters are used in load balancing algorithms to measure the path load of an adapter. This command clears the adapter counters and re-balances the I/O on all paths.

Syntax

```

▶▶—datapath clear adapter—┐——adapter_number1——┐——adaptstats——all——▶▶
                        └──adapter_number1──┘ └──adapter_number2──┘

```

Parameters

adapter_number1

When one number is entered, this command applies to the adapter with that index number.

adapter_number1 adapter_number2

When two adapter numbers are entered, this command applies to all the adapters with index numbers that fit within the range of the two adapter index numbers. The command works only for a valid adapter index or a valid adapter range.

adaptstats all

Clears active read and write I/O statistics.

Examples

For information about non-zero active read or write I/O, issue the **datapath query adaptstats** command. The following output is displayed.

```
Adapter #: 0
=====
I/O:          Total Read   Total Write   Active Read   Active Write   Maximum
SECTOR:       25272       10794049     128           230           124
              1908206     2904425620   76           45           22398

Adapter #: 1
=====
I/O:          Total Read   Total Write   Active Read   Active Write   Maximum
SECTOR:       225272     17894049     223           334           124
              1978206     290476620   45           34           22398
```

To clear the adapter statistics, issue the **datapath clear adapter 0 1 adaptstats all** command. To see the results, issue the **datapath query adaptstats** command without any background I/O's running. The following output is displayed.

```
Adapter #: 0
=====
I/O:          Total Read   Total Write   Active Read   Active Write   Maximum
SECTOR:       25272       10794049     0             0             124
              1908206     2904425620   0             0             22398

Adapter #: 1
=====
I/O:          Total Read   Total Write   Active Read   Active Write   Maximum
SECTOR:       225272     17894049     0             0             124
              1978206     290476620   0             0             22398
```

datapath disable ports

The **datapath disable ports** command sets SDD vpath device paths offline for the specified disk storage system location code.

Note: This command is not supported for Novell host systems.

Syntax

►►—datapath disable ports—<connection>—ess <essid>—————◄◄

Parameters

connection

The connection code must be in one of the following formats:

- Single port = R1-Bx-Hy-Zz

- All ports on card = R1-Bx-Hy
- All ports on bay = R1-Bx

Use the output of the **datapath query essmap** command to determine the connection code.

essid

The disk storage system serial number, given by the output of the **datapath query portmap** command.

Examples

If you enter the **datapath disable ports R1-B1-H3 ess 12028** command and then enter the **datapath query device** command, the following output is displayed:

```
DEV#: 0 DEVICE NAME: vpath0 TYPE: 2105E20 POLICY: Optimized
SERIAL: 20112028
=====
Path#      Adapter/Path Name    State   Mode      Select   Errors
  0         fscsi0/hdisk2        DEAD    OFFLINE     6         0
  1         fscsi0/hdisk4        OPEN    NORMAL     9         0
  2         fscsi1/hdisk6        DEAD    OFFLINE    11         0
  3         fscsi1/hdisk8        OPEN    NORMAL     9         0
```

datapath enable ports

The **datapath enable ports** command sets SDD vpath device paths online for the specified disk storage system location code.

Note: This command is not supported for Novell host systems.

Syntax

►—datapath enable ports—*connection*—*ess essid*—————►

Parameters

connection

The connection code must be in one of the following formats:

- Single port = R1-Bx-Hy-Zz
- All ports on card = R1-Bx-Hy
- All ports on bay = R1-Bx

Use the output of the **datapath essmap** command to determine the connection code.

essid

The disk storage system serial number, given by the output of the **datapath query portmap** command.

Examples

If you enter the **datapath enable ports R1-B1-H3 ess 12028** command and then enter the **datapath query device** command, the following output is displayed:

```
DEV#: 0 DEVICE NAME: vpath0 TYPE: 2105E20 POLICY: Optimized
SERIAL: 20112028
=====
Path#      Adapter/Path Name    State   Mode      Select   Errors
```

0	fscsi0/hdisk2	OPEN	NORMAL	6	0
1	fscsi0/hdisk4	OPEN	NORMAL	9	0
2	fscsi1/hdisk6	OPEN	NORMAL	11	0
3	fscsi1/hdisk8	OPEN	NORMAL	9	0

datapath hardware re-scan

You can rescan hardware if during NDVM, CCU, or NAR, the path goes offline. Re-scanning hardware sends the **RTPG** command to recover the path and rescan for hardware changes.

Syntax

```
▶▶—datapath rescanhw [-f] [device <device_id>] [<n>]—————▶▶
```

Parameters

-f - issues an **Inquiry** command before issuing the **RTPG** command.

device <device_id> - overrides the default action to scan all devices and limits the scan to a specific device as the target of the scan.

<n> - number of times to scan the hardware. Enter any integer up to 50.

Example

```
datapath rescanhw 2
Successfully completed node rescan iteration - 1
Successfully completed node rescan iteration - 2
```

datapath open device path

The **datapath open device path** command dynamically opens a path that is in the **INVALID** or **CLOSE_DEAD** state. You can use this command even when the I/O is actively running.

Note: This command is supported for AIX, HP, Linux, and Sun host systems.

Syntax

```
▶▶—datapath open device—device number—path—path number—————▶▶
```

Parameters

device number

The device number refers to the device *index* number as displayed by the **datapath query device** command.

path number

The path number that you want to change, as displayed by the **datapath query device** command.

Examples

If you enter the **datapath query device 8** command, the following output is displayed:

```
DEV#: 8 DEVICE NAME: vpath9 TYPE: 2105E20 POLICY: Optimized
SERIAL: 20112028
```

```
=====
```

Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0	fscsi1/hdisk18	OPEN	NORMAL	557	0
1	fscsi1/hdisk26	OPEN	NORMAL	568	0
2	fscsi0/hdisk34	INVALID	NORMAL	0	0
3	fscsi0/hdisk42	INVALID	NORMAL	0	0

Note that the current state of path 2 is INVALID.

If you enter the **datapath open device 8 path 2** command, the following output is displayed:

Success: device 8 path 2 opened

```
DEV#: 8 DEVICE NAME: vpath9 TYPE: 2105E20 POLICY: Optimized
SERIAL: 20112028
```

```
=====
```

Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0	fscsi1/hdisk18	OPEN	NORMAL	557	0
1	fscsi1/hdisk26	OPEN	NORMAL	568	0
2	fscsi0/hdisk34	OPEN	NORMAL	0	0
3	fscsi0/hdisk42	INVALID	NORMAL	0	0

After you issue the **datapath open device 8 path 2** command, the state of path 2 becomes *open*.

The terms used in the output are defined as follows:

Dev# The number of this device.

Device name

The name of this device.

Type The device product ID from inquiry data.

Policy The current path-selection policy selected for the device. See “datapath set device policy” on page 184 for a list of valid policies.

Serial The logical unit number (LUN) for this device.

Path# The path number displayed by the **datapath query device** command.

Adapter

The name of the adapter to which the path is attached.

Hard Disk

The name of the logical device to which the path is bound.

State The condition of the named device:

Open Path is in use.

Close Path is not being used.

Close_Dead

Path is broken and is not being used.

Dead Path is no longer being used.

Invalid

The path failed to open.

Mode The mode of the named path, which is either Normal or Offline.

Select The number of times that this path was selected for input and output.

Errors The number of input errors and output errors that are on this path.

datapath query adapter

The **datapath query adapter** command displays information about a single adapter or all adapters.

Syntax

►►—datapath query adapter—*n itype*—*-a*—————◄◄

Parameters

- n adapter number*
The index number for the adapter for which you want information displayed. If you do not enter an adapter index number, information about all adapters is displayed.
- itype*
Interface type
- a* Shows adapter state with respect to referenced path count.

Examples

If you enter the **datapath query adapter -itype fc** command, the following output is displayed:

Active FC Adapters :2

Adpt#	Name	Interface	State	Mode	Select	Errors	Paths	Active	
0	Scsi Port6	Bus0	FC	NORMAL	ACTIVE	3304	2	60	60
1	Scsi Port5	Bus0	FC	NORMAL	ACTIVE	3777	2	60	60

datapath.exe query adapter -itype iscsi

No active ISCSI adapter found.

If you enter the **datapath query adapter -a** command, the following output is displayed:

Active FC Adapters :2

Adpt#	Name	Interface	State	Mode	Select	Errors	Paths	Active	
1	Scsi Port6	Bus0	FC	DEGRAD	ACTIVE	6189054	5	20	19

This example shows the adapter state degraded because the Active Path count is less than the total number of paths previously marked as reference.

The terms used in the output are defined as follows:

- Adpt #**
The number of the adapter defined by SDD.
- Adapter Name**
The name of the adapter.
- Interface**
The type of the interface.
- State** The condition of the named adapter. It can be either:
- Normal**
Adapter is in use.

Degraded

One or more paths attached to the adapter are not functioning.

Failed All paths attached to the adapter are no longer operational.

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 attached to this adapter minus any that are identified as failed or offline.

datapath query adaptstats

The **datapath query adaptstats** command displays performance information for all SCSI and fibre-channel adapters that are attached to SDD devices. If you do not enter an adapter number, information about all adapters is displayed.

Syntax

►►—datapath query adaptstats—*adapter number*—————►►

Parameters

adapter number

The index number for the adapter for which you want information displayed. If you do not enter an adapter index number, information about all adapters is displayed.

Examples

If you enter 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

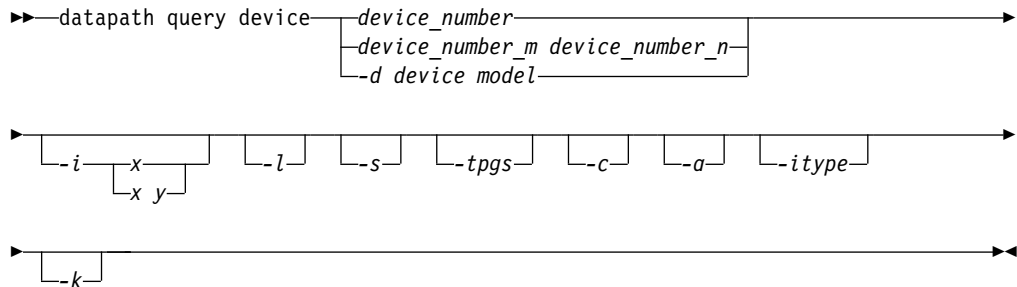
Maximum

- I/O: the maximum number of queued I/O requests
- SECTOR: the maximum number of queued sectors to *read* or *write*

datapath query device

The **datapath query device** command displays information about a single device, a range of devices, a specific model of supported storage devices, or all devices. If you do not enter a device number, information about all devices is displayed. You cannot use the option to specify a device model when you query with device numbers.

Syntax



Parameters

device_number

The device index number that is displayed by the **datapath query device** command, rather than the SDD device number.

device_number_m device_number_n

The option that you can use to provide a range of device index numbers.

-d device model

The device model that you want to display. The option to specify a device model is supported on all platforms except Novell.

Examples of valid device models include the following models:

2105 All 2105 models (ESS).

2105F All 2105 F models (ESS).

2105 800

All 2105 800 models (ESS).

2145 All 2145 models (SAN Volume Controller).

2107 All DS8000 models.

1750 All DS6000 models.

- i Repeats the command every *x* seconds for *y* times. If *y* is not specified, the command repeats every *x* seconds indefinitely.
- l Marks the nonpreferred paths with an asterisk, displays the LUN identifier, and for AIX only, displays the qdepth_enable value.
- s Queries the SCSI address of the device. This option is available for both SDD 1.6.1.x (or later) and SDDDSM 2.1.1.x (or later) for Windows platforms.

-tpgs

Shows state of all the available paths based on SCSI TPGS standards. Here is a sample output:

DEV#:	6	DEVICE NAME:	Disk7 Part0	TYPE:	2145	POLICY:	LOAD BALANCE
SERIAL:	60050768019B02A81000000000000185	Reserved:	No			LUN SIZE:	50.0GB
=====							
Path#	Adapter/Hard Disk			State	Mode	Select	Errors
4	Scsi Port6 Bus0/Disk7 Part0			Standby	OFFLINE	544	0
5	Scsi Port6 Bus0/Disk7 Part0			Active/Optimized	NORMAL	527	0
6 *	Scsi Port6 Bus0/Disk7 Part0			Active/Unoptimized	NORMAL	5	0
7 *	Scsi Port6 Bus0/Disk7 Part0			Active/Unoptimized	NORMAL	2	1

- Paths from the preferred controllers are shown as "Active Optimized".
- Paths from the non-preferred controllers are shown as "Active Unoptimized".
- Paths that are in dead state are shown as "Standby".
- To get the unavailable path states, use the option "-a".

Note: This parameter is available with SDDDSM 2.4.4.0 and later.

- c Does not show the removed device.

Note: This parameter is available with SDDDSM 2.4.4.0 and later.

- a Shows state of all the available and unavailable paths. Here is a sample output:

DEV#:	6	DEVICE NAME:	Disk7 Part0	TYPE:	2145	POLICY:	LOAD BALANCE
SERIAL:	60050768019B02A81000000000000185	Reserved:	No			LUN SIZE:	50.0 GB
=====							
Path#	Adapter/Hard Disk			State	Mode	Select	Errors
0	Scsi Port5 Bus0/Disk7 Part0			CLOSE	OFFLINE	323	0
1	Scsi Port5 Bus0/Disk7 Part0			CLOSE	NORMAL	335	0
2 *	Scsi Port5 Bus0/Disk7 Part0			CLOSE	NORMAL	9	0
3 *	Scsi Port5 Bus0/Disk7 Part0			CLOSE	NORMAL	8	0
4	Scsi Port6 Bus0/Disk7 Part0			DEAD	OFFLINE	544	0
5	Scsi Port6 Bus0/Disk7 Part0			OPEN	NORMAL	527	0
6 *	Scsi Port6 Bus0/Disk7 Part0			OPEN	NORMAL	5	0
7 *	Scsi Port6 Bus0/Disk7 Part0			OPEN	NORMAL	2	1

Note: This parameter is available with SDDDSM 2.4.4.0 and later.

-itype

Specifies the interface type. The allowed values are iscsi and fc.

Note: This parameter is available with SDDDSM 2.4.5.0 and later.

- k shows colored output of path healths, lunid, policy

Note: This parameter is available with SDDDSM 2.4.6.0 and later.

Examples

If you enter the **datapath query device 0** command, the following output is displayed:

```

DEV#: 0 DEVICE NAME: vpath0 TYPE: 2145 POLICY: Optimized
SERIAL: 6005076801818008C000000000000065
=====
Path# Adapter/Hard Disk State Mode Select Errors
0 fscsil/hdisk72 OPEN NORMAL 0 0
1 fscsi0/hdisk22 OPEN NORMAL 5571118 0
2 fscsi0/hdisk32 OPEN NORMAL 0 0
3 fscsil/hdisk62 OPEN NORMAL 5668419 0

```

If you enter the **datapath query device 0 -l** command for a device type that has preferred and non-preferred paths, the following output is displayed:

```

DEV#: 0 DEVICE NAME: vpath0 TYPE: 2145 POLICY: Optimized
SERIAL: 6005076801818008C000000000000065
LUN IDENTIFIER: 6005076801818008C000000000000065
=====
Path# Adapter/Hard Disk State Mode Select Errors
0* fscsil/hdisk72 OPEN NORMAL 0 0
1 fscsi0/hdisk22 OPEN NORMAL 5571118 0
2* fscsi0/hdisk32 OPEN NORMAL 0 0
3 fscsil/hdisk62 OPEN NORMAL 5668419 0

```

If you enter the **datapath query device -itype fc** command, the following output is displayed:

Total FC Devices : 15

```

DEV#: 0 DEVICE NAME: Disk2 Part0 TYPE: 2145 POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768019B02A8100000000000001FA Reserved: No LUN SIZE: 5.0GB
HOST INTERFACE: FC
=====
Path# Adapter/Hard Disk State Mode Select Errors
0 * Scsi Port6 Bus0/Disk2 Part0 OPEN NORMAL 7 1
1 * Scsi Port6 Bus0/Disk2 Part0 OPEN NORMAL 6 1
2 * Scsi Port5 Bus0/Disk2 Part0 OPEN NORMAL 7 1
3 * Scsi Port5 Bus0/Disk2 Part0 OPEN NORMAL 8 1
4 Scsi Port5 Bus0/Disk2 Part0 OPEN NORMAL 173 0
5 Scsi Port5 Bus0/Disk2 Part0 OPEN NORMAL 96 0
6 Scsi Port6 Bus0/Disk2 Part0 OPEN NORMAL 81 0
7 Scsi Port6 Bus0/Disk2 Part0 OPEN NORMAL 90 0

```

Note:

1. 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, always run the **datapath query device** command first.
2. For SDD 1.4.0.0 (or later), the location of the policy and serial number are swapped.

The terms that are used in the output are defined as follows:

Dev# The number of this device that is defined by SDD.

Name The name of this device that is defined by SDD.

Type The device product ID from inquiry data.

Policy The current path selection policy that is selected for the device. See “datapath set device policy” on page 184 for a list of valid policies.

Serial The LUN for this device.

Path# The path number.

Adapter

The name of the adapter to which the path is attached.

Hard disk

The name of the logical device to which the path is bound.

State The condition of the named device:

Open Path is in use.

Close Path is not being used.

Close_Dead

Path is broken and 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

The path failed to open.

Mode The mode of the named path. The mode can be either Normal or Offline.

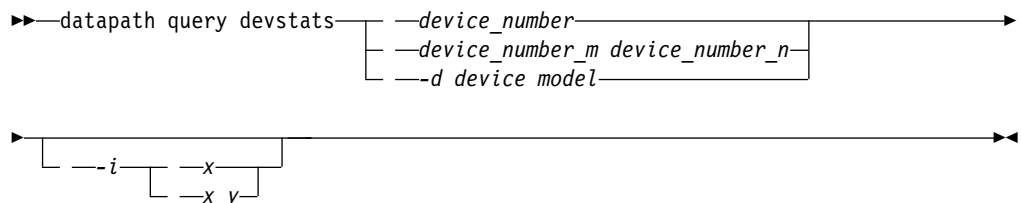
Select The number of times this path was selected for input or output.

Errors The number of input and output errors on a path that is attached to this device.

datapath query devstats

The **datapath query devstats** command displays performance information for a single SDD device, a range of devices, a specific model of supported storage devices, or all SDD devices. If you do not enter a device number, information about all devices is displayed.

The option to specify a device model cannot be used when you query with device numbers.

Syntax**Parameters***device number*

The device index number that is displayed by the **datapath query device** command, rather than the SDD device number.

device_number_m device_number_n

The option that you can use to provide a range of device index numbers.

-d device model

The device model that you want to display.

Note: The *-d device model* option is supported on AIX only.

Examples of valid device models include the following models:

2105 All 2105 models (ESS).

2105F All 2105 F models (ESS).

2105800
All 2105 800 models (ESS).

2145 All 2145 models (SAN Volume Controller).

2107 All DS8000 models.

1750 All DS 6000 models.

Note: The option to specify a device model is supported on all platforms except Novell.

-i Repeats the command every *x* seconds for *y* times. If *y* is not specified, the command will repeat every *x* seconds indefinitely.

Examples

If you enter 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 or Write

Transfer size

- <= 512: the number of I/O requests received, whose transfer size is 512 bytes or less
- <= 4k: the number of I/O requests received, whose transfer size is 4 KB or less (where KB equals 1024 bytes)
- <= 16K: the number of I/O requests received, whose transfer size is 16 KB or less (where KB equals 1024 bytes)
- <= 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 query essmap

The **datapath query essmap** command displays data collected from the **sddfcmap** program invoked by **cfgmgr**. **sddfcmap** issues SCSI commands directly to the disks (inquiry, read capacity, and log sense) to collect the information displayed.

Note:

1. This command is not supported for Novell host systems.
2. This command is supported for disk storage systems only.
3. If the output of **datapath query essmap** does not display the correct volume group name on an HP-UX host system, complete the following steps:
 - a. Find the process ID number (PID) of **sddsrv**.
 - b. Enter **kill -SIGUSR1** (the PID of **sddsrv**).
 - c. Wait for a little while and then run the **datapath query essmap** command again.

Syntax

▶▶—datapath query essmap—————▶▶

Examples

If you enter the **datapath query essmap** command, the following output is displayed:

Disk	Path	P	Location	adapter	LUN	SN	Type	Size	LSS	Vol	Rank	C/A	S	...
vpath20 hdisk1			30-60-01[FC]	fscsi1	13AAAKA1200	IBM	1750-500	1.1	18	0	0000	01	Y	...
vpath20 hdisk720	*		30-60-01[FC]	fscsi1	13AAAKA1200	IBM	1750-500	1.1	18	0	0000	01	Y	...
vpath20 hdisk848			20-60-01[FC]	fscsi0	13AAAKA1200	IBM	1750-500	1.1	18	0	0000	01	Y	...
vpath20 hdisk976	*		20-60-01[FC]	fscsi0	13AAAKA1200	IBM	1750-500	1.1	18	0	0000	01	Y	...

The terms used in the output are defined as follows:

Disk The logical device name assigned by the host.

Path The logical path name of an SDD vpath device.

P Indicates whether the logical path is a preferred path or nonpreferred path. "*" indicates that it is a nonpreferred path. This field applies only to 1750 devices.

Location

The physical location code of the host adapter through which the LUN is accessed.

Adapter

The logical adapter name that is assigned by the host LUN.

LUN SN

The unique serial number for each LUN within the disk storage system.

Type The device and model.

Size The configured capacity of the LUN.

LSS The logical subsystem where the LUN resides. (Beginning with 1.6.3.0, the value displayed is changed from decimal to hexadecimal.)

Vol The volume number within the disk storage system.

Rank The unique identifier for each RAID within the disk storage system.

C/A The cluster and adapter accessing the array.

S Indicates that the device is shared by two and more disk storage system ports. Valid values are *yes* or *no*.

Connection

The physical location code of disk storage system adapter through which the LUN is accessed.

Port The disk storage system port through which the LUN is accessed.

RaidMode

The disk RAID mode.

datapath query port

Displays the attached Target Port details.

Syntax

►►—datapath query port—◄◄

Examples

If you enter **datapath query port** command, the following output is displayed:

```
C:\Program Files\IBM\SDDDSM>datapath.exe query port
```

```
Adapter Name : Scsi Port3:
PortWWN : 21000024FF298506
Number Of Discovered Storage Host Ports : 8

Host Port:0 WWPN : 500507680C1166B2 PortState : HBA_PORTSTATE_ONLINE
PortSpeed: HBA_PORTSPEED_UNKNOWN
Host Port:1 WWPN : 500507680C116813 PortState : HBA_PORTSTATE_ONLINE
PortSpeed: HBA_PORTSPEED_UNKNOWN
Host Port:2 WWPN : 500507680C1266B2 PortState : HBA_PORTSTATE_ONLINE
PortSpeed: HBA_PORTSPEED_UNKNOWN
Host Port:3 WWPN : 500507680C126813 PortState : HBA_PORTSTATE_ONLINE
PortSpeed: HBA_PORTSPEED_UNKNOWN
Host Port:4 WWPN : 500507680C1366B2 PortState : HBA_PORTSTATE_ONLINE
PortSpeed: HBA_PORTSPEED_UNKNOWN
Host Port:5 WWPN : 500507680C136813 PortState : HBA_PORTSTATE_ONLINE
PortSpeed: HBA_PORTSPEED_UNKNOWN
Host Port:6 WWPN : 500507680C156813 PortState : HBA_PORTSTATE_ONLINE
PortSpeed: HBA_PORTSPEED_UNKNOWN
Host Port:7 WWPN : 500507680C166813 PortState : HBA_PORTSTATE_ONLINE
```

Adapter Name : Scsi Port4:
 PortWWN : 21000024FF298507
 Number Of Discovered Storage Host Ports : 0

datapath query portmap

The **datapath query portmap** command displays the status of the logic paths that are managed by SDD between the host and the storage ports.

Note:

1. This command is not supported for Novell host systems.
2. This command is supported for disk storage systems only.
3. For Solaris, only the state of slice c of a lun is displayed. The states of other slices of the same lun might be in different states.

Syntax

►►—datapath query portmap—◄◄

Examples

If you enter the **datapath query portmap** command, the following output is displayed:

ESSID	DISK	BAY-1(B1)				BAY-2(B2)				BAY-3(B3)				BAY-4(B4)				
		H1	H2	H3	H4	H1	H2	H3	H4	H1	H2	H3	H4	H1	H2	H3	H4	
		ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD
		BAY-5(B5)				BAY-6(B6)				BAY-7(B7)				BAY-8(B8)				
		H1	H2	H3	H4	H1	H2	H3	H4	H1	H2	H3	H4	H1	H2	H3	H4	
		ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD
13AAAKA	vpath20	0---	----	----	----	0---	----	----	----	----	----	----	----	----	----	----	----	----
13AAAKA	vpath21	Y---	----	----	----	y---	----	----	----	----	----	----	----	----	----	----	----	----

Y = online/open
 O = online/closed
 N = offline
 - = path not configured
 PD = path down
 y = (alternate path) online/open
 o = (alternate path) online/closed
 n = (alternate path) offline

The terms used in the output are defined as follows:

- Y** The port is online and open. At least one path attached to this port is functional.
- y** Paths connected to this port are nonpreferred paths. The port is online and open. At least one path attached to this port is functional.
- O** The port is online and closed. At least one path state and mode is closed and online.
- o** Paths connected to this port are nonpreferred paths. The port is online and closed. At least one path state and mode is closed and online.
- N** The port is offline. All paths attached to this port are offline.
- n** Paths connected to this port are nonpreferred paths. The port is offline. All paths attached to this port are offline.
- The path is not configured.
- PD** The path is down. It is either not functional or has been placed offline.

Note: The following fields apply only to 1750 devices:

- y
- o
- n

The serial number of ESS devices is five digits, whereas the serial number of DS6000 and DS8000 devices is seven digits.

datapath query version

The **datapath query version** command displays the version of the SDD that is installed.

Syntax

```
▶▶—datapath query version—┐ —r—▶▶
```

Parameters

-r (Optional) Shows the version of the SDDDSM that is running in the Windows kernel. For example, if you did not reboot the system after upgrading the SDDDSM, the version running is not the same as the version that is installed.

The **datapath query version** command displays the version of the SDD that is installed.

The **datapath query version -r** command displays the version of the SDD that is running in the Windows kernel.

Examples

If you enter the **datapath query version -r** command, the following output is displayed:

```
> datapath query version -r
IBM SDDDSM Version 2.5.2.0
```

If you enter the **datapath query version** command, the following output is displayed:

```
> datapath query version
IBM SDDDSM Version 2.5.2.0
Microsoft MPIO Version 6.3.9600.18907
```

datapath query wwpn

The **datapath query wwpn** command displays the worldwide port name (WWPN) of the host fibre-channel adapters.

Note:

1. This command is available for AIX, Linux, HP, and Solaris host systems.
2. For Solaris, this option is supported on Solaris 8, 9, and 10. It requires that SNIA HBA libraries are installed in the Solaris system. The SNIA HBA library consists of the following two components:
 - Common SNIA HBA library
 - Vendor-specific SNIA HBA library

The common SNIA HBA library is included in the Solaris 10 installation, but users need to download the common SNIA HBA library from SUN for Solaris 8 and 9. The vendor-specific SNIA HBA library is provided by each HBA vendor.

3. Because this command is only for fibre-channel adapters, it does not display the WWPN of serial-attached SCSI (SAS) HBAs that are used to connect to RSSM devices on Windows hosts.

Syntax

►►—datapath query wwpn—►►

Parameters

None

Examples

If you enter the **datapath query wwpn** command, the following output is displayed:

```
[root@abc]> datapath query wwpn
Adapter Name  PortWWN
fscsi0        10000000C925F5B0
fscsi1        10000000C9266FD1
```

datapath remove adapter

The **datapath remove adapter** command dynamically removes an adapter and all paths attached to this adapter from SDD. This command is used when a new adapter must be installed, for example, due to failure of an existing adapter. SDD reserves the last path of a device. If all accessible paths to a device are attached to one adapter, this command fails.

Note: The newly installed adapter can be reclaimed with the **addpaths** command.

Note: This command is available for AIX host systems only.

Syntax

►►—datapath remove adapter—*adapter number*—►►

Parameters

adapter number

The index number of the adapter that you want to remove.

Examples

If you enter the **datapath query adapter** command, the following output is displayed:

```
+-----+
| Active Adapters :4 |
+-----+
| Adpt#   Name   State   Mode   Select   Errors   Paths   Active |
| 0       fscsi0  NORMAL  ACTIVE 62051    0        10      10    |
+-----+
```

1	fscsi1	NORMAL	ACTIVE	65386	3	10	10
2	fscsi2	NORMAL	ACTIVE	75697	27	10	10
3	fscsi3	NORMAL	ACTIVE	4788	35	10	10

If you enter the **datapath remove adapter 0** command, the following actions occur:

- The entry for Adpt# 0 disappears from the **datapath query adapter** command output.
- All paths that are attached to adapter 0 disappear from the **datapath query device** command output.

You can enter this command while I/O is running.

Active Adapters :3							
Adpt#	Name	State	Mode	Select	Errors	Paths	Active
1	fscsi1	NORMAL	ACTIVE	65916	3	10	10
2	fscsi2	NORMAL	ACTIVE	76197	27	10	10
3	fscsi3	NORMAL	ACTIVE	4997	35	10	10

The adapter/hard disk Adpt# 0 fscsi0 is removed and the select counts are increased on the other three adapters, indicating that I/O is still running.

datapath remove device path

The **datapath remove device path** command dynamically removes a specific path of an SDD vpath device that is attached to an adapter. SDD reserves the last path of an SDD vpath device. If the requested path is the only accessible path to an SDD vpath device, the command fails.

Note:

1. A removed path can be reclaimed by using the **addpaths** command.
2. This command is available for AIX host systems only.

Syntax

►► **datapath remove device** *device number* **path** *path number* ◀◀

Parameters

device number

The device number shown in the output of the **datapath query device** command.

path number

The path number shown in the output of the **datapath query device** command.

Examples

If you enter the **datapath query device 0** command, the following output is displayed:

DEV#: 0	DEVICE NAME: vpath0	TYPE: 2105E20	POLICY: Optimized
SERIAL: 20112028			
=====			

Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0	fscsi1/hdisk18	OPEN	NORMAL	557	0
1	fscsi1/hdisk26	OPEN	NORMAL	568	0
2	fscsi0/hdisk34	OPEN	NORMAL	566	0
3	fscsi0/hdisk42	OPEN	NORMAL	545	0

If you enter the **datapath remove device 0 path 1** command, the entry for DEV# 0 Path# 1 (that is, fscsi1/hdisk26) disappears from the **datapath query device 0** command output and the path numbers are rearranged.

Success: device 0 path 1 removed					
DEV#:	0	DEVICE NAME:	vpath0	TYPE:	2105E20
SERIAL:	20112028				
POLICY:	Optimized				
Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0	fscsi1/hdisk18	OPEN	NORMAL	567	0
1	fscsi0/hdisk34	OPEN	NORMAL	596	0
2	fscsi0/hdisk42	OPEN	NORMAL	589	0

The adapter/hard disk fscsi1/hdisk26 is removed and path 1 is now fscsi0/hdisk34.

The **addpaths** command reclaims the removed path. The mode of the added path is set to NORMAL and its state to either OPEN or CLOSE, depending on the device state.

DEV#:	0	DEVICE NAME:	vpath0	TYPE:	2105E20
SERIAL:	20112028				
POLICY:	Optimized				
Path#	Adapter/Hard Disk	State	Mode	Select	Errors
0	fscsi1/hdisk18	OPEN	NORMAL	580	0
1	fscsi0/hdisk34	OPEN	NORMAL	606	0
2	fscsi0/hdisk42	OPEN	NORMAL	599	0
3	fscsi1/hdisk26	OPEN	NORMAL	14	0

Note that fscsi1/hdisk26 is back online with path 3 and is selected for I/O.

datapath set adapter

The **datapath set adapter** command sets all SDD vpath device paths attached to an adapter either to online or offline.

SDD reserves the last path of an SDD vpath device. If all accessible paths to an SDD vpath device are attached to one adapter, the offline option will fail.

Note: The **datapath set adapter offline** command can be entered even when the SDD vpath device is closed.

Syntax

```

▶▶ datapath set adapter—adapter number—
    —online—
    —offline—
    —pathcountref—

```

Parameters

adapter number

The index number of the adapter that you want to change.

online

Sets the adapter online.

offline

Sets the adapter offline.

pathcountref

Resets the reference path count to the available discovered paths.

Examples

If you enter the **datapath set adapter 0 offline** command:

- The mode of Adapter 0 will be changed to OFFLINE while the state of the adapter remains the same.
- All paths attached to adapter 0 change to OFFLINE mode and their states change to Dead, if they were in the Open state.

You can use the **datapath set adapter 0 online** command to cause an adapter that is offline to come online:

- Adapter 0's mode changes to ACTIVE and its state to NORMAL.
- The mode of all paths attached to adapter 0 changes to NORMAL and their state to either OPEN or CLOSE depending on the SDD vpath device state.

datapath set adapter 0 pathcountref command resets the reference path count to the total available path count and is equal to Active path count. Following this command the adapter state is shown as Normal on running **datapath query adapter -a**. If Active path count decreases further, adapter shows the degraded state.

Output with "datapath query adapter -a" is as below. The Active paths are less than the referenced path count.

Active Adapters :1

Adpt#	Name	Interface	State	Mode	Select	Errors	Paths	Active
0	Scsi	Port5	Bus0	FC	DEGRAD	ACTIVE	2822	0

After running the **datapath set adapter 0 pathcountref** command, active paths are equal to the total number of paths.

Adpt#	Name	Interface	State	Mode	Select	Errors	Paths	Active
0	Scsi	Port5	Bus0	FC	NORMAL	ACTIVE	2822	0

Note: The behavior of **datapath query adapter** (without **-a** option) is not changed.

datapath set device policy

The **datapath set device policy** command dynamically changes the path selection policy per SDD vpath device.

Syntax

→ **datapath set device** — *device_num1* — *device_num2* — **policy** — *option* →

Parameters

device number1 [device number2]

When two device numbers are entered, this command will apply to all the devices whose index numbers fit within the range of these two device index numbers.

option

Specifies one of the following policies:

Windows

- **fo** - failover (no load balance)
- **lb** - least number of I/O and adapter weight
- **sqst** - shortest queue service time
- **lqd** - least queue depth
- **lbytes** - least bytes
- **rr** - round robin
- **rrss** - round robin with subset
- **df** - default (uses lb)
- **optNodes** - I/O routed to Optimized Nodes
- **allNodes** - I/O routed to All Nodes

Note: optNodes/allNodes is applicable only to sqst, lqd, and lbytes. For rr I/O routes to allNodes. For rrss, lb I/O routed to Optimized nodes.

AIX and Linux

- **rr** - round robin
- **rrs** - round robin sequential
- **lb** - load balancing (also known as optimized policy)
- **lbs** - load balancing sequential
- **df** - default policy which is load balancing
- **fo** - failover policy

Note: You can enter the **datapath set device N policy** command to dynamically change the policy associated with SDD vpath devices in either Close or Open state.

Examples

If you enter **datapath set device 2 7 policy rr**, the path-selection policy of SDD vpath devices with device index 2 to 7 is immediately changed to the round robin policy.

datapath set device path

The **datapath set device path** command sets the path of an SDD vpath device either to online or offline. You cannot remove the last path to an SDD vpath device from service. This prevents a data access failure from occurring. The **datapath set device path** command can be entered even when the SDD vpath device is closed.

Syntax

```
►► datapath set device device number path 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 enter the **datapath set device 0 path 0 offline** command, path 0 for device 0 changes to Offline mode.

datapath set device preferred path

Sets a single preferred path for I/Os for the LUN.

Syntax

```
►► datapath set device <n> path <m> preferred <0/1>\n\ ►►
```

Examples

The command **datapath set device 0 path 4 preferred 1**, sets path at index 4 as preferred path for all the I/O's to that LUN.

datapath set performance

The **datapath set performance on** command initiates the performance statistics collection in the SDDDSM driver. The **off** switch stops the statistics collection in the driver.

Note: The switch **on/off** must be used without any device number on the command line.

Note: This command is available for Windows host systems only.

Syntax

```
►► datapath set performance [ on | off ] device number <n> ►►
```

Parameters

on/off

Enables or disables performance collection in the SDDDSM driver.

device <n>

The device number for which performance statistics need to be collected.

Examples

If you enter **datapath set performance on**, the following output is generated:

Success:Performance Collection set to ON

If you enter **datapath set performance device 4**, the following output is generated:

Performance Collection set for the required device

datapath set qdepth

The **datapath set qdepth** command dynamically sets the queue depth logic of an SDD vpath device to either *enable* or *disable* even when I/O is running.

Note: This command is available for AIX host systems only.

Syntax

►►datapath set device _n_ _m_ qdepth _enable_ _disable_ ►►

Parameters

n The beginning vpath number for which the queue depth logic setting is to be applied.

m Then ending vpath number for which the queue depth logic setting is to be applied.

Enable

Enable the queue depth logic.

Disable

Disable the queue depth logic.

Examples

If you enter the **datapath set device 0 2 qdepth disable** command, the following output is displayed:

Success: set qdepth_enable to no for vpath0

Success: set qdepth_enable to no for vpath1

Success: set qdepth_enable to no for vpath2

The qdepth_enable ODM attribute of these SDD vpath devices is updated. The following output is displayed when you enter **lsattr -El vpath0**.

```
# lsattr -El vpath0
active_hdisk hdisk66/13AB2ZA1020/fscsi3      Active hdisk      False
active_hdisk hdisk2/13AB2ZA1020/fscsi2      Active hdisk      False
active_hdisk hdisk34/13AB2ZA1020/fscsi2     Active hdisk      False
```

active_hdisk	hdisk98/13AB2ZA1020/fscsi3	Active hdisk	False
policy	df	Scheduling Policy	True
pvid	0005f9fdcda4417d0000000000000000	Physical volume identifier	False
qdepth_enable	no	Queue Depth Control	True
reserve_policy	PR_exclusive	Reserve Policy	True
serial_number	13AB2ZA1020	LUN serial number	False
unique_id	yes	Device Unique Identification	False

Appendix A. SDD, SDDPCM, and SDDDSM data collection for problem analysis

The following sections describe enhanced trace capability for SDD, SDDPCM and SDDDSM.

Enhanced trace capability for the SDD and SDDDSM

Starting with SDD 1.5.1.0 (and later), SDD has enhanced its trace capability for problem determination.

SDD has been enhanced to collect SDD trace data periodically and write the trace data to the system local hard drive. SDD maintains 4 files for its trace data:

- sdd.log
- sdd_bak.log
- sddsrv.log
- sddsrv_bak.log

Starting with SDDDSM 2.4.3.4 on Windows, the logging feature is enhanced. The size and number of log files that can be maintained on the system are dynamically configurable. The sddsrv.conf file has two parameters (**max_log_size** and **max_log_count**) to configure the size and the number of log files. Trace data is stored in one or all of the following eight files:

- sdd.log
- sdd.log.1
- sdd.log.2
- sdd.log.3
- sddsrv.log
- sddsrv.log.1
- sddsrv.log.2
- sddsrv.log.3

These files can be found in the following directories:

- AIX - /var/adm/ras
- HP-UX - /var/adm
- Linux - /var/log
- Solaris - /var/adm
- Windows Server 2008, Windows Server 2012, Windows Server 2016, or Windows Server 2019 - %windir%\system32

Using sddgetdata to collect information for problem determination

SDD provides the **sddgetdata** script to collect information used for problem determination. For UNIX platforms, **sddgetdata** creates a tar file or a compressed tar file at the current directory with the current date and time as a part of the file

name (for example, `sdddata_hostname_yyyymmdd_hhmmss.tar` or `sdddata_hostname_yyyymmdd_hhmmss.tar.Z`, where `yyymmdd_hhmmss` is the timestamp of the file creation).

For Windows, you can run the **sddgetdata** script from the install directory to collect the data for problem determination. **sddgetdata** creates a cab file in the install directory with the current date and time as part of the file name (for example, `sdddata_hostname_yyyymmdd_hhmmss.cab`), where `yyymmdd_hhmmss` is the timestamp of the file creation). For SDD, the install directory is `%root%\Program Files\IBM\Subsystem Device Driver`. For SDDDSM, the install directory is `%root%\Program Files\IBM\SDDDSM`.

When you report an SDD problem, it is essential to run this script and send this output file for problem determination.

Steps within the **sddgetdata** script might fail depending on the problem and the system condition. In this case, you might have to issue manual commands.

Here is an example output for the AIX platform:

```
/tmp/sdd_getdata>sddgetdata
/tmp/sdd_getdata>ls
./ ../ sdddata_host1_20050315_122521.tar
```

Enhanced trace capability for SDDPCM

For SDDPCM release 2.1.0.7 and later releases, SDDPCM enhanced its trace capability for problem determination. It was enhanced to periodically collect SDDPCM trace data and write the trace data to the system local hard drive. Four files are maintained to store the trace data:

- `pcm.log`
- `pcm_bak.log`
- `pcmsrv.log`
- `pcmsrv_bak.log`

Beginning with SDDPCM 3.0.x.x, SDDPCM will maintain two additional files for its trace data:

- `AE.log`
- `AE_bak.log`

All six of these files can be found in the `/var/adm/ras` directory.

When you report an SDDPCM problem, the following information is essential for problem determination:

- `pcm.log`
- `pcm_bak.log`
- `pcmsrv.log`
- `pcmsrv_bak.log`
- Output of the **pcmpath query adapter** command
- Output of the **pcmpath query device** command
- AIX system error log
- `AE.log`
- `AE_bak.log`

Starting with SDDPCM 2.6.4.x on AIX, the logging feature is enhanced. The size and number of log files that can be maintained on the system are dynamically configurable. The `pcmsrv.conf` file has two parameters (**max_log_size** and **max_log_count**) to configure the size and the number of log files. Trace data is stored in one or all of the following eight files:

- `pcm.log`
- `pcm.log.1`
- `pcm.log.2`
- `pcm.log.3`
- `pcmsrv.log`
- `pcmsrv.log.1`
- `pcmsrv.log.2`
- `pcmsrv.log.3`

Using `sddpcmgetdata` to collect information for problem determination

SDDPCM provides the `sddpcmgetdata` script to collect information used for problem determination. `sddpcmgetdata` creates a tar file at the current directory with the current date and time as a part of the file name (for example, `sddpcmdata_hostname_yyyymmdd_hhmmss.tar`, where `yyymmdd_hhmmss` is the timestamp of the file creation). When you report an SDDPCM problem, it is essential to run this script and send this tar file for problem determination.

For example:

```
/tmp/sddpcmgetdata>sddpcmgetdata/tmp/sddpcmgetdata>ls  
./ ../ sddpcmdata_test1_20050315_122521.tar
```

Appendix B. System log messages

The following sections list the log messages for AIX SDD and Windows SDDDSM.

AIX error and information messages

This section lists log messages for AIX SDD.

SDD logs error messages into the AIX error log system. To check if SDD has generated an error message, enter the **errpt -a | grep VPATH** command. The **errpt -a | grep SDDSRV** command will show any error messages logged by sddsrv.

The following list shows general SDD error messages.

VPATH_XBUF_NOMEM

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

VPATH_DEVICE_OFFLINE

Several attempts to retry an I/O request for an SDD vpath device on a path have failed. The path state is set to DEAD and the path is taken offline. Enter the **datapath** command to set the offline path to online. For more information, see Chapter 6, “Using the datapath commands,” on page 163.

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.

VPATH_OUT_SERVICE

An SDD vpath device has no path available for an I/O operation. The state of the SDD vpath device is set to LIMBO. All following I/Os to this SDD vpath device are immediately returned to the caller.

The following list shows the error messages logged by SDD in a persistent reserve environment.

VPATH_FAIL_RELPRESERVE

An attempt was made to close an SDD vpath device that was not opened with the **RETAIN_RESERVE** option on the persistent reserve. The attempt to close the SDD 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 an SDD vpath device, but the reservation key of the SDD 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.

The following are information messages that are logged if you perform AIX Hot Plug procedures with SDD:

VPATH_ADPT_REMOVED

The **datapath remove adapter *n*** command runs. Adapter *n* and its child devices are removed from SDD.

VPATH_PATH_REMOVED

The **datapath remove device *m* path *n*** command runs. Path *n* for device *m* is removed from SDD.

The following error messages are logged by sddsrv:

SDDSRV_CONF_MISMATCH

This error is logged when sddsrv finds out hdisk information in the driver is different from what sddsrv discovered. sddsrv logs the error to the system error log immediately and every 15 minutes thereafter

SDDSRV_PORTBINDFAIL

This error is logged when sddsrv cannot bind the TCP/IP port number specified in its sddsrv.conf file.

SDDSRV_LOG_WFAIL

This error is logged when sddsrv cannot write its log file (that is, sddsrv.log) to file system. sddsrv logs the error to the system error log immediately and every 10 minutes thereafter until sddsrv can write again.

SDDSRV_DRLOG_WFAIL

This error is logged when sddsrv cannot write the driver log file (that is, sdd.log) to file system.

SDDSRV_PROBEENABLE

This message is logged when the sddsrv probing functionality is enabled.

SDDSRV_PROBEDISABLE

This message is logged when the sddsrv probing functionality is disabled.

SDDSRV_PROBEINTERVAL

This message is logged when the sddsrv probing interval is changed.

SDDPCM error log messages

This section lists log messages for AIX SDDPCM.

SDDPCM logs error messages into the AIX error log system. To check if SDDPCM generated an error message, enter the **errpt -a | grep SDDPCM** command.

The following list shows general SDD error messages.

SDDPCM_CHKHSACTION

All I/O paths on an active device of an Open HyperSwap device fail, requiring Tivoli Productivity Center for Replication to initiate an unplanned Open HyperSwap.

SDDPCM_OPENPATH_FAILED

One of the SDDPCM MPIO hdisk's paths has failed to open. The failing path is put in the INVALID state if the MPIO hdisk is opened.

SDDPCM_OSPAIRASSOCIATE

Couple a source device and a target device into one Open HyperSwap device.

SDDPCM_OSPAIRBLOCK

An Open HyperSwap device I/O is blocked.

SDDPCM_OSPAIRDISABLED

The Open HyperSwap functionality of an Open HyperSwap device is disabled because there are no available paths on either the source or target devices.

SDDPCM_OSPAIRDISASSOCIATE

Disassociate an Open HyperSwap device from a session. The device is no longer an Open HyperSwap-enabled device

SDDPCM_OSPAIREENABLED

The Open HyperSwap functionality of an Open HyperSwap device is enabled, with paths available to both source and target devices.

SDDPCM_OSPAIRSFAILED

An Open HyperSwap device failed to perform swap and resume.

SDDPCM_PATH_FAILED

Several attempts to retry an I/O request for an MPIO device on a path have failed, or a path reaches the threshold of continuous I/O errors. The path state is set to FAILED and the path is taken offline. A FAILED path can be automatically recovered by the health checker if the problem is fixed, or the user can enter the **pcmpath set device M path N online** command to manually recover the path. For more information, see "Using SDDPCM pcmpath commands" on page 58.

SDDPCM_PATH_RECOVERED

A failed path is recovered and is in an operational state.

SDDPCM QUIESCETIMEOUT

Exceeded time limit for quiescing I/Os on an Open HyperSwap device.

SDDPCM_RESUMEDONE

Resuming I/Os on all Open HyperSwap devices in a session is complete.

SDDPCM_SESSIONQUIESCE

Quiescing I/Os to all Open HyperSwap devices in a session.

SDDPCM_SESSIONRDY

A session is ready for HyperSwap.

SDDPCM_SESSIONRESUME

Initiate resume I/Os on all Open HyperSwap devices in a session.

SDDPCM_SESSIONSWAPRESUME

Initiate swapping and resuming I/Os to target devices on all Open HyperSwap devices in a session.

SDDPCM_SWAPRESUMEDONE

Swapping and resuming I/Os to target devices on all Open HyperSwap devices in a session is complete.

Windows log messages

This section lists log messages for SDDDSM on a Windows platform.

The log of events can be viewed in Windows Event Viewer under **Windows Logs** > **System**.

The following messages are logged to the System Event log.

Event ID: 1

Event Type: Informational
Event Source: sdddsm
Description: Multipath device X created, identifier I.

Event ID: 2

Event Type: Informational
Event Source: sdddsm
Description: Multipath device X was assigned disk number N by Windows.

Event ID: 3

Event Type: Warning
Event Source: sdddsm
Description: Multipath device X removed.

Event ID: 4

Event Type: Informational
Event Source: sdddsm
Description: Path N added to multipath device X.

Event ID: 5

Event Type: Warning
Event Source: sdddsm
Description: Path N removed from multipath device X by MPIO.

Event ID: 6

Event Type: Informational
Event Source: sdddsm
Description: MPDISK X path N online by driver.

Event ID: 7

Event Type: Informational
Event Source: sdddsm
Description: MPDISK X path N online by sddsrv.

Event ID: 8

Event Type: Informational
Event Source: sdddsm
Description: MPDISK X path N online by datapath.

Event ID: 9

Event Type: Informational
Event Source: sdddsm
Description: MPDISK X path N online by pathtest.

Event ID: 10

Event Type: Informational
Event Source: sdddsm
Description: MPDISK X path N online by unknown application.

Event ID: 11

Event Type: Warning
Event Source: sdddsm
Description: MPDISK X path N offline by driver.

Event ID: 12

Event Type: Warning
Event Source: sdddsm
Description: MPDISK X path N offline by sddsrv.

Event ID: 13

Event Type: Warning
Event Source: sdddsm
Description: MPDISK X path N offline by datapath.

Event ID: 14

Event Type: Warning
Event Source: sdddsm
Description: MPDISK X path N offline by pathtest.

Event ID: 15

Event Type: Warning
Event Source: sdddsm
Description: MPDISK X path N set to dead by driver.

Event ID: 16

Event Type: Warning
Event Source: sdddsm
Description: MPDISK X path N set to dead by sddsrv.

Event ID: 17

Event Type: Informational
Event Source: sdddsm
Description: Adapter X set to online.

Event ID: 18

Event Type: Warning
Event Source: sdddsm
Description: Adapter X set to offline.

Event ID: 19

Event Type: Informational
Event Source: sdddsm
Description: MPDISK X reserved through path N.

Event ID: 20

Event Type: Warning
Event Source: sdddsm
Description: MPDISK X released.

Event ID: 21

Event Type: Informational
Event Source: sdddsm
Description: MPDISK X path Y registered.

Event ID: 22

Event Type: Warning
Event Source: sdddsm
Description: MPDISK X reservation cleared.

Event ID: 23

Event Type: Warning
Event Source: sdddsm
Description: Multipath device X exceeded max paths.

Event ID: 100

Event Type: Informational
Event Source: SDD_Service
Description: The SDD_service was installed.

Event ID: 101

Event Type: Error
Event Source: SDD_Service
Description: The SDD_service cannot be installed.

Event ID: 102

Event Type: Informational
Event Source: SDD_Service
Description: The SDD_service was removed.

Event ID: 103

Event Type: Error
Event Source: SDD_Service
Description: The SDD_service could not be removed.

Event ID: 104

Event Type: Informational
Event Source: SDD_Service
Description: The SDD_service control dispatcher was started.

Event ID: 105

Event Type: Error
Event Source: SDD_Service
Description: The control handler could not be installed.

Event ID: 106

Event Type: Error
Event Source: SDD_Service
Description: The initialization process failed.

Event ID: 107

Event Type: Informational
Event Source: SDD_Service
Description: The SDD_Service service was started.

Event ID: 108

Event Type: Error
Event Source: SDD_Service
Description: The SDD_Service service cannot be started.

Event ID: 109

Event Type: Informational
Event Source: SDD_Service
Description: The SDD_Service service was stopped.

Event ID: 110

Event Type: Informational
Event Source: SDD_Service
Description: The SDD_Service service cannot be stopped.

Event ID: 111

Event Type: Error
Event Source: SDD_Service
Description: The SDD_Service service cannot be bind to port.

Event ID: 112

Event Type: Error
Event Source: SDD_Service
Description: The SDD_Service service encountered a configuration mismatch.

Event ID: 113

Event Type: Error
Event Source: SDD_Service
Description: The SDD_Service failed to write the server log to file.

Event ID: 114

Event Type: Error
Event Source: SDD_Service
Description: The SDD_Service failed to write the driver log to file.

Event ID: 115

Event Type: Informational
Event Source: SDD_Service
Description: The SDD_Service service probing enabled with interval T min.

Event ID: 116

Event Type: Informational
Event Source: SDD_Service
Description: The SDD_Service service probing disabled.

Event ID: 117

Event Type: Informational
Event Source: SDD_Service
Description: The SDD_Service service probing interval changed to T min.

Appendix C. SDDDSM tools

Several support utilities are available to help you diagnose problems or issues that you might face when you work with SDDDSM.

Overview

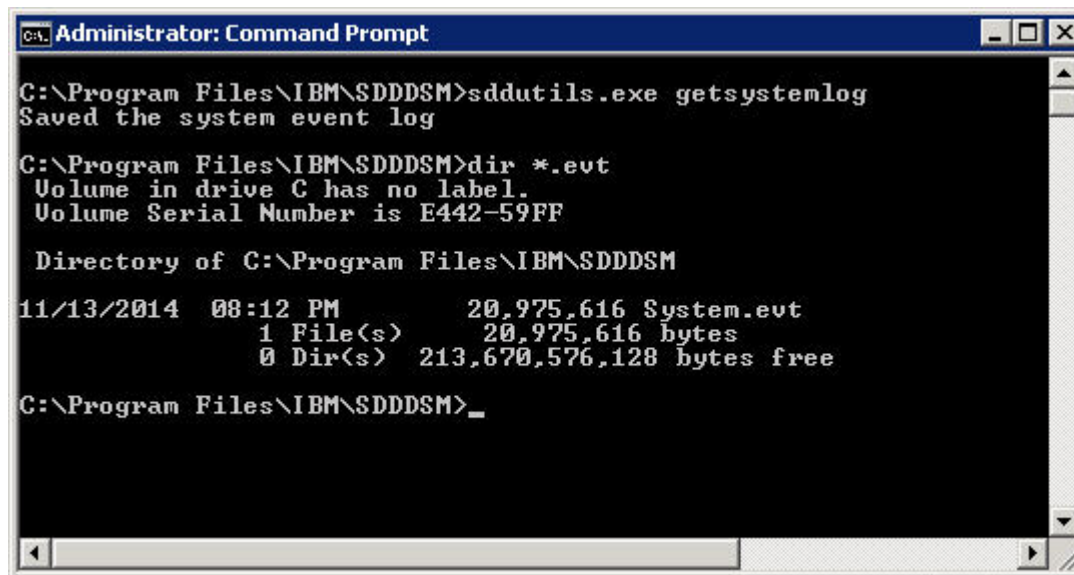
The following support utilities or tools are packaged with the SDDDSM release:

- PRTool.exe
- sddutils.exe
- HBAInfo.exe
- gethba.exe
- sddgetdata.bat
- sasflash.exe
- saswwpn.bat
- pathtest.exe
- sddsrv.exe
- mpiolist.exe
- sddShowCSVLuns.exe

All these tools are available in the installation directory of SDDDSM.

PRTool.exe

Use this tool to read or set data that is related to persistent reservation on the disk. You can read registrations, read reservations, or set registrations and reservations on the disk.



```
C:\Program Files\IBM\SDDDSM>sddutils.exe getsystemlog
Saved the system event log

C:\Program Files\IBM\SDDDSM>dir *.evt
Volume in drive C has no label.
Volume Serial Number is E442-59FF

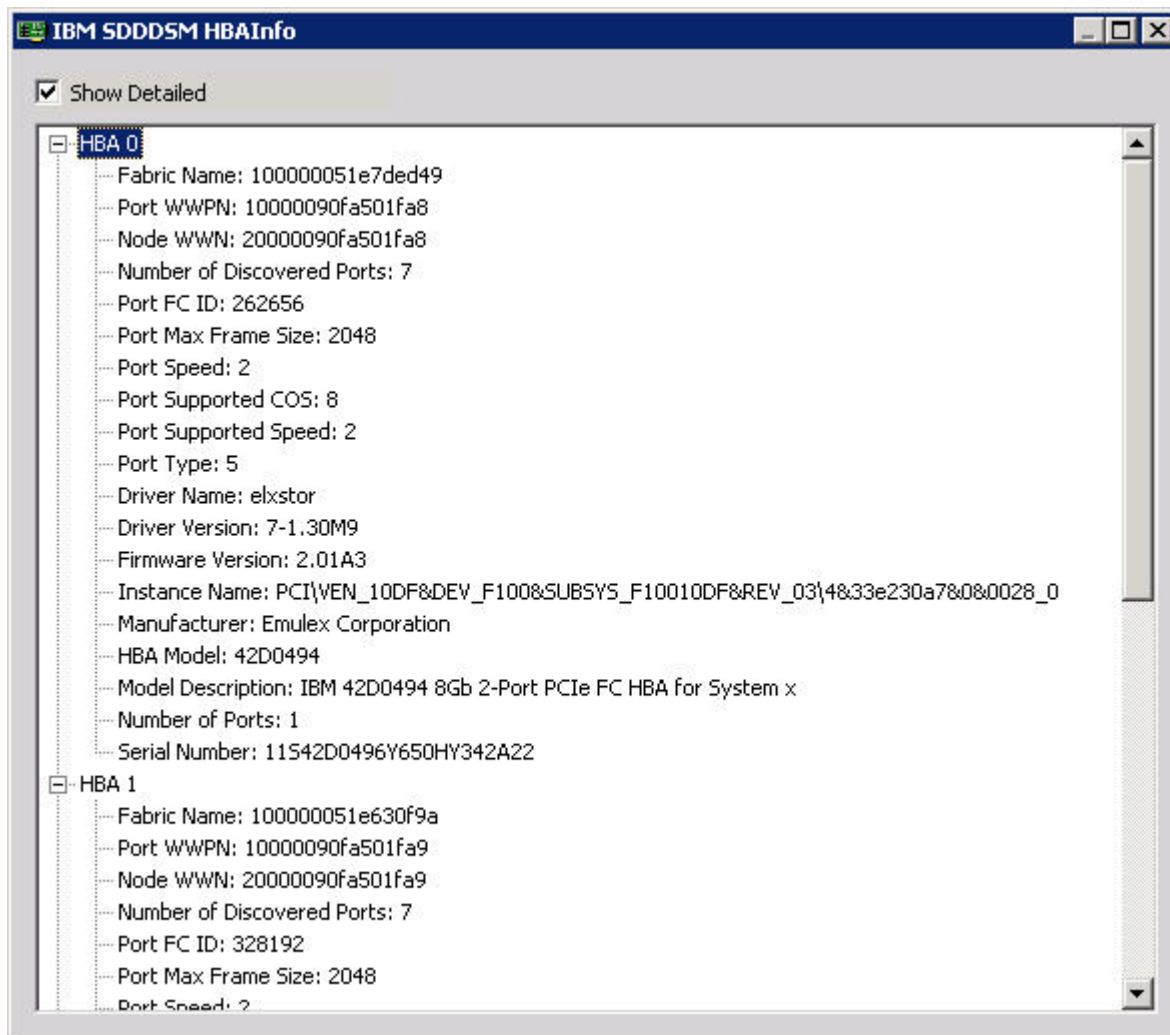
Directory of C:\Program Files\IBM\SDDDSM

11/13/2014  08:12 PM          20,975,616 System.evt
               1 File(s)          20,975,616 bytes
               0 Dir(s)  213,670,576,128 bytes free

C:\Program Files\IBM\SDDDSM>_
```

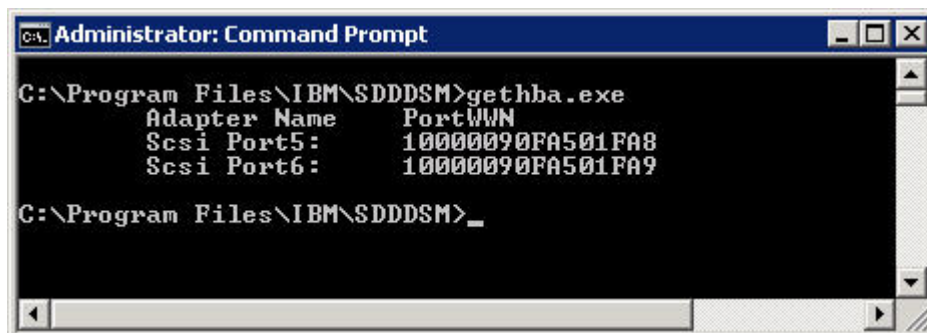
HBAInfo.exe

Use this tool to get detailed HBA information. You must install the VC Redistributable files on host.



gethba.exe

Use this tool to get Qlogic/Emulex HBA WWPNs. Alternatively, you can use datapath query wwpn or use the HBAInfo.exe file.

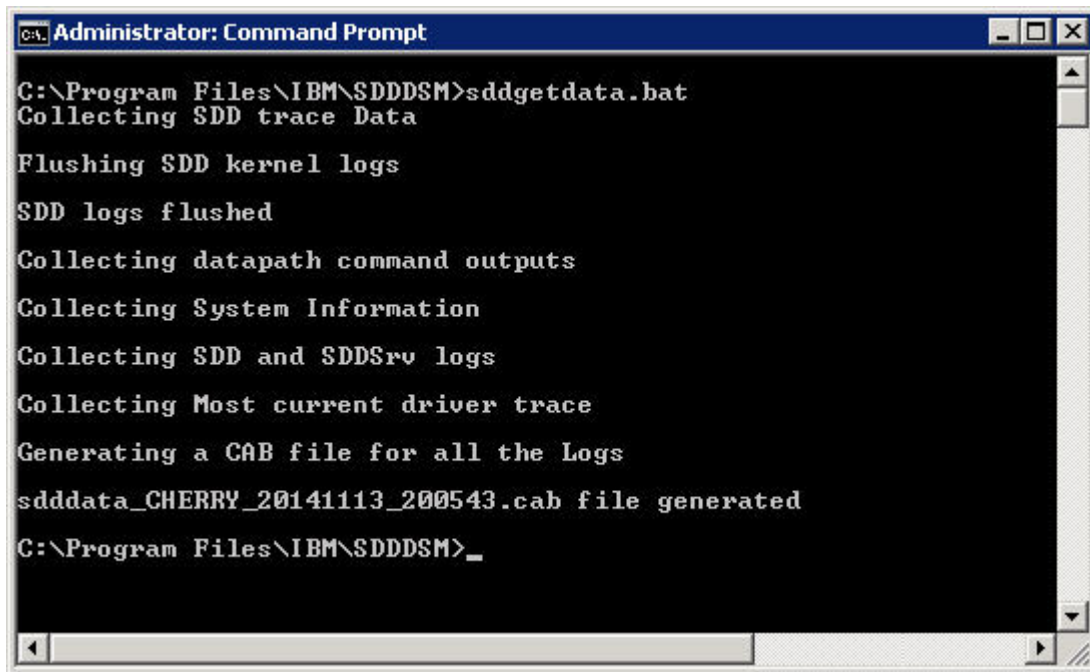


sddgetdata.bat

Use this tool to get SDD trace data.

This tool creates a cab file in the installation directory with the current date and time as part of the file name. For example, sdddata_hostname_yyyymmdd_hhmmss.cab, where yyyymmdd_hhmmss is the time stamp of the file creation. The cab file includes the following information:

- systemInfo
- "HKLM \SYSTEM\CurrentControlSet", "HKLM\HARDWARE\DEVICEMAP", and "HKLM\Cluster" output from registry
- sdddsm directory contents
- hba details
- datapath outputs
- pathtest trace
- sddsrv logs
- cluster logs



```
Administrator: Command Prompt
C:\Program Files\IBM\SDDDSM>sddgetdata.bat
Collecting SDD trace Data
Flushing SDD kernel logs
SDD logs flushed
Collecting datapath command outputs
Collecting System Information
Collecting SDD and SDDSRV logs
Collecting Most current driver trace
Generating a CAB file for all the Logs
sdddata_CHERRY_20141113_200543.cab file generated
C:\Program Files\IBM\SDDDSM>_
```

sasflash.exe

Use this tool to get SAS HBA details and to download the firmware.

You can use the following parameters when you run the sasflash.exe file:

- <-c x> - x stands for adapter index
- <-verbose> - set output to verbose mode
- <-l x> - log output to a file
- <-f x> - flash firmware image
- "x" - firmware file to flash

Important: For the current version of the sasflash.exe file and for information about the current command-line options, go to the LSI website (<http://technet.microsoft.com/en-us/library/dd361921.aspx>).

saswwpn.bat

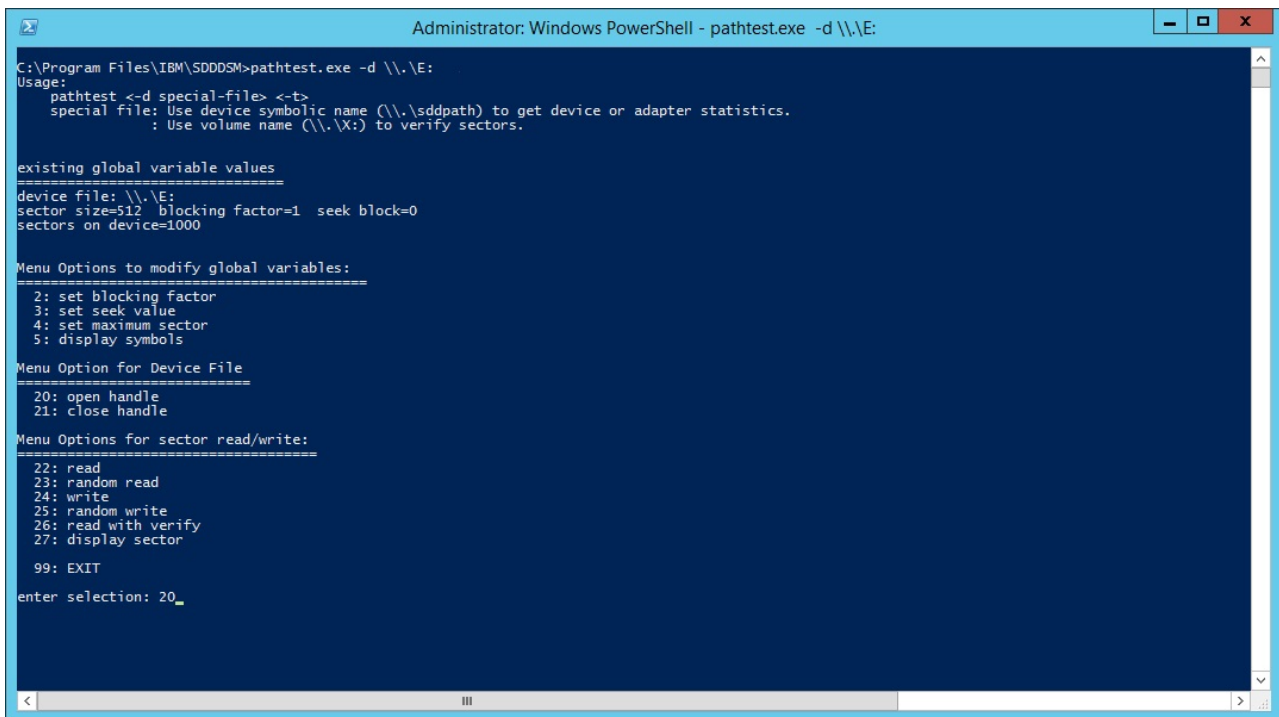
Use this batch file to gather information about SAS HBA. This tool uses the sasflash.exe tool.

```
sasflash.exe -o -listsasadd -c %CONTROLLER% >NUL
```

pathtest.exe

Use this tool to get device or adapter statistics, enable trace flags, and verify sectors of a Volume.

The following figure shows the usage pattern and menu options.



```
Administrator: Windows PowerShell - pathtest.exe -d \\.\E:
C:\Program Files\IBM\SDDDSM>pathtest.exe -d \\.\E:
Usage:
  pathtest <-d special-file> <-t>
  special file: Use device symbolic name (\\.\sddpath) to get device or adapter statistics.
                : Use volume name (\\.\X:) to verify sectors.

existing global variable values
=====
device file: \\.\E:
sector size=512 blocking factor=1 seek block=0
sectors on device=1000

Menu Options to modify global variables:
=====
  2: set blocking factor
  3: set seek value
  4: set maximum sector
  5: display symbols

Menu Option for Device File
=====
  20: open handle
  21: close handle

Menu Options for sector read/write:
=====
  22: read
  23: random read
  24: write
  25: random write
  26: read with verify
  27: display sector

  99: EXIT
enter selection: 20_
```

You must use -d with the command. Before using any other options, use **open handle** to open the device file.

The command provides various options to read, and write to the desired sectors of the Volume. You can select either read or write mode. If you use the **write** option, the first byte of the sector with the sector number is written, followed by random values. To verify whether the particular sector is written using the **write** option, you can use the **Read with Verify** option. The first byte of the sector is checked.

The default size of the sector to read, or to write is 512 bytes. You can change the read or write size by using the **set blocking factor** option to multiples of 512. The **Set seek value** option can be used to position the file pointer at the beginning of the desired sector. **Random Read** and **Random Write** option can be used to read or write a random sector within the maximum sector number. The maximum sector number is set by the using **Set maximum sector** option. Always use the **Display sector** option after reading a particular sector.

Menu options for symbolic name as special file


```

Administrator: Windows PowerShell - pathtest.exe -d \\.\sddpath\

C:\Program Files\IBM\SDDDSM>pathtest.exe -d \\.\sddpath\
Usage:
    pathtest <-d special-file> <-t>
    special file: Use device symbolic name (\\.\sddpath) to get device or adapter statistics.
                  : Use volume name (\\.\X:) to verify sectors.

existing global variable values
=====
device file: \\.\sddpath\
handle=0000000000000000

Menu Option for Device File
=====
    20: open handle
    21: close handle

Menu Options for device or adapter statistics:
=====
    45: get adapter statistics
    46: get device statistics

Miscellaneous menu options:
=====
    60: execute command
    88: Trace Menu
    99: EXIT

enter selection: 20
Enter open mode (1) RO (2) RW 2
device file (\\.\sddpath\) will be opened
Open mode: Read and write.
analyze return code 44  errno 0 (Successful)
        error value 0 (Successful) residual 0 data 0
Command elapsed time in seconds =      3.00
Return to continue:

existing global variable values
=====
device file: \\.\sddpath\
handle=000000000000002C

```

```

Administrator: Windows PowerShell - pathtest.exe -d \\.\sddpath\

=====
device file: \\.\sddpath\
handle=000000000000002C

Menu Option for Device File
=====
    20: open handle
    21: close handle

Menu Options for device or adapter statistics:
=====
    45: get adapter statistics
    46: get device statistics

Miscellaneous menu options:
=====
    60: execute command
    88: Trace Menu
    99: EXIT

enter selection: 88

Menu options for driver trace
=====

current trace output file is <trace.out>
current flags 0X00DB0000

Trace Flag Operations:
13 : apply flags to driver
(Note:Use 0X0DB000 for DEFAULT flag setting, 0XDFB0000 for DEFAULT+IO trc flag, 0XDFF0000 to enable all)
19 : start driver trace
21 : end driver trace
22 : write driver trace data to file <trace.out>
23 : clear trace table

99 : return to test menu

enter selection:

```

You can get device or adapter statistics and execute various system and datapath commands by using the **execute command** option. You can use the **trace menu** option to enable or disable the kernel trace flags which are helpful to write detailed traces to SDD logs.

The trace menu options are as follows:

- **Apply flags to driver:** Use this option to enable or disable kernel trace flags. Use **0XDD80000** for default flag setting, **0XDDF0000** for default+IO trc flag, **0XD8B0000** for default+CFG trc flag, **0XDFF0000** to enable all.
- **Start device driver trace:** Use this option to enable kernel flags belonging to report option. If the kernel flags are disabled, the logging stops. Hence, set those bits after setting the kernel flag by using the **Apply flags to driver** option.
- **End device driver trace:** Use this option to disable the logging of traces.
- **Write driver data to a file:** Use this option to dump the trace data in kernel memory to a file trace-out.

sddsrv.exe

sddsrv.exe is an SDDDSM path recovery daemon that runs as a service in the Windows OS.

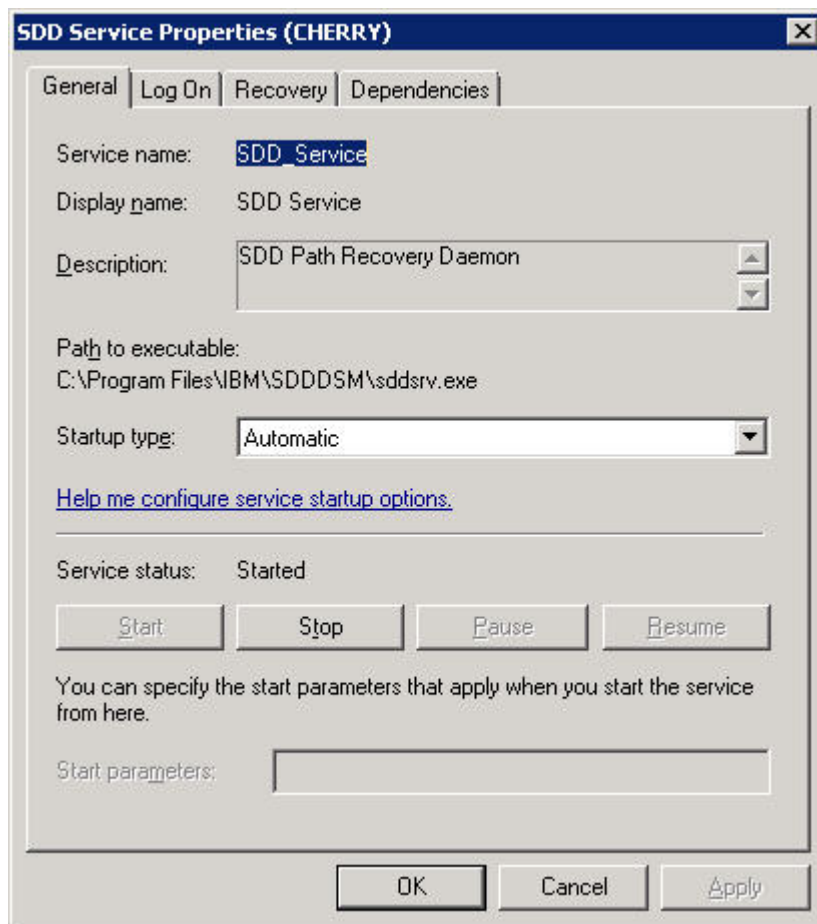
This tool generates log files, `sdd.log` and `sddsrv.log`, in the `windows\system32` folder to help with debugging any issues. The log files get generated even for the release builds of the sdddsm driver. The `sddgetdata.bat` file copies these logs in to its cab file.

To use this tool, run the following command:

```
sddsrv d|v|q|f|s0|s1 \n
```

where

- d = produce detailed console output
- v = produce summary console output
- q = produce no console output (default)
- f = allow multiple servers on the same host
- s0 = disable driver interface
- s1 = enable driver interface



The sample content of the sdd.log file is as follows:

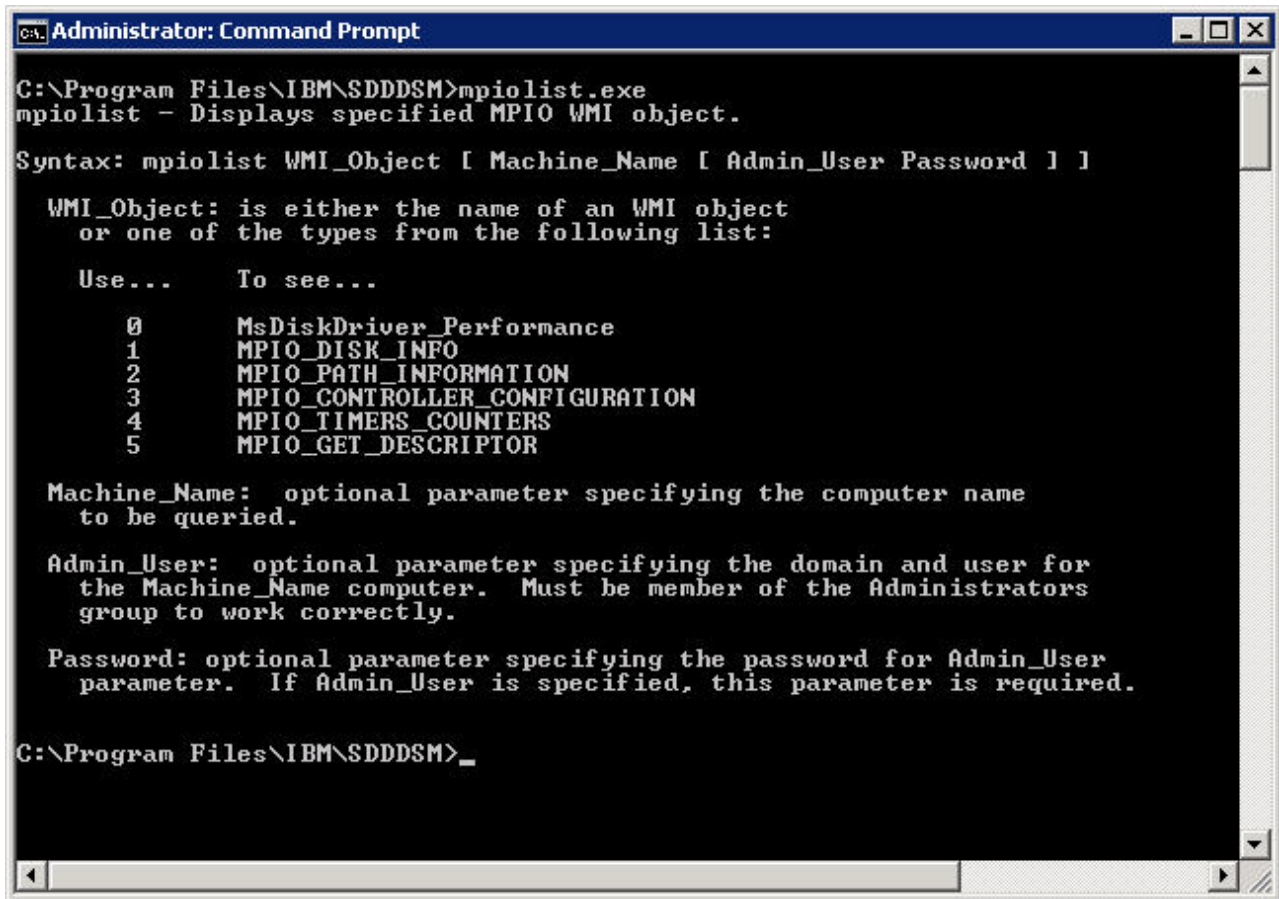
```
GmSrbDeviceControl(1126) MPD-000-60050768019B02A8100000000000192, SCSI_ADDRESS 05-00-00-00
GmSrbDeviceControl(1126) MPD-001-60050768019B02A8100000000000193, SCSI_ADDRESS 05-00-00-01
GmSrbDeviceControl(1126) MPD-002-60050768019B02A8100000000000180, SCSI_ADDRESS 05-00-00-02
GmClusterPRIN(1579) MPD-002-60050768019B02A8100000000000180, Key Count= 8, Ac-tivePathCount 8
GmClusterPRIN(1579) MPD-000-60050768019B02A8100000000000192, Key Count= 8, Ac-tivePathCount 8
```

The sample content of the sddsrv.log file is as follows:

```
WinSock 2.0 initialized successfully
T4684 RegisterServiceCtrlHandler failed 0x0000043B
T4684 GetLastError = 1083 (0x0000043B), WSAGetLastError = 1083
.....
.....
.....
T4308 device \\.\PhysicalDrive4Path7 has serial 60050768019B02A8100000000000180
T4308 sddsrv map file out C:\Program Files\IBM\SDDDSM\sddessmap.out
T4308 28 devices found
>>>>>> END Configuration Scan
Collecting sdd driver trace
T2704 Size of the trace buffer=27079
T2704 SDD Trace was put to file at 11/16 11:40:53
Exiting SDD GET Trace
```

mpiolist.exe

Use this tool to view information about MPIO WMI Class such as MPIO DISK, MPIO PATHS.



```
Administrator: Command Prompt
C:\Program Files\IBM\SDDDSM>mpiolist.exe
mpiolist - Displays specified MPIO WMI object.

Syntax: mpiolist WMI_Object [ Machine_Name [ Admin_User Password ] ]

WMI_Object: is either the name of an WMI object
or one of the types from the following list:

Use...    To see...
0         MsDiskDriver_Performance
1         MPIO_DISK_INFO
2         MPIO_PATH_INFORMATION
3         MPIO_CONTROLLER_CONFIGURATION
4         MPIO_TIMERS_COUNTERS
5         MPIO_GET_DESCRIPTOR

Machine_Name: optional parameter specifying the computer name
to be queried.

Admin_User: optional parameter specifying the domain and user for
the Machine_Name computer. Must be member of the Administrators
group to work correctly.

Password: optional parameter specifying the password for Admin_User
parameter. If Admin_User is specified, this parameter is required.

C:\Program Files\IBM\SDDDSM>_
```

You can view the same information in WMI CIM Studio.

sddShowCSVLuns.ps1

Use this tool to get the details related to all the Clustered Shared Volumes on the host.

```
Administrator: Windows PowerShell

CLUSTER DETAILS:
=====START=====
Cluster Name: OLIVE-PEAR
Cluster IP Address: 9.193.231.219
=====END=====

LIST OF ALL DATAPATH VOLUMES:
=====START=====

Total Devices : 5

DEV#: 0 DEVICE NAME: Disk1 Part0          TYPE: 2145      POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768DC80034098000000000002A5  Reserved: Yes  LUN SIZE: 7.0GB
HOST INTERFACE: FC
PREFERRED PATH SET :None
=====
Path#   Adapter/Hard Disk      State   Mode    Select  Errors
  0     Scsi Port6 Bus0/Disk1 Part0  OPEN   NORMAL  23849596  85
  1 *   Scsi Port6 Bus0/Disk1 Part0  OPEN   NORMAL  10894758  53
  2     Scsi Port6 Bus0/Disk1 Part0  CLOSE  NORMAL   0        0

DEV#: 1 DEVICE NAME: Disk2 Part0          TYPE: 2145      POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768DC80034098000000000002A6  Reserved: No   LUN SIZE: 7.0GB
HOST INTERFACE: FC
PREFERRED PATH SET :None
=====
Path#   Adapter/Hard Disk      State   Mode    Select  Errors
  0     Scsi Port6 Bus0/Disk2 Part0  OPEN   NORMAL   0        0
  1 *   Scsi Port6 Bus0/Disk2 Part0  OPEN   NORMAL  246       0
  2 *   Scsi Port6 Bus0/Disk2 Part0  CLOSE  NORMAL   0        0

DEV#: 2 DEVICE NAME: Disk3 Part0          TYPE: 2145      POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768DC80034098000000000002A7  Reserved: No   LUN SIZE: 7.0GB
HOST INTERFACE: FC
PREFERRED PATH SET :None
=====
Path#   Adapter/Hard Disk      State   Mode    Select  Errors
  0     Scsi Port6 Bus0/Disk3 Part0  OPEN   NORMAL  343       1
  1 *   Scsi Port6 Bus0/Disk3 Part0  OPEN   NORMAL   0        0
  2     Scsi Port6 Bus0/Disk3 Part0  CLOSE  NORMAL   0        0

DEV#: 3 DEVICE NAME: Disk4 Part0          TYPE: 2145      POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768DC80034098000000000002A8  Reserved: No   LUN SIZE: 7.0GB
HOST INTERFACE: FC
PREFERRED PATH SET :None
=====
Path#   Adapter/Hard Disk      State   Mode    Select  Errors
  0     Scsi Port6 Bus0/Disk4 Part0  OPEN   NORMAL   0        0
  1 *   Scsi Port6 Bus0/Disk4 Part0  OPEN   NORMAL  246       0
  2 *   Scsi Port6 Bus0/Disk4 Part0  CLOSE  NORMAL   0        0

DEV#: 4 DEVICE NAME: Disk5 Part0          TYPE: 2145      POLICY: LEAST I/O AND WEIGHT
SERIAL: 60050768DC80034098000000000002A9  Reserved: No   LUN SIZE: 7.0GB
HOST INTERFACE: FC
PREFERRED PATH SET :None
=====
Path#   Adapter/Hard Disk      State   Mode    Select  Errors
  0     Scsi Port6 Bus0/Disk5 Part0  OPEN   NORMAL 12219709 113
```

```
For more information about a particular disk, use 'mpclaim -s -d #' where # is the MPIO disk number.

MPIO Disk   System Disk  LB Policy   DSM Name
-----
MPIO Disk24  Disk 5        VS          IBM SDDDSM
MPIO Disk23  Disk 4        VS          IBM SDDDSM
MPIO Disk22  Disk 3        VS          IBM SDDDSM
MPIO Disk21  Disk 2        VS          IBM SDDDSM
MPIO Disk20  Disk 1        VS          IBM SDDDSM
=====END=====

LIST OF ALL CLUSTERED VOLUMES (NON-CSV):
=====START=====

Name                State              OwnerGroup          ResourceType
-----
Cluster Disk 6      Online            Cluster Group       Physical Disk
Cluster Disk 5
=====END=====

LIST OF ALL CLUSTERED SHARED VOLUMES (CSV):
=====START=====

Name                SytemDisk CSVPath          PhysicalDisk  Size(GB) FreeSpace(GB) UsedSpace(GB) PercentFree
-----
Cluster Disk 1      1 C:\ClusterStorage\Volume3 PHYSICALDRIVE1 7.00 0.71 6.29 10.16
Cluster Disk 4      5 C:\ClusterStorage\Volume1 PHYSICALDRIVE5 6.97 5.13 1.84 73.64
=====END=====

CLUSTERED DISKS TO PHYSICAL SYSTEM DISKS MAPPING:
=====START=====

ClusterResourceName: Cluster Disk 6
DiskName:           \\?\PhysicalDrive2

ClusterResourceName: Cluster Disk 5
DiskName:           \\?\PhysicalDrive4

CSV ClusterResourceName: Cluster Disk 1
DiskName:           \\?\PhysicalDrive 1

CSV ClusterResourceName: Cluster Disk 4
DiskName:           \\?\PhysicalDrive 5
=====END=====
```

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This glossary includes terms for disk storage system products and Virtualization products.

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See This refers the reader to one of two kinds of related information:

- A term that is the expanded form of an abbreviation or acronym. This expanded form of the term contains the full definition.
- A synonym or more preferred term.

See also

This refers the reader to one or more related terms.

Special characters

1750 The machine type for the IBM System Storage DS6000 series. Models for the DS6000 include the 511 and EX1.

1820 The machine number for the RSSM.

2105 The machine number for the IBM TotalStorage Enterprise Storage Server (ESS). Models of the ESS are expressed as the number 2105 followed by “Model <xxx>”, such as 2105 Model 800. The 2105 Model 100 is an ESS expansion enclosure that is typically referred to simply as the Model 100. See also *IBM TotalStorage Enterprise Storage Server* and *Model 100*.

2107 A hardware machine type for the IBM System Storage DS8000 series. Hardware models for the 2107 include base units 921, 922, 931, 932, 9A2, 9B2 and expansion units 92E and 9AE.

2145 A hardware machine type for the IBM System Storage SAN Volume Controller. Models of the SAN Volume Controller are expressed as the number 2145 followed by “-xxx”, such as 2145-8G4. Hardware models for the 2145 include 2145-4F2, 2145-8F2, 2145-8F4, and 2145-8G4.

3390 The machine number of an IBM disk storage system. The ESS, when interfaced to IBM S/390 or IBM z/OS 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 eight pack*.

/ file system

The root file system; contains files that contain machine-specific configuration data.

/tmp file system

A shared storage location for files.

/usr file system

Contains files and programs necessary for operating the machine.

/var file system

Contains files that are variable on a per-client basis, such as spool and mail files.

A

access To obtain the use of a computer resource.

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 disk storage system product during initial configuration. It enables all fibre-channel-attached host systems with no defined access profile to access all logical volumes on the disk storage system. 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 also *pseudo-host* and *worldwide port name*.

ACK See *request for acknowledgement and acknowledgement*.

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 also *backup Copy Services server*, *Copy Services client*, and *primary Copy Services server*.

active/active mode

A configuration that enables one controller node of a storage system pair to process I/O requests and provide a standby capability for the other controller node. Generally, an active/active storage system involves a battery-backed mirrored cache, in which the cache content of a controller is mirrored to another for data integrity and availability.

active/passive mode

A configuration that enables one controller node of a storage system pair to process I/O requests, while the other controller node is idle in standby mode

ready to take over I/O activity if the active primary controller fails or is taken offline.

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 also *implicit allegiance*, *contingent allegiance*, and *reserved allegiance*.

allocated storage

In a disk storage system, the space that is allocated to volumes but not yet assigned. See also *assigned storage*.

American National Standards Institute (ANSI)

An organization of producers, consumers, and general interest groups that establishes the procedures by which accredited organizations create and maintain voluntary industry standards in the United States. (A)

Anonymous

In ESS Specialist, the label on an icon that represents all connections that are using fibre-channel adapters between the ESS and hosts and that are not completely defined to the ESS. See also *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 also *Anonymous* and *pseudo-host*.

ANSI See *American National Standards Institute*.

APAR See *authorized program analysis report*. (GC)

arbitrated loop

For fibre-channel connections, a topology that enables the interconnection of a set of nodes. See also *point-to-point connection* and *switched fabric*.

array An ordered collection, or group, of physical devices (disk drive modules) that are used to define logical volumes or devices. More specifically, regarding the disk storage system, an array is a group of disks designated by the user to be

managed by the RAID-5 technique. See also *redundant array of independent disks*.

ASCII (American National Standard Code for Information Interchange) The standard code, using a coded character set consisting of 7-bit coded characters (8 bits including parity check), that is used for information interchange among data processing systems, data communication systems, and associated equipment. The ASCII set consists of control characters and graphic characters. (A) Some organizations, including IBM, have used the parity bit to expand the basic code set.

assigned storage

On a disk storage system, 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. (GC)

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 also *active Copy Services server*, *Copy Services client*, and *primary Copy Services server*.

bay In the disk storage system, the physical space used for installing SCSI, ESCON, and fibre-channel host adapter cards. The ESS has four bays, two in each cluster. See also *service boundary*.

bit Either of the digits 0 or 1 when used in the binary numeration system. (T)

The storage medium required to store a single binary digit. See also *byte*.

block A string of data elements recorded or transmitted as a unit. The elements may be characters, words, or physical records. (T)

In the disk storage system, a group of consecutive bytes used as the basic storage unit in fixed-block architecture (FBA). All blocks on the storage device are the same size (fixed size). See also *fixed-block architecture* and *data record*.

byte A group of eight adjacent binary digits that represent one EBCDIC character.

The storage medium required to store eight bits. See also *bit*.

C

cache A special-purpose buffer storage, smaller and faster than main storage, used to hold a copy of instructions and data obtained from main storage and likely to be needed next by the processor. (T)

cache fast write

In the disk storage system, a form of the fast-write operation in which the storage server writes the data directly to cache, where it is available for later destaging.

cache hit

An event that occurs when a read operation is sent to the cluster, and the requested data is found in cache. The opposite of *cache miss*.

cache memory

Memory, typically volatile memory, that a storage server uses to improve access times to instructions or data. The cache memory is typically smaller and faster than the primary memory or storage medium. In addition to residing in cache memory, the same data also resides on the storage devices in the storage 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 disk storage system and a service provider. The disk storage system 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 also *heartbeat* and *remote technical assistance information network*.

cascading

Connecting network controllers to each other in a succession of levels, to concentrate many more lines than a single level permits.

In high-availability cluster multiprocessing (HACMP), 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 a disk storage system sends to it.

CCR See *channel command retry*.

CCW See *channel command word*.

CD See *compact disc*.

compact disc

An optically read disc, typically storing approximately 660 MB. CD-ROM (compact disc read-only memory) refers to the read-only format used to distribute disk storage system code and documentation.

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*. See also *Copy Services command-line interface*.

cluster

In the disk storage system, a partition capable of performing all disk storage system functions. With two clusters in the disk storage system, any operational cluster can take over the processing of a failing cluster.

In the AIX operating system, a group of nodes within a complex.

cluster processor complex (CPC)

In the disk storage system, the unit within a cluster that provides the management function for the disk storage system. It consists of cluster processors, cluster memory, and related logic.

Code Distribution and Activation (CDA)

Process of installing licensed machine code on a disk storage system while applications continue to run.

command-line interface (CLI)

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). See also *Copy Services command-line interface*.

compression

The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks.

Any encoding that reduces the number of bits used to represent a given message or record. (GC)

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 download of licensed machine code

Process of installing licensed machine code while applications continue to run.

concurrent maintenance

Service that is performed on a unit while it is operational.

concurrent media maintenance

Service performed on a disk drive module (DDM) without losing access to the data.

configure

In storage, to define the logical and physical configuration of the input/output (I/O) subsystem through the user interface that the storage facility provides for this function.

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 also *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 the channel accepts unit-check status. The allegiance causes the control unit to guarantee access; the control unit does not present the busy status to the device. The allegiance enables the channel to retrieve sense data that is associated with the unit-check status on the channel path associated with the allegiance.

control unit (CU)

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.

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.

In the ESS, the portion of the ESS that supports the attachment of emulated CKD devices over ESCON, FICON, or OEMI interfaces. See also *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 that the ESS uses to request that an operating system of an IBM System z or S/390 host verify that one or more subsystem resources can be taken offline 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 might be model-dependent, might depend on the IBM TotalStorage Enterprise Storage Server Subsystem Device Driver, or might not exist.

Coordinated Universal Time (UTC)

The international standard of time that is kept by atomic clocks around the world.

Copy Services 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.

See also *active Copy Services server*, *backup Copy Services server*, and *primary Copy Services server*.

Copy Services CLI

See *Copy Services Command-Line Interface*.

Copy Services domain

A collection of user-designated ESS clusters participating in Copy Services functions managed by a designated active Copy Services server. See also *Copy Services server*, *dual-active server*, and *single-active server*.

Copy Services command-line interface (Copy Services CLI)

In the ESS, command-line interface software provided with ESS Copy Services and used for invoking Copy Services functions from host systems attached to the ESS. See also *command-line interface*.

Copy Services server

An ESS cluster designated by the copy services administrator to perform the ESS Copy Services functions. See also *active Copy Services server*, *backup Copy Services server*, and *primary 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. See also *active Copy Services server*, *backup Copy Services server*, and *primary Copy Services server*.

copy set

A set of volumes that contain copies of the same data. All the volumes in a copy set are the same format (count key data [CKD] or fixed block) and size.

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* field identifying the record and specifying its format, an optional *key* field that can be used to identify the data area contents, and an optional *data* field that typically contains the user data. 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. See also *data record*.

CPC See *cluster processor complex*.

CRC See *cyclic redundancy check*.

CU See *control unit*.

CUIR See *control-unit initiated reconfiguration*.

custom volume

In the ESS, a volume in count-key-data (CKD) format that is not a standard volume, which basically means that it does not necessarily present the same number of cylinders and capacity to its assigned logical control unit as provided by one of the following standard S/390 volume types: 3390-2, 3390-3, 3390-9, 3390-2 (3380-track mode), or 3390-3 (3380-track mode). See also *count-key-data*, *interleave*, *standard volume*, and *volume*.

CUT See *Coordinated Universal Time*.

cyclic redundancy check (CRC)

A redundancy check in which the check key is generated by a cyclic algorithm. (T)

cylinder

A unit of storage on a CKD device with a fixed number of tracks.

D

DA See *device adapter*. See also *SSA adapter*.

daisy chain

See *serial connection*.

DASD

See *direct access storage device*.

DASD fast write (DFW)

A function of a storage server in which active write data is stored in nonvolatile cache, thus avoiding exposure to data loss.

data availability

The degree to which data is available when needed, typically measured as a percentage of time that the system would be capable of responding to any data request (for example, 99.999% available).

data compression

A technique or algorithm used to encode data such that the encoded result can be stored in less space than the original data. The original data can be recovered from the encoded result through a reverse technique or reverse algorithm. See also *compression*.

Data Facility Storage Management Subsystem

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 IBM System z 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 also *count-key-data* and *fixed-block architecture*.

data sharing

The ability of multiple 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 eight pack*.

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 storage server demotes a data unit to make room for other logical data units in the cache or because the logical data unit is not valid. The ESS must destage logical data units with active write units before they can be demoted.

destaging

Movement of data from an online or higher priority to an offline or lower 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 ID

In the ESS, the unique two-digit hexadecimal number that identifies the logical device.

device interface card

A physical subunit of a storage cluster that provides the communication with the attached 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.

DFS See *distributed file service*.

direct access storage device (DASD)

A mass storage medium on which a computer stores data.

A disk device.

disk cage

A container for disk drives. Each disk cage supports eight disk eight packs (64 disks).

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

See *disk eight pack*.

disk eight pack

In the ESS, a group of eight disk drive modules (DDMs) installed as a unit in a DDM bay.

disk group

In the ESS, a collection of disk drives in the same SSA loop set up by the ESS to

be available to be assigned as a RAID array. A disk group can be formatted as CKD or fixed block, and as RAID or non-RAID, or it can be left unformatted. A disk group is a logical assemblage of eight disk drives, in contrast to a disk eight pack. See also *disk eight pack*.

disk storage system

One or more storage devices that are installed with a storage software application to provide a single common pool of storage that is used to store, safeguard, retrieve, and share data. Most disk storage systems also include disaster planning and recovery options. In SDD, a disk storage system refers to an ESS, DS6000, or DS8000 device.

distributed file service (DFS)

A service that provides data access over IP networks.

DNS See *domain name system*.

domain

That part of a computer network in which the data processing resources are under common control.

In TCP/IP, the naming system used in hierarchical networks.

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

A peripheral device, especially one that has addressed storage media. See also *disk drive module*.

The mechanism used to seek, read, and write information on a storage medium.

dual-active mode

With respect to a Copy Services server,

- the mode of operation of the server when the LIC level of the associated ESS cluster is 2.0 or higher.
- With respect to a Copy Services domain, the mode of operation of the domain, when the Copy Services servers are dual-active servers. See also *Copy Services server*, *Copy Services domain*, *mixed mode*, and *single-active server*.
- duplex**
Regarding ESS Copy Services, the state of a volume pair after PPRC has completed the copy operation and the volume pair is synchronized.
- In general, pertaining to a communication mode in which data can be sent and received at the same time.
- dynamic sparing**
The ability of a storage server to move data from a failing disk drive module (DDM) to a spare DDM while maintaining storage functions.
- E**
- E10** The predecessor of the F10 model of the ESS. See also *F10*.
- E20** The predecessor of the F20 model of the ESS. See also *F20*.
- EBCDIC**
See *extended binary-coded decimal interchange code*.
- EC** See *engineering change*.
- ECKD™**
See *extended count key data*.
- eight pack**
See *disk eight pack*.
- electrostatic discharge (ESD)**
An undesirable discharge of static electricity that can damage equipment and degrade electrical circuitry.
- emergency power off (EPO)**
A means of turning off power during an emergency, usually a switch.
- EMIF** See *ESCON multiple image facility*.
- enclosure**
A unit that houses the components of a storage subsystem, such as a control unit, disk drives, and power source.
- end of file**
A coded character recorded on a data medium to indicate the end of the medium. On a 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)**
An IBM architecture for mainframe computers and peripherals. Processor systems that follow the ESA/390 architecture include the ES/9000® family. See also *z/Architecture®*.
- Enterprise Systems Connection (ESCON)**
An Enterprise Systems Architecture/390 and IBM System z computer peripheral interface. The I/O interface uses ESA/390 logical protocols over a serial interface that configures attached units to a communication fabric.
- A set of IBM products and services that provide a dynamically connected environment within an enterprise.
- EPO** See *emergency power off*.
- ERDS** See *error-recording data set*.
- error-recording data set (ERDS)**
On S/390 and IBM System z hosts, a data set that records data-storage and data-retrieval errors. A service information message (SIM) provides the error information for the ERDS.
- 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 IBM z/OS 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 IBM System z hosts that attach to the ESS with an ESCON adapter. Such host systems run on operating systems that include MVS™, VSE, TPF, or versions of VM.

ESCON multiple image facility (EMIF)

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 that represents a host connection that uses the ESCON protocol and that is not completely defined on the ESS. See also *pseudo-host* and *access-any mode*.

ESD See *electrostatic discharge*.

eServer

See *IBM eServer*.

ESS See *IBM TotalStorage Enterprise Storage Server*.

ESS Copy Services

In the ESS, a collection of optional software features, with a Web-browser interface, used for configuring, managing, and monitoring data-copy functions.

ESS Copy Services CLI

See *Copy Services Command-Line Interface*.

ESS Expert

See *IBM TotalStorage Enterprise Storage Server Expert*.

ESS Master Console

See *IBM TotalStorage ESS Master Console*.

ESSNet

See *IBM TotalStorage Enterprise Storage Server Network*.

ESS Specialist

See *IBM TotalStorage Enterprise Storage Server Specialist*.

Expert See *IBM TotalStorage 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 also *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 also *failover*.

failover

In SAN Volume Controller, the function that occurs when one redundant part of the system takes over the workload of another part of the system that has failed.

In the ESS, the process of transferring all control of the ESS to a single cluster in the ESS when the other cluster in the ESS fails. See also *cluster*.

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 See *feature code*. **Note:** FC is a common abbreviation for fibre channel in the industry, but the ESS customer documentation library reserves FC for feature code.

FC-AL See *Fibre Channel-Arbitrated Loop*.

FCP See *fibre-channel protocol*.

FCS See *fibre-channel standard*.

feature code (FC)

A code that identifies a particular orderable option and that is used by service personnel to process hardware and software orders. Individual optional features are each identified by a unique feature code.

fibre channel

A data-transmission architecture based on the ANSI fibre-channel standard, which supports full-duplex communication. The ESS supports data transmission over fiber-optic cable through its fibre-channel adapters. See also *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. See 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)

A protocol used in fibre-channel communications with five layers that define how fibre-channel ports interact through their physical links to communicate with other ports.

fibre-channel standard (FCS)

An ANSI standard for a computer peripheral interface. The I/O interface defines a protocol for communication over a serial interface that configures attached units to a communication fabric. The protocol has two layers. The IP layer defines basic interconnection protocols. The upper layer supports one or more logical protocols (for example, FCP for SCSI command protocols and SBICON for ESA/390 command protocols). See American National Standards Institute (ANSI) X3.230-199x. See also *fibre-channel protocol*.

FICON

See *fibre-channel connection*.

FiconNet

In ESS Specialist, the label on a pseudo-host icon that represents a host connection that uses the FICON protocol and that is not completely defined on the ESS. See also *pseudo-host* and *access-any mode*.

field replaceable unit (FRU)

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

FIFO See *first-in-first-out*.

File Transfer Protocol (FTP)

In TCP/IP, an application protocol used to transfer files to and from host computers. See also *Transmission Control Protocol/Internet Protocol*.

firewall

A protection against unauthorized connection to a computer or a data storage system. The protection is usually in the form of software on a gateway server that grants access to users who meet authorization criteria.

first-in-first-out (FIFO)

A queuing technique in which the next

item to be retrieved is the item that has been in the queue for the longest time.
(A)

fixed-block architecture (FBA)

An architecture for logical devices that specifies the format of and access mechanisms for the logical data units on the device. The logical data unit is a block. All blocks on the device are the same size (fixed size). The subsystem can access them independently.

fixed-block device

An architecture for logical devices that specifies the format of the logical data units on the device. The logical data unit is a block. All blocks on the device are the same size (fixed size); the subsystem can access them independently. This is the required format of the logical data units for host systems that attach with a SCSI or fibre-channel interface. See also *fibre-channel* and *small computer systems interface*.

FlashCopy

An optional feature 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*.

FTP See *File Transfer Protocol*.

full duplex

See *duplex*.

G

GB See *gigabyte*.

GDPS[®]

See *Geographically Dispersed Parallel Sysplex[®]*.

Geographically Dispersed Parallel Sysplex[™] (GDPS)

An S/390 multisite application-availability solution.

gigabyte (GB)

A gigabyte of storage is 10⁹ bytes. A gigabyte of memory is 2³⁰ bytes.

group In ESS documentation, a nickname for two different kinds of groups, depending on the context. See *disk eight pack* or *Copy Services server group*.

H

HA See *host adapter*.

HACMP

See *High-Availability Cluster Multiprocessing*.

hard disk drive (HDD)

A storage medium within a storage server used to maintain information that the storage server requires.

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 on an AS/400 or IBM System i[®] 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.

HBA See *host bus adapter*.

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 also *call home*, *heartbeat call home record*, and *remote technical assistance information network*.

heartbeat call home record

Machine operating and service information sent to a service machine. These records might include such information as feature code information and product logical configuration information.

hierarchical storage management

A function provided by storage management software such as Tivoli Storage Management or Data Facility Storage Management Subsystem/MVS (DFSMS/MVS) to automatically manage free space based on the policy that the storage administrator sets.

In AS/400 storage management, an automatic method to manage and distribute data between the different storage layers, such as disk units and tape library devices.

High-Availability Cluster Multiprocessing (HACMP)

Software that provides host clustering, so that a failure of one host is recovered by moving jobs to other hosts within the cluster.

high-speed link (HSL)

A hardware connectivity architecture that links system processors to system input/output buses and other system units.

home address (HA)

A nine-byte field at the beginning of a track that contains information that identifies the physical track and its association with a cylinder.

Note: In the ESS, the acronym HA is shared between home address and host adapter. See also *host adapter*.

hop Interswitch connection. A hop count is the number of connections that a particular block of data traverses between source and destination. For example, data traveling from one hub over a wire to another hub traverses one hop.

host See *host system*.

host adapter (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.

In the ESS, the acronym HA is shared between home address and host adapter. See also *home address*.

host bus adapter

An interface card that connects a host bus, such as a peripheral component interconnect (PCI) bus, to the storage area network.

host name

The Internet address of a machine in the network. In the ESS, the host name can be entered in the host definition as the fully

qualified domain name of the attached host system, such as `mycomputer.city.company.com`, or as the subname of the fully qualified domain name, for example, `mycomputer`. See also *host system*.

host processor

A processor that controls all or part of a user application network. In a network, the processing unit in which the data communication access method resides. See also *host system*.

host system

A computer, either of the mainframe (S/390 or IBM system z) or of the open-systems type, that is connected to the ESS. S/390 or IBM z/OS 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.

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*.

HSM See *hierarchical storage management* or *Hardware Service Manager*.

I

IBM eServer

The IBM brand name for a series of server products that are optimized for e-commerce. The products include the IBM System i, System p, IBM System x, and IBM System z.

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 System Storage Multipath Subsystem Device Driver (SDD)

Software that is designed to provide multipath configuration environment support for a host system that is attached to storage devices. SDD resides in a host system with the native disk device driver.

IBM System Storage Multipath Subsystem Device Driver Path Control Module (SDDPCM)

A loadable path control module for disk

storage system devices to supply path management functions and error recovery algorithms. When the disk storage system devices are configured as Multipath I/O (MPIO)-devices, SDDPCM becomes part of the AIX MPIO Fibre Channel Protocol device driver during the configuration. The AIX MPIO-capable device driver with the disk storage system SDDPCM module enhances the data availability and I/O load balancing.

IBM System Storage Subsystem Device Driver Device Specific Module (SDDDSM)

An IBM storage subsystems multipath I/O solution that is based on Microsoft MPIO technology. It is a device-specific module that is designed to support IBM storage subsystems devices such as SAN Volume Controller, DS8000, and DS6000. SDDDSM resides on a host server with the native disk device driver and provides enhanced data availability, automatic path failover protection, concurrent download of controller firmware code, and path selection policies for the host system.

IBM TotalStorage Enterprise Storage Server (ESS) A member of the Seascape 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 multiple 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 Expert (ESS Expert)

The software that gathers performance data from the ESS and presents it through a Web browser.

IBM TotalStorage Enterprise Storage Server Specialist (ESS Specialist)

Software with a Web-browser interface for configuring the ESS.

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 microcode load (IML)

The action of loading microcode for a computer into that computer's storage.

initial program load (IPL)

The action of loading software into a computer, typically an operating system that controls the computer.

initiator

A SCSI device that communicates with and controls one or more targets. 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 also *target*.

i-node The internal structure in an AIX operating system that describes the individual files in the operating system. It contains the code, type, location, and owner of a file.

input/output (I/O)

Pertaining to (a) input, output, or both or

- (b) a device, process, or channel involved in data input, data output, or both.
- input/output configuration data set**
A configuration definition built by the I/O configuration program (IOCP) and stored on disk files associated with the processor controller.
- interleave**
In the ESS, to automatically create two striped partitions across the drives in a RAID-5 array, both of which use the count-key-data (CKD) record format.
- Internet Protocol (IP)**
In the Internet suite of protocols, a protocol without connections that routes data through a network or interconnecting networks and acts as an intermediary between the higher protocol layers and the physical network. The upper layer supports one or more logical protocols (for example, a SCSI-command protocol and an ESA/390 command protocol). See ANSI X3.230-199x. The IP acronym is the IP in TCP/IP. See also *Transmission Control Protocol/Internet Protocol*.
- invalidate**
To remove a logical data unit from cache memory because it cannot support continued access to the logical data unit on the device. This removal might be the result of a failure within the storage server or a storage device that is associated with the device.
- I/O** See *input/output*.
- I/O adapter (IOA)**
In the ESS, an input-output adapter on the PCI bus.
- IOCDs**
See *input/output configuration data set*.
- 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 system administrator to set priorities for queueing I/Os from different system images. See also *multiple allegiance* and *parallel access volume*.
- I/O processor (IOP)**
Controls input-output adapters and other devices.
- I/O sequential response time**
The time an I/O request is queued in processor memory waiting for previous I/Os to the same volume to complete.
- IOSQ** See *I/O sequential response time*.
- IP** See *Internet Protocol*.
- IPL** See *initial program load*.
- IBM System i**
An IBM eServer product that emphasizes integration. It is the successor to the AS/400 family of servers.
- J**
- Java Virtual Machine (JVM)**
A software implementation of a central processing unit (CPU) that runs compiled Java code (applets and applications). (GC)
- JVM** See *Java Virtual Machine*.
- K**
- KB** See *kilobyte*.
- key field**
The second (optional) field of a 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)**
For processor storage, real, and virtual storage, and channel volume, 2¹⁰ or 1024 bytes.

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)

The algorithm used to identify and make available the cache space that contains the least-recently used data.

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. See also *licensed machine code (LMC)*.

LIFO See *last-in first-out*.

light-emitting diode (LED)

A semiconductor chip that gives off visible or infrared light when activated.

LMC See *licensed machine code*.

licensed machine code (LMC)

Microcode, basic input/output system code (BIOS), utility programs, device drivers, and diagnostics delivered with an IBM machine.

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)

In Enterprise Systems Architecture/390, a set of functions that create the programming environment in which more than one logical partition (LPAR) is established on a processor. An LPAR is conceptually similar to a virtual machine environment except that the LPAR is a function of the processor. Also, the LPAR

does not depend on an operating system to create the virtual machine environment.

logical path

In the ESS 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)

In the ESS, a topological 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 might 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 IBM System z hosts, a logical subsystem represents a logical control unit (LCU). Each control-unit image is associated with only one logical subsystem. See also *control-unit image*.

logical unit

In open systems, a logical disk drive.

logical unit number (LUN)

In the SCSI protocol, a unique number 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 array, is spread over the drives in the array.

logical volume manager (LVM)

A set of system commands, library routines, and other tools that allow the user to establish and control logical volume storage. The LVM maps data between the logical view of storage space and the physical disk drive module (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.

In the ESS, a mechanism that the ESS uses for locating errors. The LRC checks the data as it progresses from the host, through the ESS controller, into the device adapter, and to the array.

longwave laser adapter

A connector used between a host and the ESS to support longwave fibre-channel communication.

loop The physical connection between a pair of device adapters in the ESS. See also *device adapter*.

LPAR See *logical partition*.

LRC See *longitudinal redundancy check*.

LRU See *least recently used*.

LSS See *logical subsystem*.

LUN See *logical unit number*.

LVM See *logical volume manager*.

M

machine level control (MLC)

A database that contains the EC level and configuration of products in the field.

machine reported product data (MRPD)

Product data gathered by a machine and sent to a destination such as an IBM support server or RETAIN. These records might include such information as feature code information and product logical configuration information.

mainframe

A computer, usually in a computer center, with extensive capabilities and resources to which other computers may be connected so that they can share facilities.

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)

A collection of objects that can be

accessed by means of a network management protocol. (GC)

In the ESS, the MIB record conforms to the Open Systems Interconnection (OSI) standard defined by the International Organization for Standardization (ISO) for the exchange of information. See also *simple network management protocol*.

MAP See *maintenance analysis procedure*.

mass storage

The various techniques and devices for storing large amounts of data in a persisting and machine-readable fashion. Mass storage devices include all types of disk drives and tape drives.

master boot record

The boot program that the BIOS loads. This boot program is located in the first sector of the hard disk and is used to start the boot process

Master Console

See *IBM TotalStorage ESS Master Console*.

MB See *megabyte*.

MBR See *master boot record*.

MCA See *Micro Channel architecture*.

mean time between failures (MTBF)

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.

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)

For processor storage, real and virtual storage, and channel volume, 2^{20} or 1 048 576 bytes.

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.

migration

In the ESS, the replacement of a system or subsystem with a different type of system or subsystem, such as replacing a SCSI host adapter with a fibre-channel host adapter. When used in the context of data migration regarding the ESS, the transfer of data from one storage facility to another, such as from a 3390 to the ESS.

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.

mixed mode

With respect to a Copy Services domain, the mode of operation of the domain when one Copy Services server is a dual-active server and the other Copy Services server is a single-active server. See also *Copy Services server, dual-active server*, and *single-active server*.

MLC See *machine level control*.

mobile solutions terminal (MoST)

The mobile terminal used by service personnel.

mode conditioning patch

This cable is used to convert a single mode signal generated by a longwave

- adapter into a light signal that is appropriate for multimode fibre. Another mode conditioning patch cable is required at the terminating end of the multimode fibre to convert the signal back to single mode light sent into a longwave adapter.
- Model 100**
A 2105 Model 100, often simply referred to as a Mod 100, is an expansion enclosure for the ESS. See also *2105*.
- MoST** See *mobile solutions terminal*.
- MRPD**
See *machine reported product data*.
- MSA** See *multiport serial adapter*.
- 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 also *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.
- multiplex**
The action of transmitting simultaneously.
- multiport serial adapter (MSA)**
An adapter on the ESS Master Console that has multiple ports to which ESSs can be attached.
- MVS** See *multiple virtual storage*.
- N**
- name server**
A server that stores names of the participating ESS clusters.
- Netfinity**
IBM Intel-processor-based server; predecessor to the IBM xSeries server.
- Netscape Navigator**
Web browser software manufactured by Netscape.
- Network Installation Management (NIM)**
An environment that provides installation and configuration of software within a network interface.
- NIM** See *Network Installation Management*.
- node**
In a network, a point at which one or more functional units connect channels or data circuits. An ESS is a node in a fibre-channel network.

One SAN Volume Controller. Each node provides virtualization, cache, and Copy Services to the storage area network.
- node fallover**
See *failover*.
- non-RAID**
A disk drive set up independently of other disk drives and not set up as part of a disk eight pack to store data using the redundant array of disks (RAID) data-striping methodology.
- nonremovable medium**
A recording medium that cannot be added to or removed from a storage device.
- nonvolatile storage (NVS)**
In the ESS, memory that stores active write data to avoid data loss in the event of a power loss.
- NVS** See *nonvolatile storage*.
- O**
- octet**
In Internet Protocol (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 FCP protocols. See also *small computer system interface* and *fibre-channel protocol*.

operating system (OS)

A set of programs that control how the system works. Controls the running of programs and provides such services as resource allocation, scheduling, input and output control, and data management.

organizationally unique identifier (OUI)

An IEEE-standards number that identifies an organization with a 24-bit globally unique assigned number referenced by various standards. OUI is used in the family of 802 LAN standards, such as Ethernet and Token Ring.

original equipment manufacturer's information (OEMI)

A reference to an IBM guideline for a computer peripheral interface. The interface uses ESA/390 logical protocols over an I/O interface that configures attached units in a multidrop bus topology.

OS See *operating system*.

OS/390

The IBM operating system that includes and integrates functions previously provided by many IBM software products (including the MVS operating system) for the IBM S/390 family of enterprise servers.

OS/400®

The IBM operating system that runs the IBM AS/400 and IBM System i eServer families of servers.

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 eight device addresses can be assigned to a PAV. The PAV function enables two or more concurrent write operations to the same logical volume, as long as the write operations are not to the same extents. See also *extent*, *I/O Priority Queueing*, and *multiple allegiance*.

parity A data checking scheme used in a computer system to ensure the integrity of the data. The RAID implementation uses parity to re-create data if a disk drive fails.

path group

In ESA/390 architecture, a set of channel paths that are defined to a control unit as being associated with a single logical partition (LPAR). The channel paths are in a group state and are online to the host. See also *logical partition*.

path group identifier

In ESA/390 architecture, the identifier that uniquely identifies a given logical partition (LPAR). The path group identifier is used in communication between the LPAR program and a device. The identifier associates the path group with one or more channel paths, thereby defining these paths to the control unit as being associated with the same LPAR. See also *logical partition*.

PAV See *parallel access volume*.

PCI See *peripheral component interconnect*.

PE See *IBM product engineering*.

Peer-to-Peer Remote Copy (PPRC)

A function of a storage server that constantly updates a secondary copy of a logical volume to match changes made to a primary logical volume. The primary and secondary volumes can be on the same storage server or on separate storage servers. See also *synchronous PPRC* and *PPRC Extended Distance*.

peripheral component interconnect (PCI)

An architecture for a system bus and associated protocols that supports attachments of adapter cards to a system backplane.

persistent binding

A feature where a device has the same identification to the operating system after it restarts and after other devices are added to the operating system.

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*.

port In the ESS, a physical connection on a host adapter to the cable that connects the ESS to hosts, switches, or another ESS. The ESS uses SCSI and ESCON host adapters that have two ports per adapter, and fibre-channel host adapters that have one port. See also *ESCON*, *fibre channel*, *host adapter*, and *small computer system interface*.

POST See *power-on self test*.

power-on self test (POST)

A diagnostic test that servers or computers run when they are turned on.

PPRC See *Peer-to-Peer Remote Copy*.

PPRC Extended Distance

An optional feature for the ESS that maintains a fuzzy copy of a logical volume on the same ESS or on another ESS. In other words, all modifications that any attached host performs on the primary logical volume are also performed on the secondary logical volume at a later point in time. The original order of update is not strictly maintained. See also *Peer-to-Peer Remote Copy (PPRC)* and *synchronous PPRC*.

PPRC-XD

See *PPRC Extended Distance*.

predictable write

A write operation that can cache without knowledge of the existing format on the medium. All write operations on FBA DASD devices are predictable. On CKD DASD devices, a write operation is predictable if it does a format write operation for the first data record on the track.

primary Copy Services server

One of two Copy Services servers in a Copy Services server group. 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. (GC)

promote

To add a logical data unit to cache memory.

protected volume

In the IBM AS/400® platform, 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.

System p

The product name of an IBM eServer product that emphasizes performance. It is the successor to the IBM RS/6000® family of servers.

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 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 also *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

R0 See *track-descriptor record*.

rack See *enclosure*.

RAID See *redundant array of independent disks*. RAID is also commonly expanded to redundant array of *independent* disks. See also *array*.

RAID 5

A type of RAID that optimizes cost-effective performance while emphasizing use of available capacity through data striping. RAID 5 provides fault tolerance for up to two failed disk drives by distributing parity across all the drives in the array plus one parity disk drive. The ESS automatically reserves spare disk drives when it assigns arrays to a device adapter pair (DA pair). See also *device adapter*, *RAID 10*, and *redundant array of independent disks*.

RAID 10

A type of RAID that optimizes high performance while maintaining fault tolerance for up to two failed disk drives by striping volume data across several disk drives and mirroring the first set of disk drives on an identical set. The ESS automatically reserves spare disk drives when it assigns arrays to a device adapter pair (DA pair). See also *device adapter*, *RAID 5*, and *redundant array of independent disks*.

random access

A mode of accessing data on a medium in a manner that requires the storage device to access nonconsecutive storage locations on the medium.

rank See *array*.

redundant array of independent 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 also *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. The REQ and ACK signals help to provide uniform timing to support synchronous data transfer between an initiator and a target. The objective of a synchronous data transfer method is to minimize the effect of device and cable delays.

reserved allegiance

In Enterprise Systems Architecture/390, a relationship that is created in a control unit between a device and a channel path when the device completes a Sense Reserve command. 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*.

RSSM IBM BladeCenter S SAS RAID Controller Module.

S

S/390 IBM enterprise servers based on Enterprise Systems Architecture/390 (ESA/390). *S/390* is the currently accepted shortened form of the original name *System/390*®.

S/390 storage

Storage arrays and logical volumes that are defined in the ESS as connected to S/390 servers. This term is synonymous with count-key-data (CKD) storage.

In ESS documentation, when noted, the term can refer to both S/390 and IBM z/OS storage. See also *IBM System z storage*.

SAID See *system adapter identification number*.

SAM See *sequential access method*.

SAN See *storage area network*.

SAS See *serial-attached SCSI*.

SBCON

See *Single-Byte Command Code Sets Connection*.

screen The physical surface of a display device upon which information is shown to users.

SCSI See *small computer system interface*.

SCSI device

A disk drive connected to a host through an I/O interface using the SCSI protocol. A SCSI device is either an initiator or a target. See also *initiator* and *small computer system interface*.

SCSI host systems

Host systems that are attached to the ESS with a SCSI interface. Such host systems run on UNIX, OS/400, Windows, 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

Synonym for fibre-channel protocol, a protocol used to transport data between an open-systems host and a fibre-channel adapter on an ESS. See also *fibre-channel protocol* and *small computer system interface*.

SDD See *IBM System Storage Enterprise Storage Server Subsystem Device Driver*.

SDDDSM

See *IBM System Storage Subsystem Device Driver Device Specific Module*.

SDDPCM

See *IBM System Storage Multipath Subsystem Device Driver Path Control Module*.

Seascape architecture

A storage system architecture developed by IBM for open-systems servers and S/390 and IBM System z host systems. It provides storage solutions that integrate software, storage management, and technology for disk, tape, and optical storage.

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-attached SCSI (SAS)

A data transfer technology that uses a host bus adapter with four or more channels that operate simultaneously. Each full-duplex channel, known as a SAS port, transfers data in each direction.

serial connection

A method of device interconnection for determining interrupt priority by connecting the interrupt sources serially.

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 also *SSA adapter*.

server A host that provides certain services to other hosts that are referred to as clients.

A functional unit that provides services to one or more clients over a network. (GC)

service boundary

A category that identifies a group of components that are unavailable for use when one of the components of the group is being serviced. Service boundaries are provided on the 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 also *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.

session

A collection of multiple copy sets that comprise a consistency group.

shared storage

In an ESS, storage that is configured so that multiple hosts can concurrently access the storage. The storage has a uniform appearance to all hosts. The host programs that access the storage must have a common model for the information on a storage device. The programs must be designed to handle the effects of concurrent access.

shortwave laser adapter

A connector 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). (GC) See also *management information base*.

simplex volume

A volume that is not part of a FlashCopy, XRC, or PPRC volume pair.

single-active mode

With respect to a Copy Services server, the mode of operation of the server when the LIC level of the associated ESS cluster is below 2.0.

With respect to a Copy Services domain, the mode of operation of the domain when the Copy Services servers are single-active servers. See also *Copy Services server*, *Copy Services domain*, *dual-active server*, and *mixed mode*.

Single-Byte Command Code Sets Connection (SBCON)

The ANSI standard for the ESCON or FICON I/O interface.

small computer system interface (SCSI)

A standard hardware interface that enables a variety of peripheral devices to communicate with one another. (GC)

smart relay host

A mail relay or mail gateway that has the capability to correct e-mail addressing problems.

SMIT See *System Management Interface Tool*.

SMP See *symmetric multiprocessor*.

SMS See *Systems Management Server*.

SNMP

See *simple network management protocol*.

Systems Management Server (SMS)

Change and configuration management software from Microsoft that runs on the

- Microsoft platform and distributes relevant software and updates to users.
- 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 also *serial storage architecture*.
- Specialist**
See *IBM TotalStorage Enterprise Storage Server Specialist*.
- Shared Product Object Tree (SPOT)**
A version of the /usr file system that diskless clients mount as their own /usr directory.

For NIM, a /usr file system or an equivalent file system that is exported by servers in the NIM environment for remote client use.
- SPOT** See *Shared Product Object Tree*.
- 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 also *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 in a holding status for the channel, and the last time the control unit attempted to present the status, the channel responded with the stack-status control.
- stage operation**
The operation of reading data from the physical disk drive into the cache.
- staging**
To move data from an offline or low-priority device back to an online or higher priority device, usually on demand of the system or on request of the user.
- standard volume**
In the ESS, a volume that emulates one of several S/390 volume types, including 3390-2, 3390-3, 3390-9, 3390-2 (3380-track mode), or 3390-3 (3380-track mode), by presenting the same number of cylinders and capacity to the host as provided by the native S/390 volume type of the same name.
- STI** See *self-timed interface*.
- storage area network**
A network that connects a company's heterogeneous storage resources.
- storage 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 also *disk drive module*.
- storage facility**
A physical unit that consists of a storage server integrated with one or more storage devices to provide storage capability to a host computer.

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, multibyte, record, or block increments across multiple disk drives.

subchannel

A logical function of a channel subsystem associated with the management of a single device.

Subsystem Device Driver

See *IBM System Storage Multipath Subsystem Device Driver*.

Subsystem Device Driver Device Specific Module (SDDDSM)

An IBM storage subsystems multipath I/O solution that is based on Microsoft MPIO technology. It is a device-specific module that is designed to support IBM storage subsystems devices such as SAN Volume Controller, DS8000, and DS6000. SDDDSM resides on a host server with the native disk device driver and provides enhanced data availability, automatic path failover protection, concurrent download of controller firmware code, and path selection policies for the host system.

subsystem identifier (SSID)

A number that uniquely identifies a logical subsystem within a computer installation.

support catcher

See *catcher*.

support catcher telephone number

The telephone number that connects the support catcher server to the ESS to receive a trace or dump package. See also *support catcher* and *remote technical assistance information network*.

switched fabric

In the ESS, one of three fibre-channel connection topologies that the ESS supports. See also *arbitrated loop* and *point-to-point*.

symmetric multiprocessor (SMP)

An implementation of a multiprocessor computer consisting of several identical processors configured in a way that any subset of the set of processors is capable of continuing the operation of the computer. The ESS contains four processors set up in SMP mode.

synchronous 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. See also *Peer-to-Peer Remote Copy* and *PPRC Extended Distance*.

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)

In the ESS, the unique identification number automatically assigned to each ESS host adapter for use by ESS Copy Services.

System Management Interface Tool (SMIT)

An interface tool of the AIX operating system for installing, maintaining, configuring, and diagnosing tasks.

System Modification Program

A program used to install software and software changes on MVS systems.

T

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 also *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)

Nominally, 1 000 000 000 000 bytes, which is accurate when speaking of bandwidth and disk storage capacity.

For ESS cache memory, processor storage, real and virtual storage, a terabyte refers to 2⁴⁰ or 1 099 511 627 776 bytes.

terminal emulator

In the ESS, a function of the ESS Master Console that allows it to emulate a terminal.

thousands of power-on hours (KPOH)

A unit of time used to measure the mean time between failures (MTBF).

time sharing option (TSO)

An operating system option that provides interactive time sharing from remote terminals.

TPF See *transaction processing facility*.

track A unit of storage on a CKD device that can be formatted to contain a number of data records. See also *home address*, *track-descriptor record*, and *data record*.

track-descriptor record (R0)

A special record on a track that follows the home address. The control program uses it to maintain certain information about the track. The record has a count field with a key length of zero, a data length of 8, and a record number of 0. This record is sometimes referred to as R0.

transaction processing facility (TPF)

A high-availability, high-performance IBM operating system, designed to support real-time, transaction-driven applications. The specialized architecture of TPF is intended to optimize system efficiency, reliability, and responsiveness for data communication and database processing. TPF provides real-time inquiry and updates to a large, centralized database, where message length is relatively short in both directions, and response time is generally less than three seconds. Formerly known as the Airline Control Program/Transaction Processing Facility (ACP/TPF).

Transmission Control Protocol (TCP)

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

Transmission Control Protocol/Internet Protocol (TCP/IP)

A combination of data-transmission protocols that provide end-to-end connections between applications over interconnected networks of different types.

A suite of transport and application protocols that run over the Internet Protocol. (GC) See also *Internet Protocol* and *Transmission Control Protocol*.

transparency

See *software transparency*.

TSO See *time sharing option*.

U

UFS UNIX filing system.

Ultra-SCSI

An enhanced small computer system interface.

unconfigure

To delete the configuration.

unit address

In Enterprise Systems Architecture/390, 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.

UNIX File System (UFS)

A section of the UNIX file tree that is physically contained on a single device or disk partition and that can be separately mounted, dismounted, and administered.

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). See 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 facility**

A virtual data processing machine that appears to the user to be for the exclusive use of that user, but whose functions are accomplished by sharing the resources of a shared data processing system. An alternate name for the VM/370 IBM operating system.

virtualization

In the storage industry, a concept in which a pool of storage is created that contains several disk subsystems. The subsystems can be from various vendors. The pool can be split into virtual disks that are visible to the host systems that use them. In SDD, virtualization product refers to SAN Volume Controller.

vital product data (VPD)

Information that uniquely defines the system, hardware, software, and microcode elements of a processing system.

VM The root name of several IBM operating systems, such as VM/370, VM/ESA, VM/CMS, and VM/SP. See also *virtual machine (VM) facility*.

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*.

VSE/ESA

IBM operating system, the letters of which represent virtual storage extended/enterprise systems architecture.

W**Web Copy Services**

See *ESS Copy Services*.

worldwide node name (WWNN)

A unique 64-bit identifier for a host containing a fibre-channel port. See also *worldwide port name*.

worldwide port name (WWPN)

A unique 64-bit identifier associated with a fibre-channel adapter port. It is assigned in an implementation- and protocol-independent manner.

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

XD See *PPRC Extended Distance*.

XRC See *Extended Remote Copy*.

xSeries

The product name of an IBM eServer product that emphasizes industry-standard server scalability and self-managing server technologies. It is the successor to the Netfinity family of servers.

Z**z/Architecture**

An IBM architecture for mainframe computers and peripherals. The IBM eServer IBM System z family of servers uses the z/Architecture architecture. It is the successor to the S/390 and 9672 family of servers. See also *Enterprise Systems Architecture/390*.

z/OS An operating system for the IBM eServer product line that supports 64-bit real storage.

IBM System z

An IBM eServer family of servers that emphasizes near-zero downtime.

IBM enterprise servers based on z/Architecture.

IBM System z storage

Storage arrays and logical volumes that are defined in the ESS as connected to IBM System z servers. See also *S/390 storage*.

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